



informs
**INTERNATIONAL
CONFERENCE**

Taipei International Convention Center
June 17-20, 2018

A Better World Through O.R., Analytics, and AI

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TABLE OF CONTENTS



Welcome Letter from General Chair	2
Program at a Glance	3
General Information & Special Events	4
Sunday Master Track	5
Monday Master Track	6-7
Tuesday Master Track	8-9
Wednesday Master Track	10
Convention Center Maps	11-12

Technical Sessions	13
Index Files	115
Sponsors & Exhibitors	Inside Front Cover
Upcoming Conferences	Inside Back Cover

WELCOME LETTER



Dear Colleagues and Guests,

I am honored and delighted to welcome you to the 2018 INFORMS International Meeting in the beautiful city of Taipei. Taipei is known not only for its rich culture, but also its friendliness and urban landscapes. International visitors also appreciate its safety and vibrancy. Taiwan is home to the world's leading high-tech original design and original equipment manufacturers, famous for its top healthcare system and medical research, and is in an exciting moment of transition toward an innovative digital economy.

All this makes for a perfect backdrop to this year's theme – *A Better World through O.R., Analytics, and AI*. INFORMS has entered an exciting new era, in which analytics and AI have become central to the work of academia and industry. Analytics and AI applications are now tightly woven into essential areas in all major industries, such as: long-term strategy and planning, and tactical, operational, and now real-time decision making. This of course translates to excellent opportunities for INFORMS and our members to make a deeper and broader impact on both theoretical and applied OR/MS.

Thank you all for your participation in this conference during this important moment of transition. With attendance of more than 800 professionals from academia and industry spanning 30 countries, and 900 presentations, this conference will help broaden and deepen your knowledge base. Even more importantly, I hope that it will spark collaboration and cooperation in the fields of analytics and AI, and the critical applications they offer the world.

I hope you enjoy the conference program, cultural events, and special tours that our organizing committee and sponsors have arranged for you.

Lastly, I wish you a productive and fun-filled time at 2018 International Conference. Enjoy the beauty and wonder of Taiwan.

Best Wishes,

Grace Lin, General Chair, 2018 INFORMS International Conference
INFORMS Fellow and Vice President, Asia University, Taichung, Taiwan



PROGRAM AT A GLANCE | TICC – Taipei International Convention Center



Sunday, June 17

7am–5pm	Registration, TICC, Main Lobby
8–9:30am	Technical Sessions A (SA), Various Locations
9am–4pm	Exhibits Open, TICC, South Foyer
9:30–10am	Coffee Break, TICC, South Foyer
10–11am	Welcome Plenary: Christopher Tang, 3rd Floor, TICC
11:15am–12:45pm	Technical Sessions B (SB), Various Locations
12:45–2pm	Lunch Break (lunch on your own)
12:30–5:15pm	Hackathon Final Presentations (Future Finance and Healthcare Hackathon), TICC, VIP Room, 4th Floor
2–2:50pm	Keynotes: John Birge, David Yao, Richard Larson, & Oleg Gusikhin, Various Locations
3–3:45pm	Coffee Break, TICC, South Foyer
3:45–5:15pm	Technical Sessions C (SC), Various Locations
5:30–7pm	Reception, Grand Hyatt, 3rd Floor, Grand Ballroom Foyer
7–9pm	Gala Dinner, Grand Hyatt, 3rd Floor, Grand Ballroom

Monday, June 18

7am–5pm	Registration, TICC, Main Lobby
8–9:30am	Technical Sessions A (MA), Various Locations
9am–4pm	Exhibits Open, TICC, South Foyer
9am–6pm	Posters on Display, South Corridor
9:30–10am	Coffee Break, TICC, South Foyer
10–10:50am	Plenary: John A. Buzacott, 3rd Floor, TICC
11am–12:30pm	Technical Sessions B (MB), Various Locations
12:30–1:30pm	Lunch Break (lunch on your own)
1:30–2:20pm	Keynotes: Shmuel S. Oren, Radhika Kulkarni, Guillermo Gallego, & Lam Khin Yong, Various Locations
2:30–3pm	Coffee Break, TICC, South Foyer
3–4:30pm	Technical Sessions C (MC), Various Locations
4:35–6:05pm	Technical Sessions D (MD), Various Locations

Tuesday, June 19

7am–5pm	Registration, TICC, Main Lobby
8–9:30am	Technical Sessions A (TA), Various Locations
9:30–10am	Coffee Break, TICC, South Foyer
10–10:50am	Keynotes: Edward H. Kaplan, Sriram Raghavan, & San-Cheng Chang
10am–3:30pm	Exhibits Open, TICC, South Foyer
11am–12:30pm	Technical Sessions B (TB), Various Locations
12:30–1:30pm	Lunch Break (lunch on your own)
1:30–3pm	Technical Sessions C (TC), Various Locations
3–3:30pm	Coffee Break, TICC, South Foyer
3:30–5pm	Technical Sessions D (TD), Various Locations
5:30–10:30pm	Off-Site Tours with Taiwanese Box Dinners, Buses leave from TICC

Wednesday, June 20

8:30–11:30am	Registration, TICC, Main Lobby
8–9:30am	Technical Sessions A (WA), Various Locations
9:30–10am	Coffee Break, TICC, South Foyer
10–11:30am	Technical Sessions B (WB), Various Locations
11:30am–12noon	Farewell Drawing



MASTER TRACK SCHEDULE & MAPS

Includes a convenient summary showing the tracks, times, and locations (pages 5–10).



BADGES REQUIRED FOR TECHNICAL SESSIONS

International 2018 badges must be worn to all sessions and events. Badges will be checked at the entrance to technical sessions and events. Attendees without badges will be directed to the INFORMS registration desk to register and pick up their badges or to obtain a reprinted badge. All attendees, including speakers and session chairs, must register and pay the registration fee. Lost badges can be replaced at the registration desk.

SPEAKER/GENERAL INFORMATION



REGISTRATION DESK HOURS

Come to the registration desk to collect your badge, obtain a letter of attendance, or for any inquiries related to conference payments or the conference schedule.

Sunday	7am–5pm
Monday	7am–5pm
Tuesday	8am–5pm
Wednesday	8:30–11:30am

COFFEE BREAKS & SNACKS

Food included in conference registration: Coffee Breaks, Reception & Gala on Sunday, Off-site Dinner Tours on Tuesday. (Note: if you are staying at the Grand Hyatt Taipei, breakfast is included with your hotel reservation.)

Mix, mingle, enjoy locally-sourced pastries, and network with professionals just like you at one of our Coffee Breaks. (TICC, 1st floor, South Foyer)

Sunday	9–9:30am & 3–3:45pm
Monday	9–9:30am & 2:30–3pm
Tuesday	9:30–10am & 3–3:30pm
Wednesday	9:30–10am

WI-FI INFORMATION

The Taipei International Convention Center provides visitors with complimentary Wi-Fi. To access the Internet without password verification, visitors can simply activate the Wi-Fi function of their device and search for "TICC Free Wi-Fi."

EXHIBIT HOURS

Exhibits are located on the 1st Floor, South Foyer near the Registration Desk.

Sunday	9am–4pm
Monday	9am–4pm
Tuesday	10am–3:30pm

PRESENTATION GUIDELINES

All authors have received emails directing them to the online program for the date and time of their presentation(s). The room and location of your session will be listed in the Technical Sessions section of the meeting program and in the Master Track Schedule.

- Presentations are expected to be in English & should be limited to key issues with a summary.
- Arrive at your session early for A/V set-up.
- Time your presentation to fit within your designated time span, leaving time for questions.
- Bring copies of your paper or other handouts to distribute to the audience.

AUDIO/VISUAL SERVICES

All session rooms will be equipped with LCD (computer) projectors, but please note that you must provide your own computer or prearrange to share with others in your session. (Taiwan uses electric current of 110 volts at 60 cycles, appliances from Europe, Australia, or Southeast Asia will need an adaptor.)

SPECIAL NETWORKING EVENTS



SUNDAY, JUNE 17

Cultural Experience & Cocktail Reception
5:30–7pm | Grand Ballroom Foyer

Taipei is home to unique and traditional arts and crafts. During the reception you can experience some of these specialized crafts firsthand: Chinese Knot, Paper Cutting, and Dough Figurines. The reception includes hors d'oeuvres and time for networking.

Gala Dinner
7–9pm | Grand Ballroom & Foyer, 3rd Floor

The Taipei Committee invites you to enjoy the magic of Sichuan face-changing Opera, during which changes in mood are conveyed when an actor waves his cape or sleeve in front of his face, and in that split second it seems as if the previous full-face makeup is removed and a new color-and-pattern scheme is revealed.

Enjoy dinner to the sounds of an ancient Chinese five-stringed instrument along with a performance of traditional Taiwanese Aboriginal dance. (Admission to the banquet and reception is included in your registration fee, and your badge is your ticket to the Gala. A guest registration can be purchased for \$200 USD.)

TUESDAY, JUNE 19

Off-Site Dinner Tours
5:30pm - Buses Depart from TICC
9:30pm - Buses Return to TICC

Tuesday tours are in lieu of the General Reception and will give attendees the chance to see some of the hidden gems of Taipei. A box dinner will be provided on the bus. Buses will depart from TICC starting at 5:30pm and space is limited. If you have not signed up for ONE of the tours please stop by the registration desk to register for an unforgettable evening at no extra cost.

SUNDAY, JUNE 17

Room	Track	8-9:30am	10-11am	11:15am-12:45pm	2-2:50pm	3:45-5:15pm
101A, 1st Floor	1	New Approaches in Supply Chain Risk Management	Plenary Christopher Tang Making Supply Chain Transparent for a Better World: Information and Analysis 3rd Floor, Plenary Room	Supply Chain Coordination Under Risk	Keynotes John Birge 101 CD, 1st Floor David Yao 102, 1st Floor Oleg Gusikhin 101 AB, 1st Floor Richard Larson 103, 1st Floor	Risk Analysis
101B, 1st Floor	2	Inventory Problems in Supply Chains		Interface Between Supply Chain & Information Technology		Modelling Real-life Inventory Systems
101C, 1st Floor	3	Inventory Sharing & Collaboration		Panel: Industry 4.0 Opportunities for Integrative Decisions in Smart Manufacturing		Data-driven Decisions
101D, 1st Floor	4	Operations/Marketing Interface I		Operations/Marketing Contributed		Operations/Marketing Interface II
102, 1st Floor	5	Tutorial: Applications of Custom 3D Printed Physiological Heart Valve Models for Reducing Heart Surgery		Practice I		Practice II
103, 1st Floor	6	Tutorial: Models for the Sharing Economy		Tutorial: Healthcare Informatics & Analytics - I		Tutorial: Healthcare Informatics & Analytics - II
105, 1st Floor	7	No Session		Simulation Optimization		Simulation Optimizations
201A, 2nd Floor	8	Panel: Transforming Education through Analytics & Learning Science & Engineering		Retail Operations		Meet the Editors Panel
201B, 2nd Floor	9	Topics in Military O.R.: Conflict Analysis & Logistics		Data Analytics & Artificial Intelligence with Manufacturing & Service Applications		New Developments in Design, Manufacturing, Health & Productivity
201C, 2nd Floor	10	Application of Operation Analytics & Optimization Methods		Data-driven Analysis for Health Service Design		Energy Operation Analytics & Optimization
201D, 2nd Floor	11	Crowdsourcing & Crowdfunding Platforms		R&D Management: Competitors & Contractors		Managing Partnerships & Innovation Adoption
201E, 2nd Floor	12	New Optimization Methods for Vehicle Routing Problems		Recent Advances in Public Transit Scheduling		Scheduling & Logistics
201F, 2nd Floor	13	Emerging Topics in Operations		Innovative Business Operations		MSOM Energy & Sustainability
North Lounge, 3rd Floor	18	No Session		Data-driven Healthcare Operations		Healthcare Management
South Lounge, 3rd Floor	19	AI Methods for Healthcare & Medical Informatics		Healthcare Operations Management		Data Analytics & Technology in Healthcare for Efficiency, Quality, & Privacy

MONDAY, JUNE 18

Room	Track	8-9:30am	10-10:50am	11am-12:30pm	12:30-1:30pm / 1:30-2:20pm	3-4:30pm	4:35-6:05pm
101A, 1st Floor	1	Modeling & Computations in Financial Engineering	Plenary John A. Buzacott 3rd Floor, Plenary Room Improving Manufacturing Systems by Understanding Variability	Topics in Logistics & Transportation	Poster Session (12:30-1:30pm) Keynotes (1:30-2:20pm) Shmuel S. Oren 101 C/D, 1st Floor Radhika Kulkarni 102, 1st Floor Guillermo Gallego 101A/B, 1st Floor Lam Khin Yong 103, 1st Floor	Revenue Management & Pricing in OM & IS	Smart Pricing & Inventory Control
101B, 1st Floor	2	Frontiers in China's Largest E-commerce Supply Chain		Inventory Management I		Inventory Management II	New Topics in Operations with Pricing & Inventory Considerations
101C, 1st Floor	3	Supply Chain Analytics in Developing Markets		Big Data Analytics on Healthcare & Transportation Applications		Data-Driven Methods for Dynamical Systems	No Session
101D, 1st Floor	4	Optimization Involving Advertising, Promotions & Branding		Integrated Simulation & Optimization		Competition & Contracting in Supply Chains	Operations & Marketing Interface
102, 1st Floor	5	Practice III		Practice Track IV		Practice V	Innovation/Entrepreneurship
103, 1st Floor	6	Tutorial: Research & Teaching Opportunities in Project Management		Tutorial: Model-Based Optimization for Operations Research: Best Practices & Current Trends		Tutorial: How to Leverage Big Data Analytics to Grow Business – I	Tutorial: How to Leverage Big Data Analytics to Grow Business – II
105, 1st Floor	7	Data Science in Manufacturing		Information Management in Supply Chains		No Session	Modeling & Algorithmic Approaches for Critical Intelligent Systems
201A, 2nd Floor	8	Building & Deploying Real World Optimization & Machine Learning Models		Tutorial: Machine Learning & Big Data Analytics		Information Extraction & Utilization	SCM Finance & Big Data Institutional Research
201B, 2nd Floor	9	Applications of Additive Manufacturing for Healthcare & Clinical Applications		Cyber-physical Systems & Industry 4.0 for Manufacturing & Service Industries		Operations Management I	Data Mining & Computation with Emerging Applications
201C, 2nd Floor	10	Intelligent Resource Allocations & Competitions in Networks & Systems with Big Data		Logistics Operation Analytics & Optimization		Manufacturing Operation Analytics & Optimization	Optimal Design & Operations in Supply Chains
201D, 2nd Floor	11	Financial Engineering I		Optimization & Risk Management in Financial Applications		Simulation & Finance	Simulation & Optimization

MONDAY, JUNE 18							
Room	Track	8-9:30am	10-10:50am	11am-12:30pm	12:30-1:30pm / 1:30-2:20pm	3-4:30pm	4:35-6:05pm
201E, 2nd Floor	12	Transportation Safety & Traffic Control	Plenary John A. Buzacott 3rd Floor, Plenary Room Improving Manufacturing Systems by Understanding Variability	Intelligent Transportation Systems I	Poster Session (12:30-1:30pm) Keynotes (1:30-2:20pm) Shmuel S. Oren 101 C/D, 1st Floor Radhika Kulkarni 102, 1st Floor Guillermo Gallego 101A/B, 1st Floor Lam Khin Yong 103, 1st Floor	Last Mile Logistics	Logistics
201F, 2nd Floor	13	Operations & Economics Interface V		Operations & Economics Interface II		Operations & Economics Interface II	Operations & Economics Interface IV
202A, 2nd Floor	14	Climate Change, Corporate Performance & Natural Resources		O.R. Applications in Sustainable Energy		Harnessing Renewable Energy & Efficiency	Sustainable Energy & Environmental Policy
202B, 2nd Floor	15	IT Supportive Innovative Service Design		Managing Services Online		Service Design & Service Systems	Service Science I
203A, 2nd Floor	16	Scheduling Applications		No Session		First-order & Stochastic Algorithms for Large-scale Optimization Problems	Reinforcement Learning & Optimal Sequential Decision Making
203B, 2nd Floor	17	Advanced Maritime Simulation Technologies		Advances & Applications of Scheduling Theory		Automated Traffic System in Container Terminals	Future of Yard Operation in Maritime Logistics
North Lounge, 3rd Floor	18	Recent Advances in Emergency Medical Service Management		Stochastic Modeling & Optimization in Healthcare Operations		Decision Analysis in Healthcare Systems	Healthcare Policy & Applications
South Lounge, 3rd Floor	19	Elderly Care Management		Data Driven Approach in Healthcare		Scheduling Optimization & Management in Healthcare	Dynamic Decision Making for Healthcare Policy
401, 4th Floor	20	Behavioral Decision Making		Consumer Decision Analysis		Computation & Control in Stochastic Systems	Performance Analysis of Computer Systems & Networks
Joy, 4th Floor	21	Best Practices in Business & Big Data Analytics		Energy Management		No Session	Measurement & Evaluation
Elegance, 4th Floor	22	Fintech & Mobile Service		Multidisciplinary Applications of MCDM		Negotiation Analysis & Support	Preference Elicitation, Communication, & Use

TUESDAY, JUNE 19						
Room	Track	8-9:30am	10-10:50am	11am-12:30pm	1:30-3pm	3:30-5pm
101A, 1st Floor	1	Pricing & Behavioral Issues	Keynotes Edward H. Kaplan 101 B, 1st Floor Sriram Raghavan 101 C, 1st Floor San-Cheng Chang 102, 1st Floor	Pricing & Revenue Optimization	Retail Management	Operations Management II
101B, 1st Floor	2	Supply Chain Inventory		Topics in Inventory Management & Pricing Management	Inventory Management III	Queueing Models
101C, 1st Floor	3	Data Privacy, Path Models & Predictive Analytics		Industrial IoT & ML Applications	Optimization & Machine Learning for Big Data-driven Problems	Predictive Analytics in Service & Education
101D, 1st Floor	4	Special Session: Condition-Based Maintenance & Hazards Modeling		Topics in Military O.R.: Health Monitoring & Scheduling Systems	Special Session: Military Operations Research: Past, Present, Future	Transforming U.S. Army Supply Chains: A Project Update
102, 1st Floor	5	Practice VI		Practice VII	Marketing	Retail Operations Management
103, 1st Floor	6	Tutorial: Analytics for the Supply Chain 4.0		Tutorial: Responsible Operations: Models, Relevance & Impact	Tutorial: Data Integrated Stochastics: Models & Methods	Tutorial: Machine Learning & Big Data Analytics
105, 1st Floor	7	No Session		Smart Transportation in Industrial Parks	Smart City Applications	Simulation & Optimization for Design & Control of Complex Systems
201A, 2nd Floor	8	Transportation Operations		No Session	Artificial Intelligence	Next Generation Air Transportation
201B, 2nd Floor	9	Data Mining, Graphs, & Networks		Data Mining & Statistics with Emerging Applications	Supply Chain Management I	Supply Chain Management
201C, 2nd Floor	10	Supply Chain & Logistics Management		Optimization Modeling & Analytics	Data Analytics for Engineering System Improvement	Manufacturing & Supply Chains
201D, 2nd Floor	11	No Session		Financial Engineering II	Finance - Theory & Empirics	Finance - Risk Management

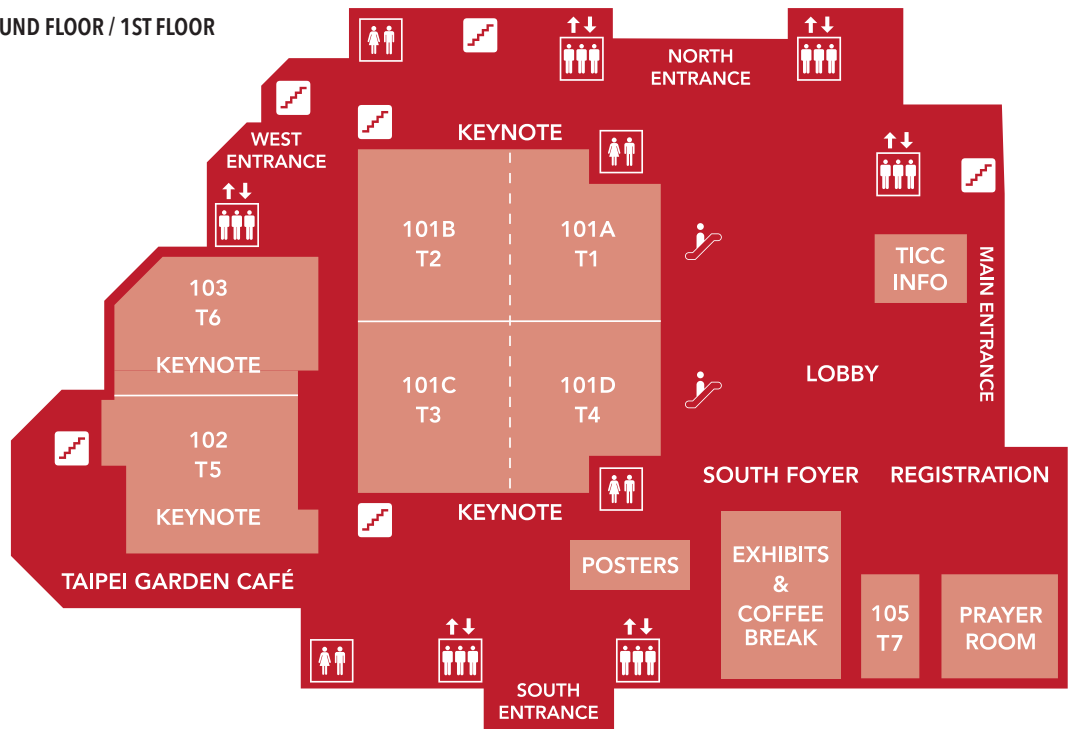
TUESDAY, JUNE 19					
Room	Track	8-9:30am	10-10:50am	11am-12:30pm	1:30-3pm
201E, 2nd Floor	12	Intelligent Transportation Systems II	Keynotes Edward H. Kaplan 101 B, 1st Floor Sriram Raghavan 101 C, 1st Floor San-Cheng Chang 102, 1st Floor	Metaheuristics in Transportation	Disaster Logistics
201F, 2nd Floor	13	Operations & Economics Interface V		Operations & Economics Interface VI	Sharing Economy
202A, 2nd Floor	14	Location Model		Strategic Location Analysis for Safety & Logistics	Behavioral Operations
202B, 2nd Floor	15	Machine Learning & Big Data Analytics		Technology-enabled & Knowledge-Intensive Service	Customer Relationship Management
203A, 2nd Floor	16	Optimization I		Optimization II	Forecasting
203B, 2nd Floor	17	Future of Yard Operation in Maritime Logistics II		Land Logistics & Warehousing	Future of Yard Operation in Maritime Logistics III
North Lounge, 3rd Floor	18	Innovative Applications in Healthcare & Health Policy Research		Managing Patient Inflow at Hospitals	Healthcare Analytics & Operations Management
South Lounge, 3rd Floor	19	Healthcare System Resource Allocation: Insight, Analysis, & Optimization		Data & Literature: A Quality & Informatics Perspective	O.R. & Healthcare
401, 4th Floor	20	Stochastic Models in Quantitative Finance		Queueing Models & Their Applications	Product Development
Joy, 4th Floor	21	New Technology & Service Innovation		Quality Control & Reliability	Smart Traffic
Elegance, 4th Floor	22	Multidisciplinary Applications of MCDM		MCDM Tutorial	Multidisciplinary Applications of MCDM III

WEDNESDAY, JUNE 20

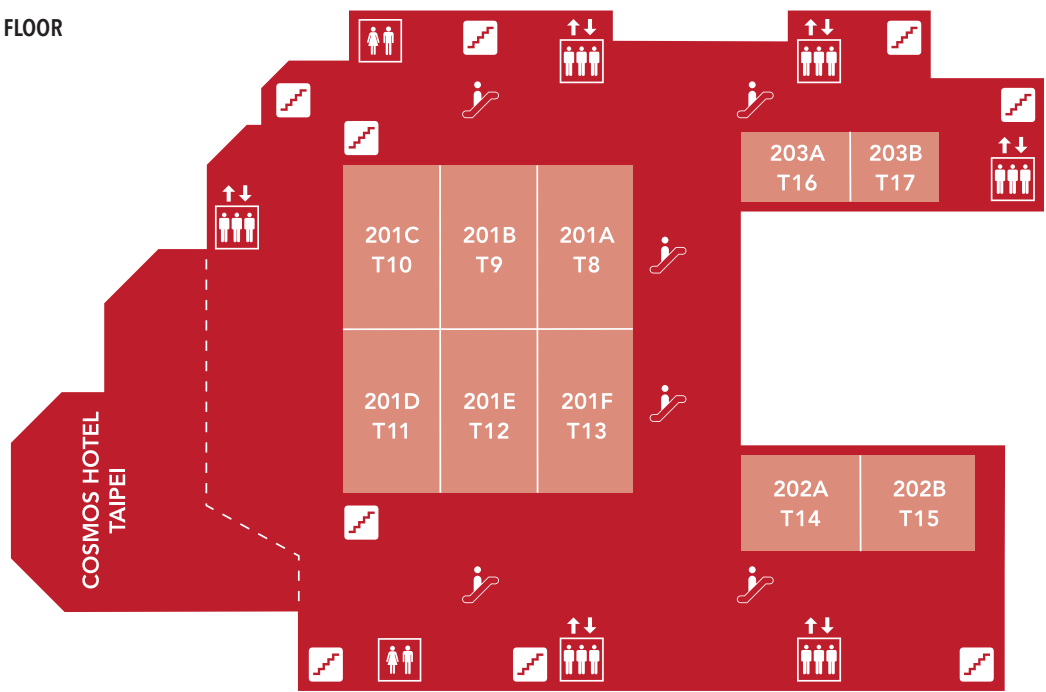
Room	Track	8-9:30am	10-11:30am
101A, 1st Floor	1	Sustainable Supply Chain I	Sustainable Supply Chain II
101B, 1st Floor	2	No Session	No Session
101C, 1st Floor	3	Operations Management III	No Session
101D, 1st Floor	4	No Session	No Session
102, 1st Floor	5	No Session	No Session
103, 1st Floor	6	Tutorial: How to Leverage Big Data Analytics to Grow Business II	No Session
105, 1st Floor	7	Scheduling I	Scheduling II
201A, 2nd Floor	8	Big Data & Business Applications	Domain Specific Analytics on Innovative Commerce Applications
201B, 2nd Floor	9	Supply Chain Management III	Supply Chain Management IV
201C, 2nd Floor	10	Global Logistics I	Global Logistics II
201D, 2nd Floor	11	Financial Analytics	No Session
201E, 2nd Floor	12	VRP	Urban Transport
201F, 2nd Floor	13	Operations in Supply Chains	Operations & Economics Interface IV
202A, 2nd Floor	14	No Session	No Session
202B, 2nd Floor	15	Business Applications	E-Business/Commerce
203A, 2nd Floor	16	Stochastic Optimization	No Session
203B, 2nd Floor	17	Operations Research in Maritime Transportation	No Session
North Lounge, 3rd Floor	18	Stochastic Modeling in Healthcare Management	Quality Management & Reliability
South Lounge, 3rd Floor	19	Healthcare	No Session
401, 4th Floor	20	Data Envelopment Analysis	No Session
Joy, 4th Floor	21	Technology & Applications	No Session
Elegance, 4th Floor	22	Decision Support Systems	Multiple Attribute Decision Making (MADM)

TAIPEI INTERNATIONAL CONVENTION CENTER MAPS

GROUND FLOOR / 1ST FLOOR

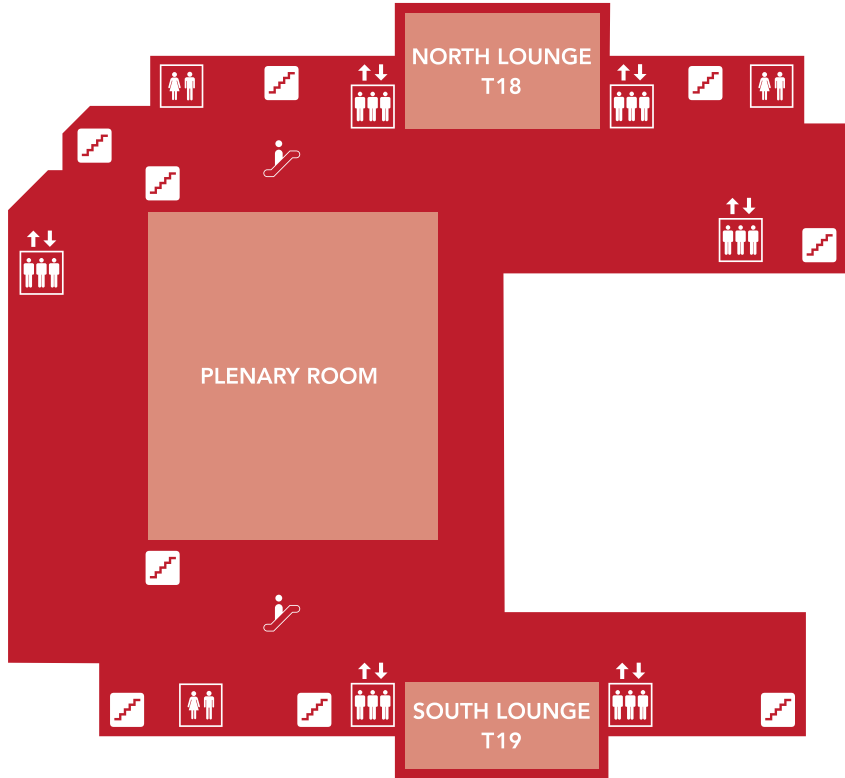


2ND FLOOR

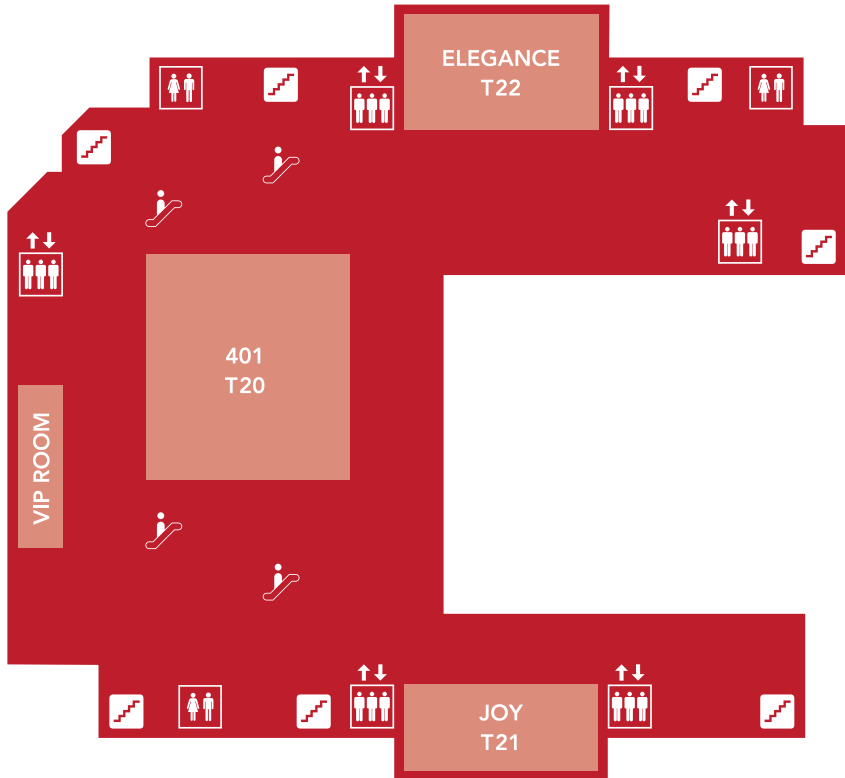


TAIPEI INTERNATIONAL CONVENTION CENTER MAPS

3RD FLOOR



4TH FLOOR



How to Navigate the Technical Sessions

There are four primary resources to help you understand and navigate the Technical Sessions:

- This Technical Session listing, which provides the most detailed information. The listing is presented chronologically by day/time, showing each session and the papers/abstracts/authors within each session.
- The Author and Session indices provide cross-reference assistance (pages 115-124).
- The floor plan is on the pages 5-10 and shows you where technical session tracks are located.
- The Master Track Schedule is on the inside back cover.

Quickest Way to Find Your Own Session

Use the Author Index (page 115) — the session code for your presentation will be shown along with the room location. You can also refer to the full session listing for the room location of your session.

The Session Codes

SA01

Room number. Room locations are also indicated in the listing for each session.

The day of the week

Time Block. Matches the time blocks shown in the Program Schedule.

Time Blocks

Sunday

- A** — 8:00am - 9:30am
Plenary 10:00am - 11:00pm
B — 11:00am - 12:30pm
Keynote 2:00pm - 2:50pm
C — 3:45pm - 5:15pm

Monday

- A** — 8:30am - 9:30am
Plenary 10:00pm - 10:50pm
B — 11:00am - 12:30pm
Poster 12:30pm - 1:30pm
Keynote 1:30pm - 2:30pm
C — 3:00pm - 4:30pm
D — 4:35pm - 6:05pm

Tuesday

- A** — 8:00am - 9:30am
B — 11:00am - 12:30pm
Keynote 10:00am - 10:50am
B — 11:00am - 12:30pm
C — 1:30pm - 3:00pm
D — 3:30pm - 5:00pm

Wednesday

- A** — 8:00am - 9:30am
B — 10:00am - 11:30am

TECHNICAL SESSIONS

Sunday, 8:00AM - 9:30AM

SA01

101A, 1st Floor

New Approaches in Supply Chain Risk Management

Sponsored: Mitigating Risk in Supply Chains

Sponsored Session

Chair: Chieh Lee, Ph.D., Yuan Ze University, Taipei, Taiwan, chiehlee@saturn.yzu.edu.tw

1 - Impact of Alternative Fuel on Logistics Transportation Industry – in Case of Road Transportation Vehicle

Ming-Fong Yang, PhD, National Taiwan Ocean University, Keelung City, Taiwan, yang60429@mail.ntou.edu.tw, Mei-Chuan Qang, Jia-Wen Zheng

During the past economic development process, carbon emissions accumulated from the long-term use of fossil fuel have caused certain impact on our environment. Among the discussions about pollution emissions, the indispensable economic activity-transportation-is one of the key topics to be reviewed. Regression equations and data standardization are used to compare and discuss the advantages and disadvantages for the transportation economic while replacing the fossil fuel by green energy, and aim to provide reference for our government's green transportation policies.

2 - Optimal Policy in a Supply Chain with Trade-Credit under Variable Demand and Default Risk

Ming-Jong Yao, Professor, National Chiao Tung University, Rm 809 Assembly Building One, 1001 University Road, Hsinchu, 30010, Taiwan, myaoie@gmail.com, Jen-Yen Lin, Chieh Lee, Po-Hung Wang

This study investigates the optimal replenishment and payment strategies considering two-stage permissible delay in payment in a three-echelon supply chain with variable demand under trade-credit and default risk. We formulate the corresponding mathematical model and solve the optimal solution under different scenarios. Interestingly, our experiments show a partially integrated supply chain could gain more profit than a fully centralized one.

3 - The Supplier Selection under Joint Innovation Based on Early Quality Characteristics of Testing Samples

Taichih Huang, Department of Industrial Engineering and Management Yuan Ze University 135 Yuan-Tung Road, Taichih-Huang 32003, Taiwan (R.O.C). Email: huang.taichih@gmail.com, Chieh Lee

We apply the latent class analysis (LCA) on testing samples from new processing material suppliers. Based on the LCA assessment model established in this study, we can effectively distinguish members of the leading group and identify the factors that have significant impact on joint innovation of processing material supplier.

4 - Applying RFID to Integrated Inventory Model under Considering Inventory Risk

Ming-Feng Yang, National Taiwan Ocean University, Keelung City, Taiwan, yang60429@mail.ntou.edu.tw, Mei-Chuan Wang, Jia-Wen Zheng

More and more research is devoted to the development and introduction of radio frequency identification (RFID). The main purpose of integrated inventory model is to achieve the goal of real time purchasing and manufacturing available demand. However, once enterprises have inventory, they have to face the risk of incomplete inventory sales. In our study, RFID will be applied to the integrated inventory model, to explore its application performance, and whether it can effectively improve the inventory system. This study will explore the investment benefits and risks with RFID.

■ SA02

101B, 1st Floor

Inventory Problems in Supply Chains

Invited: Supply Chain Inventory Management

Invited Session

Chair: Fang Liu, Nanyang Technological University, Singapore, 639798, Singapore, liu_fang@ntu.edu.sg

1 - Presenter Stock or Print? Impact of 3D Printing on Spare Parts Logistics

Jing-Sheng Jeannette Song, Duke University, Fuqua School of Business, Box 90120, Durham, NC, 27708-0120, United States, jssong@duke.edu, Yue Zhang

We present a general framework to analyze and quantify the impact of 3D printing on spare parts logistics. We consider multiple parts facing stochastic demands. To minimize long-run average system cost, our model determines which parts should be printed and which should be stocked and the corresponding base-stock levels.

2 - Dynamic Inventory Management with General Replenishment Cost: The Lost Sales Case.

Yange Xiao, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, 430074, China, younger@hust.edu.cn, Peng Hu, Xiting Gong

Stochastic periodic-review inventory systems with different types of replenishment cost functions have been studied for decades since the seminal work by Scarf, where the focus is to characterize the optimal replenishment policy. It is not surprising that a more general cost structure usually makes the optimal policy more complicated. Our work follows this stream and studies the classic model under the lost sales setting, where the replenishment cost could be arbitrary. Surprisingly, by only assuming demands are independent and follow log-concave densities, as well as some mild conditions on the inventory-related cost functions, we manage to completely characterize the optimal policy, e.g., a replenishment should be executed if and only if the initially inventory level of a period falls below some threshold.

3 - The Supplier Selection Under Joint Innovation Based On Early Quality Characteristics of Testing Samples

Taichih Huang, Department of Industrial Engineering and Management Yuan Ze University 135 Yuan-Tung Road, Taichih-Huang 32003, Taiwan (R.O.C). Email: huang.taichih@gmail.com, Chieh Lee

We apply the latent class analysis (LCA) on testing samples from new processing material suppliers. Based on the LCA assessment model established in this study, we can effectively distinguish members of the leading group and identify the factors that have significant impact on joint innovation of processing material supplier.

4 - Constant-order Policies for Lost-sales Inventory Models with Random Supply Functions: Asymptotics and Heuristic

Xiting Gong, Assistant Professor, The Chinese University of Hong Kong, Room 506, William M.W. Mong Engineering Building, Hong Kong, xtong@cuhk.edu.hk, Jinzhi Bu, Dacheng Yao

In this paper, we study the constant-order policies (COP) for the lost-sales inventory system with positive lead times and general supply functions. Besides analyzing the asymptotic properties of the best COP with large lead times and large penalty costs, we construct a simple while asymptotically optimal heuristic COP and carry out extensive numerical studies to investigate the COP's performances.

5 - Developing Long-term Voluntary Partnerships with Suppliers to Achieve Sustainable Quality

Fang Liu, Nanyang Technological University, S3-B2a-13, 50 Nanyang Avenue, Singapore, 639798, Singapore, liu_fang@ntu.edu.sg, Tracy Lewis, Jing-Sheng Jeannette Song

Several leading companies have initiated sustainability programs to achieve sustainable quality supply, but the details of the sustainability programs differ. This paper explores how a new comer should design such programs and what are the key factors for achieving sustainable quality supply during the implementation phase. We design a partnership agreement between a retailer and multiple economically weaker suppliers to ensure sustainable supply of a high-quality material over a finite horizon with double-sided asymmetric information and moral hazard. We show that the constructed agreement induces truthful information exchange, self-enforcement, and efficient supplier-development investments. We identify a minimum contract length to ensure sustainable quality supply. We also show that the payments to the suppliers need to reflect both the current and future production and market conditions. We identify contract length and knowledge-sharing with pooled-investments as key factors for implementing sustainable quality supply.

■ SA03

101C, 1st Floor

Inventory Sharing and Collaboration

Invited: Stochastic Inventory Theory

Invited Session

Chair: Qing Li, Hong Kong University of Science & Technology-HKUST, Kowloon, Hong Kong, imqli@ust.hk

Co-Chair: Bharadwaj Kadiyala, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, bkadiyala@ust.hk

1 - Value of By-product Synergy: A Supply Chain Perspective

He Xu, Professor, Huazhong University of Science and Technology, No. 1037 Luoyu Road, Wuhan, 430074, China, xuhe@mail.hust.edu.cn, Pin Zhou, Hongwei Wang

By-product synergy (BPS) is an innovation method to dispose of waste and create value from waste. We examine a supply chain composed of two competing manufacturers and one downstream processing plant with limited BPS capacity. The plant generates a by-product with waste from manufacturers and sells the by-product in a market with uncertain prices. We derive each manufacturer's equilibrium decisions (production quantity and disposal amount) and the plant's capacity investment plan (ex ante). We show that BPS always benefits manufacturers, but the extent of this benefit depends on two opposite effects (a competition effect and a cost-saving effect). A counterintuitive result that higher investment cost may increase each manufacturer's profit arises due to these two effects. Finally, we discuss the implications of different market parameters (investment cost, intensity of competition and efficiency of production process) and extend our basic model in two directions.

2 - Managing Perishable Inventory Systems with Product Returns and Remanufacturing

Ke Fu, Sun Yat-sen University, Guangzhou, China, fuke@mail.sysu.edu.cn, Xiting Gong, Guitian Liang

Motivated by an emerging practice in the cut flower industry, we consider a periodic-review inventory system for a perishable product with a lifetime of two periods. There are two separate customer demands for the new product with two-period remaining lifetime and the old product with one-period remaining lifetime; and a fixed proportion of the unsatisfied demand for one product will purchase the other product as a substitute. The objective is to maximize the expected total discounted profit over a finite planning horizon. We show that the optimal remanufacturing policy is a modified base-stock policy and the optimal manufacturing quantity of the new product is decreasing in the total inventory level of the old product after remanufacturing. We numerically demonstrate that remanufacturing can be a powerful lever to mitigate the negative environmental impacts in the cut flower industry.

3 - A Strategic Approach to Collaborative Inventory Management

Bharadwaj Kadiyala, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, bkadiyala@ust.hk

This paper studies an inventory management problem faced by an upstream supplier who is in a collaborative agreement, such as vendor-management inventory (VMI), with a retailer. A VMI partnership provides the supplier a unique opportunity to manage inventory for the supply chain, in exchange for point-of-sales (POS) and inventory level information from the retailer. However, retailers typically possess superior local market information and, as has been the case in recent years, are able to capture and analyze customer purchasing behavior beyond the traditional POS data. We propose a dynamic inventory mechanism for the supplier, to manage inventory and information in the supply chain. The proposed mechanism combines the ability of the supplier to learn about market conditions from POS data (over multiple selling periods) and to dynamically determine when to screen the retailer and acquire his demand information, while taking into account both firms' market power.

4 - Transshipment of Perishable Inventories in Retailing

Qing Li, Hong Kong University of Science & Technology-HKUST, Dept of ISOM, Clear Water Bay, Kowloon, Hong Kong, imqli@ust.hk, Peiwen Yu

We consider a retailer that sells a perishable product through two outlets. Items are picked by customers on a last-in-first-out basis. The product has a general finite life time. The retailer can transship the inventory between the two outlets. How should the retailer optimally transship and replenish inventory, and when should it start a clearance sale?

■ SA04

101D, 1st Floor

Operations/Marketing Interface I

Invited: Operations/Marketing Interface

Invited Session

Chair: Jiong Sun, Purdue University, Purdue University, West Lafayette, IN, United States, sun664@purdue.edu

Co-Chair: Chenxi Zhou, PhD, Xiamen University, Xiamen University, Xiamen, China, chenxi.zhou@xmu.edu.cn

1 - On the Effect of Wal-mart Sales Disclosure on Supplier Performance

Chenxi Zhou, Xiamen University, Xiamen, China,
chenxi.zhou@xmu.edu.cn, Jiong Sun, Juncai Jiang

This paper investigates whether and how the change of a dominant retailer's sales information disclosure affects supplier performance. Specifically, we focus on an important retailer performance index, the monthly Comparable Store Sales Index (CSS) index, and empirically test suppliers' financial performance when Wal-Mart withdraws monthly CSS index. We found that the cease of Wal-Mart's monthly CSS disclosure is associated with negative supplier abnormal returns. However, the cease of dominant retailer's monthly CSS disclosure does not hurt all suppliers equally: the negative financial response is stronger for suppliers with higher sales volatility but weaker for suppliers which also serve other retailers in the same category. Finally, the withdrawal of Wal-Mart monthly CSS is also associated with higher supplier inventory volatility for those who only serve Wal-Mart.

2 - Counterfeiters on Online Marketplaces: Sharing Your Costs or Stealing Your Sales

Jiong Sun, Purdue University, 812 W State St, Purdue University, West Lafayette, IN, 47907, United States, sun664@purdue.edu,
Lin Tian, Qingyuan Zhu

This paper studies the interaction of an authentic seller and a counterfeiter on an online marketplace. Both sellers exert efforts to attract sales for the brand, and the platform determines its effort level of combating the counterfeiter. Our analysis reveals interesting insights to both the platform and the authentic seller. For example, we find that the platform's combating effort has a non-monotonic impact on both sellers' profits. Second, we find that the authentic seller may benefit from its own higher unit product costs. This is because it may motivate the counterfeiter to take over more sales efforts which happens when the cost is in a low-value region. Otherwise, the sales-stealing effect dominates and higher unit costs hurt the authentic seller.

3 - Product Development and Advertising Strategies in the Presence of Competition

Yingchen Yan, Tianjin University, Tianjin, China,
ychyan@tju.edu.cn, Jiong Sun, Lin Tian

We study the interplay between product development and advertising strategies in a duopoly setting. Each firm can choose which attribute to focus on in its development strategy and which attribute to play up in its advertising strategy in order to influence consumers' preference. We find that the emergence of symmetric or asymmetric equilibrium depends on both market and cost factors and their interactions. For example, a higher advertising cost increases the likelihood of an asymmetric equilibrium. Other interesting insights are also offered.

4 - A Game-theoretical Analysis in New Products Introduction in Fashion Runway

Bin Shen, Donghua University, Xuri Building, 1882 Yanan Road,,
Donghua University, Shanghai, China, binshenjerry@gmail.com

Luxury fashion brands such as Burberry and Tom Form recently announced a "see now buy now" movement, which implies that the consumers can buy the products right after the fashion runway. In this paper, we examine the optimal new products introduction in fashion runway by a game-theoretical analysis.

■ SA05

Tutorial: Applications of Custom 3D Printed Physiological Heart Valve Models for Reducing Heart Surgery Risks

Tutorial Session

1 - Applications of Custom 3D Printed Physiological Heart Valve Models for Reducing Heart Surgery Risks

Chuck Zhang, Georgia Tech Manufacturing Institute, Atlanta, GA, n/a, United States, chuck.zhang@gatech.edu

3D printing is finding more and more applications in medical fields, particularly personalized healthcare, due to its capabilities of producing patient-specific products, devices, and prototypes/models. This tutorial presents an innovative

method of producing patient-specific, tissue-mimicking heart valves with sensing capability by integrating metamaterial design, multi-material 3D printing and printed electronics techniques. The physiological models can help surgeons or cardiologists make informed diagnosis, optimize surgery planning, and practice the operation prior to the surgery. In addition, the tissue-mimicking heart valves can provide effective means for surgeon training and patient education. This method is demonstrated through an application case of predicting post-surgery paravalvular leak of transcatheter aortic valve replacement (TAVR) procedure for treating aortic stenosis conditions. The 3D printed heart valve models were found to be effective in mimicking the valves of real patients for surgery outcome prediction. This tutorial will also present the ongoing research of this project: to explore the application of the virtual physiological models to augment the limited real patients data for developing machine learning-based predictive models to improve medical devices design, and diagnosis and treatment of certain medical conditions.

■ SA06

103, 1st Floor

Tutorial: Models for the Sharing Economy

Invited Session

1 - Models for the Sharing Economy

Saif Benjaafar, University of Minnesota, 111 Church Street SE,
Department of Industrial and Systems Engr, Minneapolis, MN,
55419, United States, saif@umn.edu

The sharing economy is used to denote emerging business models that enable the access to products and services on an on-demand basis. In some cases, this access is mediated by a digital platform that connects suppliers (often single individuals who are willing to share assets or provide a service) with buyers. Some of these platforms have been successful in overcoming the inefficiencies of peer-to-peer interactions by reducing transaction and search costs, facilitating payments, reducing moral hazard, and enabling trust among strangers. Others have been successful in harnessing economies of scale by tapping into idle assets or leveraging the crowd. These platforms present unique operational challenges regarding how best to match supply and demand, including pricing, wage setting, real time matching of buyers and suppliers, and the management of inventory and workforce, among others. They also raise important questions regarding the impact on consumers, incumbent firms, and society (e.g., environmental impact and impact on labor welfare). In this tutorial, we describe recent efforts at developing models for the design, analysis, and optimization of these systems. In particular, we draw on three papers that consider (1) peer-to-peer product sharing, (2) labor platforms for on-demand services, and (3) product rental networks. We also discuss the many outstanding opportunities for operations and management science research in this area. (Based on joint work with Costas Courcoubetis, Jian-Ya Ding, Xiang Li, Xiaobo Li, Guangwen Kong, and Terry Taylor.)

■ SA08

201A, 2nd Floor

Panel: Transforming Education through Analytics and Learning Science and Engineering

Panel Session

Moderator: Ramayya Krishnan, Carnegie Mellon University, Carnegie Mellon University, Pittsburgh, PA, 15213, United States, rk2x@cmu.edu

1 - Panel: Transforming Education through Analytics and Learning Science and Engineering

Ramayya Krishnan, Carnegie Mellon University, Pittsburgh, PA,
United States, rk2x@cmu.edu

Advances in information technology, learning science and data analytics are transforming education. Technology enhanced learning, flipped classroom, and open learning initiatives are changing the ways in which students learn and demonstrate learning outcomes. In this panel, academic leaders will discuss how their universities are applying analytics and detailed data about learning and learning outcomes to create the 21st Century educational experience for their students.

Panelists:

Way Kuo, City University of Hong Kong, Kowloon, Hong Kong;
Ling San, Nanyang Technological University, Singapore, Singapore;
Jeffrey Tsai, Asia University, Taichung, Taiwan, jeffrey.tsai@asia.edu.tw

■ SA09

201B, 2nd Floor

Topics in Military OR: Conflict Analysis and Logistics

Sponsored: Military, Defense, and International Security

Sponsored Session

Chair: Greg H Parlier, North Carolina State University, 255 Avian Lane, Madison, AL, 35758, United States, gparlier@knology.net

1 - An Integrated Air Cargo Routing and Balancing Problem

Fan Xiao, Dr, Tongji University, Zhangwu Rd 1, Tongji Building A, 1913, Shanghai, 200092, China, 892225786@qq.com, Zhe Liang

We study an integrated air cargo routing and weight balancing problem. The air cargo routing problem is to decide the flight path for each cargo ULD, and the weight balancing problem is to select the cargo ULDs to be loaded on each aircraft, and to ensure the weight balance of the aircraft. Traditionally, these two problems are solved sequentially. However, the position of each ULD on the aircraft affect the connection time between flights of different aircraft. We present a mixed integer programming problem to solve the small and medium size real-life problems.

2 - Analyzing Conflict from Space Identification of Physical Destruction During the Syrian Civil War

Jonathan Hersh, Assistant Professor, Chapman University, 1 University Drive, Beckman Hall, 303, Orange, CA, 92866, United States, hersh@chapman.edu, Andre Groger, Andrea Matranga, Hannes Muller

We use remote-sensing and offer a new approach to capture fighting and destruction using high-resolution satellite imagery. We develop an automated visual classifier which uses Machine Learning techniques — so-called Convolutional Neural Networks — to spot features such as the destruction of buildings or the presence of bomb craters. We then apply this classifier to a host of satellite images of Syrian cities and villages to build an objective measure of affected areas and an alternative recount of war events in the country. The resulting dataset provides an alternative measure of medium- to large scale violent events at unprecedented spatial resolution and time frequency.

3 - Artillery Firing Shift with Two Auxiliary Targets

Michael Bendersky, PhD, Holon institute of technology, golomb 52, holon, 88000, Israel, michael.bendersky@gmail.com

Firing Shift is the shifting of artillery fire from one target to another with the application of corrections determined from the adjustment on the first target to the initial firing data for the second. We study a shift accuracy using a simultaneous registration of two auxiliary targets, deterministically solving for four major environmental factors which affect ballistic trajectories. Using a linear model for artillery fire accuracies- the parameters of which are obtainable from Firing Tables, we compare the shift performance of the extant NATO correcting algorithm (Met+VE).

■ SA10

201C, 2nd Floor

Application of Operation Analytics and Optimization Methods

Invited: Operations Analytics and Optimization for Manufacturing, Logistics and Energy Systems

Invited Session

Chair: Kunpeng Li, Huazhong University, likp@hust.edu.cn

Co-Chair: Yang Yang, Northeastern University, Northeastern University, Heping District, China, yangyang@ise.neu.edu.cn

1 - Integrated Production Scheduling and Vehicle Routing Problem

Kunpeng Li, Huazhong University of Science and Technology, Wuhan, China, likp@hust.edu.cn

In this paper, the integrated production scheduling and vehicle routing problem is considered for a Make-to-Order manufacturer, who has a single machine for production and limited vehicles with capacity constraints for transportation. The objective is to determine production scheduling and vehicle routing, which are two interacted decisions, to minimise the maximum order delivery time. A property on optimal production sequence is proposed first, based on which backward and forward batching methods are developed and are embedded into a proposed genetic algorithm. The proposed genetic algorithm is capable of providing high-quality solutions by determining the two decisions simultaneously. For comparison purpose, a two-stage algorithm is developed, which decomposes the overall problem into two successively solved sub-problems. The experiments show that the proposed genetic algorithm can provide higher quality solutions than the proposed two-stage algorithm and two published algorithms studying related problems.

2 - An Improved Differential Evolution Algorithm for Slab Allocation Problem in Steel Plant

Lulu Song, Institute of Industrial and Systems Engineering, Northeastern University, Shenyang, China, songlulu03720372@163.com, Ying Meng, Yun Dong, Lixin Tang

In this paper, a slab allocation problem is investigated aiming at reducing slab inventory in the steel production process. Different from previous studies, there are two sets of decisions to make in the problem. The first is to allocate open-order slabs to orders aiming at reducing inventory slabs. The second is to reallocate customer-order slabs to orders aiming at improving the utilization of slabs and customer satisfaction. The problem is formulated as an integer programming model. Then an improved differential evolution algorithm is designed to get the near-optimal solutions within a short computation time. Finally, to evaluate the proposed algorithm, a serial of numerical experiments with instances generated from the real-world production have been conducted. The results show that the proposed improved differential evolution algorithm is effective for solving the practical slab allocation problem.

3 - Truck Allocation in Open-pit Mine via Reinforcement Learning

Fengyuan Shi, Northeastern University, Shanyang, China, 619924487@qq.com, Te Xu, Lixin Tang

We consider a truck allocation problem where weather and load condition are uncertain. Starting with a Markov decision process (MDP) formulation, we approximate the action value and policy with value function and policy function, and tune the function under the actor-critic framework to get a dynamic truck allocation solution. Our numerical study shows the effect of the approach.

4 - Analysis of Cold Rolling Stock Model with Energy Costs

Jing Wu, wuexciting@163.com, Lixin Tang

In this paper, we present a cold-rolling inventory model which is multi-period single production. This is a stochastic dynamic programming based on markov decision processes. Energy consumption costs are an important factor affecting the cost of each stage of inventory. We show that the value function is convexity and submodular in state variable. Then we use these to analyze the property of optimal solution.

■ SA11

201D, 2nd Floor

Crowdsourcing and Crowdfunding Platforms

Sponsored: Technology Management

Sponsored Session

Chair: Mohsen Jafari Songhori, University of Twente, University of Twente, Enschede, 7522 NB, Netherlands, mj2417@gmail.com

1 - Managing Ideas Evolution on Crowd Sourcing Platforms

Mohsen Jafari Songhori, Tokyo Institute of Technology, 4259 Nagatsuta-cho, Midori-ku, J2 Building, Room 1704, Tokyo, 226-8502, Japan, mj2417@gmail.com

Management of crowd-sourcing initiatives can be highly challenging as managers need to find out how to shape flow of ideas to ensure most promising ideas are not dismissed. In this work, we present simulation and mathematical models to answer the following research question: How firms should allocate their limited resources to screen and evaluate a large number of ideas provided on platforms. Such evaluation is significantly important, as not attending or providing proper feedback can discourage idea generators.

2 - Crowdfunding Campaigns Success Prediction with Regularized Correlational Topic Modeling Algorithm

Ramin Khatami, University of Tokyo, Tokyo, Japan, tami@mlab.t.u-tokyo.ac.jp, Mohsen Jafari Songhori, Morikawa Hiroyuki

Existing works in estimating crowdfunding campaigns success are mainly based on basic numerical features such as projects' goal, duration, etc. In this work we investigate impact of textual similarities between projects on their success chance. In doing that, we have proposed a novel "regularized correlational topic modeling" method that takes into account success effects. The results show that our proposed method with a predictive algorithm like "feed-forward neural network with a single hidden layer" can achieve as much as 10% improvement in term of F1-score. Our findings enable project owners to better assess the associated risks with their crowdfunding projects.

3 - Public Research, Innovation and R&D Project Performance

Simcha Jong, Professor, Director Science Based Business, Leiden University, Leiden, Netherlands, s.jong@ucl.ac.uk, Hsini Huang

Corporate and public R&D investments in fields where publicly funded science drives advances in product development are complementary. Accordingly, we expect changes in the public funding outlook for a scientific field to affect corporate resource commitments. Analysing data on 570 R&D projects in the global cell therapy sector initiated over the period 1997-2011, we find decreased R&D project initiation rates and higher failure rates for US firms after the announcement of a federal funding moratorium on human embryonic stem cell research. We highlight how this effect was reversed as the US public funding outlook for stem cell research improved during subsequent periods.

SA12

201E, 2nd Floor

New Optimization Methods for Vehicle Routing Problems

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Xu Zhou, Hong Kong Polytechnic University, lgtzx@polyu.edu.hk

1 - An Iterative Benders Decomposition for the Unilateral Transportation Problem

Hu Qin, Huazhong University of Science and Technology, Wuhan, China, tigerqin1980@gmail.com

Motivated by the practice of leading express delivery firms in China, we study a new unilateral transport problem, seeking for optimal cyclical vehicle routes that minimizes the total transportation cost while satisfying shipping tasks. Particularly, some realistic features are considered: a toll-by-weight cost scheme, a heterogeneous fleet of vehicles, and a maximum length limit for routes. We first build a set-based model for this problem, then propose an iterative Benders decomposition solution approach, and design acceleration techniques to speed up running time. Extensive computational experiments based on real data substantiate the effectiveness and applicability of our approach.

2 - A Branch-and-Price Algorithm for the Bike Rebalancing Problem

Jiliu Li, Huazhong University of Science and Technology, lj_liushao@foxmail.com

This paper addresses a new bike rebalancing problem that rebalances the number of bikes on the whole bike sharing system. The number of bikes on some bike stations are likely to be in lack or redundant after riding by riders. The objective is to determine a set of least-cost vehicle routes which transport bikes until rebalance of bike sharing system. This problem is a generalization of the split pickup and split delivery vehicle routing problem, which consists of determining a set of least-cost vehicle routes to serve all customers while respecting the restrictions of vehicle capacity. It involves particularly the permission a bike station can be visited by a vehicle multiple times or by multiple vehicles. To solve this problem, we propose an exact branch-and-price-and-cut algorithm, where the pricing subproblem is a variant of the resource-constrained elementary shortest path problem. And then we design a tailored and novel label-setting algorithm to solve the pricing subproblem of the resource-constrained elementary shortest path problem. In label-setting algorithm, we first prove that the reduce cost of a partial route is a linear convex piece-wise non-increasing function associates with the remaining bike on vehicle.

3 - An Exact Algorithm for the Vehicle Routing Problem with Consistency Requirements

Jun Xia, Shanghai Jiao Tong University, Shanghai Shi, China, flyingdustxj@gmail.com

Consistent vehicle routing problem (ConVRP) studied in the literature aims at creating a set of route schedules for homogeneous drivers to fulfill pickup and delivery demands on multiple days. The generated route schedules have to follow the driver consistency and time consistency to improve customer satisfaction. In this work, we generalize the ConVRP by additionally constraining that each driver is confined to work on a limited number of routes (called the route consistency), which aims to improve drivers' familiarities on their working routes to guarantee the service reliability. We intend to study this generalized ConVRP by developing an exact solution method.

4 - A Column-Row-Generation Approach to Liner Shipping Network Design

Zhou Xu, Hong Kong Polytechnic University, Hong Kong, M505e, Department LMS, The Hong Kong Polytechnic University, Hong Kong, lgtzx@polyu.edu.hk, Jun Xia

In this work, we present a novel column-row generation approach to the Liner Shipping Network Design problem. Extensive computational results have demonstrated the efficiency and effectiveness of this new approach.

SA13

201F, 2nd Floor

Emerging Topics in Operations

Invited: Operations and Economics Interface

Invited Session

Chair: Chia-Wei Kuo, National Taiwan University, cwkuo@ntu.edu.tw

1 - Optimal Size of a Combined Heat and Power Generator for an Industrial Firm

Wenbin Wang, Shanghai University of Finance and Economics, School of International Business Admin, Room 428, Shanghai, 200433, China, wang.wenbin@shufe.edu.cn, Gilvan Souza, Owen Wu

We consider a manufacturer who uses both steam and electricity in its primary production process makes investment on a Combined Heat and Power (CHP) system. We provide a decision model and find the optimal capacity and operating policy for a CHP system that reduce the total investment and energy costs.

2 - Optimal Strategy in Sharing Economy Platform with Consideration of Revenue-sharing Contract

Shun-Ran Jiang, National Taiwan University, Taipei, Taiwan, r05546011@ntu.edu.tw, Kwei-Long Huang, Chen-Ni Yen

With the popularity of the internet in recent year, the "Sharing Economy" trend has risen, so that can reduce the waste and create business opportunities. Therefore, this research want to maximize the profit of the sharing economy platform, then the supply and demand will affect the profit. This research presents a two-phase setting model, and finds the optimal solutions for the rental price, commission and profit. When the rental price is between some range of the market price, it will bring about turning point in the profit of the platform.

3 - Designing a Sparse and Efficient Rebalancing Network

Mabel Chou, National University of Singapore, 360 Pasir Panjang Rd, #01-11, Singapore, 118699, Singapore, mabelchou@nus.edu.sg, Jinjia Huang, Linfeng Li, Chung-Piaw Teo

Motivated by the Bike Angels Program in New York's Citi Bike system, we study the use of crowdsourcing as an alternative to rebalance bikes in a bicycle sharing system before the morning and evening peak hours. While the daily demand for bikes is random, we develop a method to design a static sparse network to support the re-distribution activities. Our results show that when restricting the work of the Angels to only a small subset of arcs in the network, the system can still perform almost as well as the fully flexible system, in which bikes can be moved between any pair of stations based on actual usage. This simplifies dramatically the complexity of bike rebalancing operations on the ground, without affecting the system's service performance too much.

4 - OEM Selling Channels and Supply-chain Performance

Ting-Kai Chang, National Taiwan University, Taipei, Taiwan, tingkaichang@ntu.edu.tw, Hsiao-Hui Lee, Chia-Wei Kuo

We consider an OEM manufacturing products for a brand buyer that operates in two markets: domestic and international. The OEM can offer the brand at a discount price in exchange for using the excess capacity to produce products under the OEM's brand and also sells the product through the OEM's own selling channel. We find that the OEM direct selling channel can be a win-win-win strategy for the brand, OEM, and people in the domestic market.

SA19

South Lounge, 3rd Floor

AI Methods for Healthcare and Medical Informatics

Invited: Healthcare Management

Invited Session

Chair: Qingpeng Zhang, City University of Hong Kong, Hong Kong, qingpeng.zhang@cityu.edu.hk

1 - Predicting Health Condition and Disease Occurrences using EHR Data

Qingpeng Zhang, City University of Hong Kong, 83 Tat Chee Avenue, 6/F, Academic 1, Kowloon, 12180, Hong Kong, qingpeng.zhang@cityu.edu.hk, Jiaqi Zhou

In this talk, we will present a novel tensor-based machine learning model for individualized disease prediction. The proposed model is able to capture the high-dimensional interrelations among patients, diseases, and clinical attributes. We demonstrated the efficacy of the proposed model by using EHR data of a major hospital in Hong Kong.

2 - Distance Learning to Measure Similarity Between Two Graphs

Jing He, PhD, Victoria University, Australia, lotusjing@gmail.com

One of the problem in looking at the networks is to understand how they form and properties. The processes involved and simulate them, then compare the resulting models based on the simulated graphs vs real graphs. However, the unsolved problem is how to compare these graphs. That is, are they sufficient similar to each other to test the hypothesis. To solve this problem, this talk will present how to compare the similarity between the graphs. To do that, I have been looking at several well-known metrics and introduce some new metrics. The outcome should be regular methods for testing the hypothesis of the well-known graphs. With the rigor of mathematical proof to solve the graph isomorphism problem with polynomial solution, this research put forward a systematics framework - netmechanics to solve one of the big problems in graph theory and complex networks. This netmechanics is a kind of quantitative discipline. It builds a series for the networks. Basically, the generations of networks involve the operation of adding infinitely many quantities and allows quantitative analysis of graph properties, one after the other, to a given starting quantity (a zero network) to a complete network. The study of netmechanics is inspired by serialism and a major part of calculus and mathematical analysis. Through generating functions, I study the finite structures in the networks/graphs from zero network to complete network. The basic idea is produce a function in series to describe the dynamics of the network evolving based on the similarity measurement. This series has potentially infinite summation. The concept of a limit will be used to resolve many questions, such as graph isomorphism. Netmechanics focus on the research of graphs on quantity, structure, space and time and pay more attention to measure the change among them. Motivated by SVM algorithm, some relationship will be disclosed in the high dimensions. I first build the metrics space and then measure the distance between two graphs.

3 - Predicting Depressive Symptoms in Students using Smartphone Based Sensor Data

Saurabh Singh Thakur, Research Scholar, IIT Kharagpur, RMSoEE, IIT, Kharagpur, 721302, India, saurabhjan07@gmail.com

To predict depression or mental health using smartphone-based sensor data is an ongoing research problem in the domain of mobile health. We have developed two predictive model one using logistic regression and other using K-Nearest Neighbour classifier to predict depressive symptom severity in the students based on the characteristics of their movement as derived from the GPS data and their responses towards the survey PHQ9 and PSS. The prediction result is validated using k-fold cross-validation method. The fit those reported in the literature. It points to a novel application of the smartphones to develop an early warning system for mental health issues.

4 - Social Platforms on Healthy Eating Mobile App: Who Participates in What Activities, and Why Not?

Yi-Chin Kato-Lin, Assistant Professor, Hofstra University, Hempstead, NY, 11549, United States, yichin.lin@hofstra.edu, Rema Padman, Vibhanshu Abhishek, Julie Downs

Mobile apps have great potential to deliver promising interventions to engage consumers and change their health-related behaviors, such as healthy eating. Social media is a prevalent strategy for health-related apps to engage users and improve health outcomes. To understand how social media is used in health-related apps, we designed a mobile app for healthy eating for our study participants' use. Users' behaviors in interacting with peers on a closed social platform were observed. Matching the app usage data with survey data which includes demographics allows us to understand who participate in what activities, or why they were not participating.

Sunday, 10:00AM - 11:00AM**Plenary- Christopher S. Tang**

Plenary Room/Banquet Hall, 3rd Floor

Plenary: Making Supply Chain Transparent for a Better World: Information and Analysis

Plenary Session

1 - Making Supply Chain Transparent for a Better World: Information and Analysis

Christopher S. Tang, University of California-Los Angeles, UCLA Anderson School of Management, Operations and Technology Management, Los Angeles, CA, 90095-1481, United States, chris.tang@anderson.ucla.edu

Companies are gaining more supply chain visibility to reduce their supply chain risks, but few are disclosing what they know with the public. Should a firm disclose its supply chain information to the public? What are the risks and opportunities? I plan to present some recent research and case-based studies to illustrate how supply chain transparency can improve our world: planet, people and profit.

Sunday, 11:00AM - 12:30PM**SB01**

101A, 1st Floor

Supply Chain Coordination under Risk

Sponsored: Mitigating Risk in Supply Chains

Sponsored Session

Chair: Ashutosh Sarkar, Indian Institute of Management-Kozhikode, Kozhikode, 673570, India, asarkar@iimk.ac.in

1 - Risk Management Strategies for Agricultural Supply Chain under Price and Demand Uncertainty

Mrigank Prasoon, Indian Institute of Technology Kharagpur, Kharagpur, 721302, India, mrigank.iitkgp19@gmail.com, Pritee Ray, Shreya Kumari .

Agricultural supply chains encounter more sources of risk because of seasonality, perishability and weather conditions etc. Making strategies to manage these risks are quite challenging. We develop a two-stage stochastic programming model for a perishable product supply chain, which maximizes the decision maker's expected profit by selecting the optimal risk management strategies under demand and price uncertainty. The results shows that a mixed combination of robust and resilient strategies is most effective for managing supply risks with demand and price uncertainty.

2 - Global Supply Chain Network Design under Disruption Risks and Carbon Emission Regulations

Purushottam Lal Meena, PhD, New York Institute of Technology, New York, NY, United States, pmeena@nyit.edu, Shaya Sheikh

This paper studies the problem of constructing a suppliers portfolio under carbon emission regulations for multi-products in the multi-periods environment. We consider that each supplier is exposed to the risk of disruptions and offer quantity-based discounts. The problem is nonconvex and mixed-integer nonlinear programming in nature. The objective is to minimize the total economic cost and carbon emission cost. The problem is solved using particle swarm optimization algorithm and BARON. The proposed model is validated with an Indian steel company.

3 - Is Honesty the Best Policy, Always?

Rahul R Marathe, PhD, Indian Institute of Technology Madras, Chennai, India, rrmarathe@iitm.ac.in, Srinivasan G

We consider a two-echelon supply chain coordinated by a revenue sharing contract. Market demand is stochastic and can occur in two states: high and low. The retailer knows the possible demand state whereas the supplier has a belief about the likelihood of the same from the history of submitted sales report by the retailer. This provides the retailer scope to under-report sales. But, the contract allows the supplier to audit the retailer. The audit is full proof but it comes with a cost. We aim to build an analytical model to find an optimal policy each for the retailer and supplier.

4 - Supply Chain Risks and Mitigation Strategies for Indian Steel Industry

Dayal Prasad, PhD, Ex-Employee, Tata Steel, Jamshedpur, India, dayalprasad0104@gmail.com, Ashutosh Sarkar, Kunal Gaurav, Inderpal Kaur, Sagar Nayak

Supply Chain Risk Management (SCRM) has assumed strategic importance for management and stakeholders alike. The risks vary from country to country and also for specific industry sector. This paper attempts to identify the various risks which impact the operation of supply network in the particular context of Indian Steel Sector and develop appropriate framework strategy for risk mitigation. We have used a combination of existing literature review and consultation from experts in steel industry to identify the various risks, categorize them and develop a conceptual framework to understand the relationship between risks and organization's performance measures.

5 - A Little Speed-customization goes a Long Way: Imminent Delivery Networks of Online Retailers

Sandun Perera, School of Management, The University of Michigan-Flint, 2200 Riverfront Center, 303 E. Kearsley Street, Flint, MI, 48502-1950, United States, sperera@umich.edu, Milind Dawande, Ganesh Janakiraman, Vijay Mookerjee

As last mile costs decrease, the optimal number of distribution locations should also decrease due to the usual economies of scale logic of inbound delivery costs etc. In this paper, we show that when the last mile costs decrease, the number of delivery hubs could increase if the customers are sensitive to the delivery time. We introduce a perfect speed customization strategy which is more profitable than the exiting strategies used in the market, and explain how such a speed customization can be practically implemented via a discrete speed customization strategy. Interestingly, under our discrete speed customization strategy, a little speed customization goes a long way in terms of profit.

■ SB02

101B, 1st Floor

Interface Between Supply Chain and Information Technology

Invited: Supply Chain Inventory Management

Invited Session

Chair: Jim Junmin Shi, PhD, New Jersey Institute of Technology, Newark, NJ, 07102, United States, shigsu@gmail.com

Co-Chair: Jasmine Chang, PhD, Rutgers Business School, Rutgers Business School, Newark, NJ, 07102, United States, aichih@scarletmail.rutgers.edu

1 - Auctioning Information Technology Service Contracts

He Huang, Chongqing University, School of Economics & Business Administration, Chongqing, 400030, China, huanghe@cqu.edu.cn, Zhipeng Li, De Liu, Hongyan Xu

This paper studies the design of IT service contracts under procurement auction, where the project effectiveness is jointly affected by the specific investments of both the client and the winning vendor, and the project scope can be renegotiated after the project effectiveness is realized.

2 - Two Circular Economy Models for Sugar Supply Chain

Yiyan Qin, PhD, Guangxi University for Nationalities, Nanning, China, qinyiyan2002@sina.com

Sustainable supply chain management have been developed in the last decades. In parallel to this, the circular economy discourses has been propagated in the industrial ecology literature and practice. Two sugar supply chain network models are constructed for two scenarios which integrating circular economy concept. One is for traditional and the other is for eco-industrial park. The advantages and shortages of two modes are discussed.

3 - Evaluation of RFID Technology in an Outsourcing Remanufacturing Supply Chain

Zongbao Zou, Sun Yat-Sen University, Guangzhou, China, zzbkr123@163.com

High level of uncertainty in quality of end-of-life product products which affects seriously the efficiency of remanufacturing. RFID technology helps obtain more accurate quality information of end-of-life products. We investigate the incentive to invest RFID technology in an outsourcing remanufacturing supply chain comprising an original equipment manufacturer and a third-party remanufacturer.

4 - Blockchain Technology and Its Impacts on Supply Chain Management

Junmin Shi, New Jersey Institute of Technology, Tuchman School of Management, University Heights, Newark, NJ, 07102, United States, jshi@njit.edu, Aichih Chang-Shi, Michael N. Katehakis, Benjamin Melamed

Advances in blockchain technology (BCT) can help firms to reduce order quantities, offer lower selling prices, and reduce target inventory levels. To investigate the impact of blockchain technology on supply chain performance, we develop a comprehensive stochastic model for a firm that seeks to maximize the total expected discounted profit, by jointly managing a) choice of blockchain design, and b) production or ordering decisions and dynamic pricing and selling. It is shown that the volatility pertaining to either supply or demand market will lower the expected profit. While facing higher volatility, the firm prefers to leverage high degree of blockchain. Finally, we provide a numerical study that illustrates rich managerial insights. For example, the lifecycle of the product impact the decision on blockchain, and the tech-savvy customer behavior provide more incentive to apply blockchain technology.

■ SB03

Panel: Industry 4.0 Opportunities for Integrative Decisions in Smart Manufacturing Panel Session

Chair: Judy Jin, University of Michigan, Ann Arbor, MI, United States, jhjin@umich.edu

1 - Industry 4.0 Opportunities for Integrative Decisions in Smart Manufacturing

Moderator: Judy Jin, University of Michigan, University of Michigan, Ann Arbor, MI, United States, jhjin@umich.edu

Industry 4.0 with digitalization and Internet of Things (IoT) provides tremendous opportunities for achieving smart manufacturing through real time data sharing across different levels of enterprise operations. Meanwhile, it also brings about new research challenges on how to effectively utilize those data to make integrative decisions so that a smart manufacturing system can adaptively respond

in real time to meet changing demands and conditions in the factory, in the supply network, and in customer needs. This panel session is especially organized to promote broad communication and interdisciplinary research for making integrative decisions across manufacturing process design, quality control, production system operations and logistics/supply chain management. The panelist is consisted of five invited speakers from North American, Europe, and Asia, whose research expertise crossly cover these areas. Each panelist will firstly give a 10mins talk to share his/her expert point of view on the research opportunities, challenges and strategies to achieve integrated decision-making for smart manufacturing under Industry 4.0. The remaining time of the session will be Q&A interactions between the panelist and audience.

Panelists:

Kai Hoberg, Kuehne Logistics University, Großer Grasbrook 17, Hamburg, 20457, Germany, Kai.Hoberg@the-klu.org; Dongni Li, Beijing Institute of Technology, Beijing, China, Dongni Li;

Leyuan Shi, University of Wisconsin-Madison, 1513 University Ave., ME3250, Madison, WI, 53706, United States, leyuan@engr.wisc.edu; Fugee Tsung, HKUST, Clearwater Bay Road, Hong

■ SB04

101D, 1st Floor

Operations/Marketing

Invited: Operations/Marketing Interface

Invited Session

Chair: Yasar Levent Kocaga, Sy Syms School of Business, Belfer Hall Room # 403/A, 2495 Amsterdam Ave, New York, NY, 10033, United States, kocaga@yu.edu

1 - A Planning Approach to Ad Resource Allocation for Nonguaranteed Targeted Display Advertising

Huaxiao Shen, Research Assistant Professor, Sun Yat-sen University, Xingang Xi Road, Haizhu District, Guangzhou, 510275, China, hxshen@outlook.com, Yanzhi Li

We propose a planning approach for ad publishers to better allocate their ad resources in nonguaranteed online display advertising. Specifically, we propose a framework comprising two building blocks: (1) a mixed-integer nonlinear programming model that solves for the optimal ad resource allocation plan, which maximizes the publisher's revenue, for which we have developed an efficient solution algorithm; (2) an arbitrary-point-inflated Poisson regression model that deals with users' ad clicking behavior, whereby we directly forecast the number of clicks, instead of relying on the click-through rate as in the literature. Extensive experiments demonstrate the effectiveness of our approach.

2 - Promotion Priority in Differentiated Electronic Channel Structures in the Presence of Strategic Customers

Pingping Chen, Tianjin University, Tianjin University, Weijin Road, Tianjin, China, ppchen@tju.edu.cn

The prevalence of specialized promotional online platforms has yielded differentiated electronic channels, including conventional reselling and novel agency selling, which endows a firm with more options in addition to the existing direct channel. Once a specialized promotion channel is adopted, the firm then needs to identify the appropriate promotion-timing sequence between channels, especially when facing customers who engage in strategic waiting. To capture the firm's preferences over online channel structures and promotion-timing sequences, we develop a dynamic game model and derive several novel managerial insights.

3 - Fit-revelation Sampling and Advertising

Shiming Deng, Huazhong University of Science and Technology, 1037 Luo Yu Rd, Apt 5, Wuhan, 430074, China, dengsm@gmail.com

Customers are often uncertain about how a product to their individual preferences. To alleviate customers' concern, sampling can be offered to resolve their preference uncertainty before purchase. We refer to sampling with such a focus as fit-revelation sampling. In marketing practice, sampling is often offered jointly with advertising. We examine whether the decision of t-revelation sampling is complementary or substitute with the effort of advertisement.

4 - Operational Perils and Benefits of Free Trials in Large Scale Service Systems

Yasar Levent Kocaga, Assistant Professor of Operations Management, Sy Syms School of Business, Belfer Hall Room # 403/A, 2495 Amsterdam Ave, New York, NY, 10033, United States, kocaga@yu.edu, Chihoon Lee

We consider the pricing and joint pricing and capacity sizing problem of a large scale service firm catering to price- and delay-sensitive customers and that has the option of offering free trials. We find that if the only decision variable is the static per usage price for service, offering free trials is in most cases not as beneficial, if beneficial at all. We also consider the case where the firm can adjust its capacity and show that offering free trials is always beneficial when capacity can be changed at a relatively low cost. Our analysis reveals that service firms should opt to simultaneously increase capacity to fully unlock the benefits associated with offering free trials.

5 - Credit Risk Propagation Along Supply Chains: Evidence from the CDs Market

John R. Birge, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States, John.Birge@ChicagoBooth.edu, Senay Agca, Volodymyr O. Babich, Jing Wu

We find that credit risk propagates through multiple supply chain tiers for both positive and negative credit shocks. We show sizeable rating and industry-adjusted CDS spread changes of 44-71 bps at the tier-1, continuing for 2nd and 3rd tiers for bad credit shocks, but attenuating for good ones. Credit risk contagion disappears with inactive supply chain links. The contagion is magnified with longer-term supply-chain relations, trade credit, sales contribution, differentiated products, and customer leverage. It is moderated when a customer is investment grade or has more inventory.

■ SB05

102, 1st Floor

Practice I

Sponsored Session

Chair: Jen-Yao Chung, Quanta Cloud Technology, Taoyuan City, Taiwan

1 - From Project Theta to Taiwan AI Academy

Sheng-Wei Chen, Institute of Information Science, Academia Sinica, Taipei, Taiwan, swc@iis.sinica.edu.tw

Taiwan AI Academy was founded in January 2018. It is unique in many ways, in particular, its close collaborations with industry in order to empower domain experts from various fields by machine learning and deep learning techniques within a short 3-4 month. In this talk, I will elaborate the story to start from the achievements of the Project Theta to the foundation of Taiwan AI Academy, and how we will transform the AI talent development in Taiwan starting from these efforts.

2 - Process to Identify Innovation and Cloud Services

Jen-Yao Chung, Quanta Cloud Technology, Taoyuan City, Taiwan

We are approaching technology shift that will drive new paradigms for software and systems. Software complexity is driving a rethinking of software development. Creating innovative solutions and services is not about doing something new, it is about creatively solving business problems with reusable assets or building blocks. It is about using a systematic process to solve business and infrastructure problems for speed and quality. IT-enabled service plays a key role of boosting the economics by integrating IT with different domain knowledge to create innovative values from existing business services. Cloud Computing is a model of shared network-delivered services, both public and private, in which the user sees only the service, and need not worry about the implementation or infrastructure. Changing business environments require quick changes, new business models and new solutions. In this talk, lessons learned and future innovation drivers will be presented. We will present how to transition services from an ad-hoc practice to a more innovative and systematic discipline. We will present building applications based on cloud and everything as a service approach.

■ SB06

103, 1st Floor

Tutorial: Healthcare Informatics and Analytics – I

Tutorial Session

1 - Healthcare Informatics and Analytics

Rema Padman, Carnegie Mellon University, The H. John Heinz III College, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States, rpadman@cmu.edu

The significant advances in clinical and consumer health technologies combined with the rapid developments in advanced analytics of high dimensional, high volume, and complex healthcare data is powering a transformation of healthcare delivery worldwide. Innovative analytical techniques are being developed to support a range of decisions that include predicting responses to different treatment regimens, individual and population level risk assessments, detecting anomalies, and preventing deterioration in the health status of the patient. Supporting patient - provider communication and shared decision making via intelligent reminders, notifications and informed guidance, and providing smart healthcare delivery operations to increase satisfaction, efficiency and quality of care are further capabilities being architected using informatics tools. Learning current and potential best practices from data using quantitative methodologies, such as statistical machine learning and operations research, and translating the new evidence to the frontlines of care via efficient software implementations and institutional deployments, offer both major challenges and opportunities for researchers and practitioners alike. This tutorial will highlight some of the methods and tools to address these issues with illustrative examples drawn from clinical, consumer self-care and public health domains.

■ SB07

105, 1st Floor

Simulation Optimization

Sponsored: Simulation

Sponsored Session

Chair: Hao Huang, Yuan Ze University, Taoyuan, 32003, Taiwan, haoh7493@uw.edu

1 - A Simulation Optimization Framework Combining Probabilistic Branch and Bound with Metaheuristic Algorithms

Hao Huang, Yuan Ze University, IEM Department, Yuan Ze University, 135 Yuan-Tung Road, Chung-Li, Taoyuan, 32003, Taiwan, haohuang@saturn.yzu.edu.tw

Probabilistic Branch and Bound (PBnB) is a partition-based simulation optimization algorithm using statistical techniques to approximate a level set or the global optimal solution. This study proposes a framework to introduce a metaheuristic algorithm to enhance the sampling strategy and increase the efficiency of PBnB. Concurrently, using this framework can also provide statistical quality on the solution provided by the algorithm.

2 - Implementing Partition Based Random Search for Global Optimization with Theoretical Motivation

David Desmond Linz, University of Washington, 5247 NE 15th Avenue, Apt 101, Seattle, WA, 98105, United States, ddlinz@gmail.com, Zelda B Zabinsky

Global optimization algorithms have difficulty determining solutions on high-dimensional domains with ill-structured objective functions. However, theory has proven that adaptive random search algorithms have the potential to be effective for solving global optimization problems, with the number of iterations required to locate a solution within a specified distance of the global optimum increasing only linearly with the dimension of the domain. This presentation discusses a new analysis on problems with and without noise that suggests implementations that control the number of iterations and replications as a function of the domain dimension. Variations on two algorithms, Probabilistic Branch and Bound and the Nested Partition algorithm, are implemented and tested. We present numerical results on performance of these methods.

3 - The Impact of Short-Stay Policy on Emergency Department Efficiency: A Discrete-Event Simulation Study

Wheyming Tina Song, National Tsing Hua University, Taipei, Taiwan, wheyming@ie.nthu.edu.tw, Pual Lee, Chi-Hao Hong, Yi-Zhu Su

This research investigates the effect of a short stay observation wards (SSOW) and the optimal bed planning to alleviate Emergency Department (ED) crowding. We develop a computer simulation model of ED patient flow using the discrete-event simulation (DES) methodology by the Flexsim Health-Care (HC) software. The DES model is based on institutional data of a Level 1 ED department in Taiwan. The associated parameters and distributions were obtained and fitted with the census of 13000 patients from April 2016 through June 2016. The decision variable in the ED model is the bed number of SSOW. The performance measure is the National Emergency Department Overcrowding Score (NEDOCS). Simulation results show that with a constant ED departure rate at the base case, the proportion of the severe ED crowding days (NEDOCS score ≥ 100) would decrease from 77% to 57% in the best case when the SSOW increased from 0 to 10; and decrease from 57% to 52% in the best case when the SSOW increased from 10 to 16.

4 - Deep Learning for Early Detection of Mental Illness

Felisa Vazquez-Abad, Professor, Hunter College-CUNY, Department of Computer Science, 695 Park Avenue, Room 1000 B, Manhattan, NY, 10065, United States, fvazquez-abad@gc.cuny.edu, Daniel Dufresne

We present a deep learning model to predict future onset of ADD (attention deficit disorder), a particularly cruel mental illness that affects many children. ADD increases propensity to crime, depression and lesser quality of life. Rather than using supervised learning for classification, we define a stochastic model to compute likelihoods and timeline for future onset of ADD, effectively implementing soft thresholds. Access to data (brain scans), particularly for healthy brains, is very costly. We explore a novel idea to create synthetic data.

SB08

Retail Operations

Invited: Stochastic Inventory Theory

Invited Session

Chair: Sean Zhou, Chinese University of Hong Kong, Shatin N.T., Hong Kong, zhous@baf.cuhk.edu.hk

1 - Population Monotonicity in Newsvendor Games

Xiangyu Gao, Hong Kong, xiangyu@cuhk.edu.hk, Xin Chen, Zhenyu Hu, Qiong Wang

We use the concept of population monotonic allocation scheme (PMAS), which requires the cost allocated to every member of a coalition to decrease as the coalition grows, to study the cooperative newsvendor game. We focus on the dual-based allocation scheme and identify conditions under which it is a PMAS.

2 - The Benefit and Cost of Skipping the Line

Yang Li, Chinese University of Hong Kong, 12 Chak Cheung Street, Cheng Yu Tung Building, Hong Kong, liyang@baf.cuhk.edu.hk, Opher Baron, Xiaole Chen

If you do not have time to wait in a long line to get your morning caffeine fix or to grab your lunch, now you can skip the line and order online. Thanks to the advancing IT technology, more and more restaurants, e.g., Starbucks and McDonald's, are offering online ordering without customer physical presences in the service line. We study the impacts of this novel business model with both online and in-store customers waiting to be served. We find that although the provider enjoys a revenue increase, both online and in-store customers endure longer delays and the social welfare may suffer.

3 - Forecasting Demand of New Products: A Hybrid Structural and Data Driven Approach

Tong Wang, National University of Singapore, Dept of Analytics and Operations, 15 Kent Ridge Drive, Singapore, 119245, Singapore, tong.wang@nus.edu.sg

We study a new product demand forecasting problem faced by a cosmetic retailer. The retailer's business strategy requires frequent launching of new products with new functionalities (e.g., facial mask) or new regimes (e.g., Tea Tree Oil). The main challenge is data availability/sparsity: there is no historical data for new products, and it is not obvious how to utilize data about existing products. Pure data-driven approaches in the literature can extrapolate the data about existing products to generate forecast for new products, however, they fail to capture subtle substitution effects between new and old products within or across product categories (in terms of functions and regimes). On the other hand, pure structural models of product substitution requires historical data to calibrate. We propose a hybrid approach that overcomes the disadvantages of both. The approach's forecast accuracy is back-tested on real dataset.

4 - Multilocation Newsvendor Problem Centralization and Inventory Pooling

Sean Zhou, Chinese University of Hong Kong, 12 Chak Cheung Street, Cheng Yu Tung Building, Shatin N T, Hong Kong, zhous@baf.cuhk.edu.hk

We study a multilocation newsvendor model with a retailer owning multiple retailing stores, each of which is managed by a manager who decides its order quantity for filling random customer demand of a product. The store managers and the retailer are all risk-averse. We adopt conditional value-at-risk (CVaR) as the performance measure and consider two alternative strategies to improve the performance of the system. First, the retailer centralizes the ordering decisions. Second, the managers still decide the order quantity for their own store whereas their inventories are pooled together. We compare the optimal order quantities and the resulting CVaR values of the systems and study their comparative statistics.

SB09

201B, 2nd Floor

Data Analytics and Artificial Intelligence with Manufacturing and Service Applications

Invited: At the Nexus of Technology, Health and Productivity
Invited Session

Chair: Cheng-Hung Wu, Taipei, 106, Taiwan, wuchn@ntu.edu.tw

1 - Taxis Strike Back: A Field Trial of the Driver Guidance System

Shih-Fen Cheng, Associate Professor, Singapore Management University, 80 Stamford Road, Singapore, 178902, Singapore, scheng@smu.edu.sg, Shashi Shekhar Jha, Rishikeshan Rajendram

Traditional taxi fleet operators world-over have been facing intense competitions from various ride-hailing services such as Uber. In this work, we discuss how efficient real-time data analytics and large-scale optimization technology could help taxi drivers compete against more technologically advanced service platforms. Our technology is based on an earlier theoretical work proven to work in a series of simulation studies. Our major contribution in this paper is the demonstration that the proposed design, when coupled with a real-time data feed of close to 22,000 taxis around Singapore, can indeed help drivers to improve their performances. We have tested the driver guidance system operationally since September 2017. With over 400 recruited drivers and 6 months of operational data, we demonstrate that drivers can reduce their roaming times by 18% when actively following our guidances. By further breaking down the analysis by time periods, workdays, and areas, we point out the spatial-temporal combinations in which the DGS is most useful.

2 - A Dynamic Inventory Model for a Perishable Commodity with Leftover Tax

Wen-Chih Chen, National Chiao Tung University, Industrial Engineering & Management, 1001 Ta Hsueh Road, Hsinchu, 30050, Taiwan, wenchih@faculty.nctu.edu.tw, Chiau-Shin Weng

We investigate the dynamic inventory management of a perishable commodity with leftover tax and purchasing price fluctuations. A stochastic dynamic programming (DP) model is used to optimize the order policy within a finite time horizon with of a limited warehouse capacity and given purchasing prices.

3 - Sequential Bayesian Maintenance Optimization via Failing to Learn

Ya-Tang Chuang, University of Toronto, Toronto, ON, M5S 3G8, Canada, ytchuang@mie.utoronto.ca

We study a class of sequential maintenance optimization problems where parameters of the lifetime distribution are not known a priori, but need to be learned over time. The goal of this paper is to characterize the structure of the optimal preventive maintenance (PM) policy to understand the basic mechanism by which learning and PM decisions are optimally combined. Through an analysis of the Bayesian dynamic programming (BDP) equations, our main result shows that BDP-optimal decisions can be expressed as the sum of a myopic-optimal PM time plus an "exploration boost". We also show that average per period regret under the BDP-optimal policy tends to zero like $O(\log(n)/n)$.

4 - Storage Location Assignment in a Rack-moving Mobile Robots Warehouse through Item Clustering

Martin Starker, National Taiwan University, Taipei, Taiwan, r05546036@ntu.edu.tw, Cheng-Hung Wu

This study explores different storage allocation strategies in a rack-moving mobile robots warehouse environment and their effects on the warehouse performance. By analyzing order data, the inventory is grouped based on the correlation between items. Existing clustering algorithms are extended to also consider inventory levels and distribute identical items over several inventory pods. A computational study demonstrates that the item assignment algorithm can reduce the effort for picking and replenishment, compared to the commonly used random item assignment.

■ SB10

201C, 2nd Floor

Data-driven Analysis for Health Service Design

Invited: Healthcare Systems and Applications

Invited Session

Chair: Yi-Chin Lin, Hofstra University, YiChin.Lin@hofstra.edu

1 - Differentiate Strong Correlations from Weak Correlations for Adverser Drug Reactions

Lian Duan, Hofstra University, Department of Information Systems and Business Analytics, Hempstead, NY, United States, lian.duan@hofstra.edu

All drugs have adverse drug reactions (ADRs), and some are severe enough to cause death. Most existing work only focus on whether a given drug is associated with a given ADR without paying attention to the degree of association. However, the correlation degree can help doctors to create better treatment plans. For example, doctors might take the risk of a weakly-correlated ADR for a cheaper and more efficient treatment plan. In this research, we exam the existing popular methods and evaluate their performance on how well they can tell strong correlations from weak correlations.

2 - Continued Use Behavior on Wearable Fitness Tracker: Comparison Study on Service System, Cultures, and Nations

Nila Armelia Windasari, National Tsing Hua University, nila.armelia@gmail.com, Fu-ren Lin

Personal health perception varies in different cultures and nationality, such as healthcare system, individuals' lifestyle, and individuals' perception towards their living system. Our study uses 2x2 between subject scenario-based survey to answer "how continued use intention differs between user agency and preferences towards an interactive design of WFT, and whether cultures and value perceived by a user lies under healthcare system also moderate the determinants?"

3 - Learning Game Play Patterns from a Pediatric Health Intervention

Yi-Chin Kato-Lin, Hofstra University, 101 Jackson Ave Apt 3L, Hempstead, NY, 11549, United States, yichin.lin@hofstra.edu, Sross Gupta, Palak Narang, Rema Padman

Dietary decisions are a leading cause of the rising epidemic of pediatric obesity in the United States and worldwide. Gamification and learnification on mobile devices have great potential to influence the behaviors of these digital natives. While there is some evidence of the positive impacts of video games on children's dietary habits, the mechanisms underlying these improved outcomes are yet to be understood. This study aims to quantitatively model and analyze children's play patterns of a mobile game using Markov modeling. Game telemetry from a randomized experiment with pre- and post-treatment measurements is analyzed to show variations in play patterns and the learning curves of game play.

4 - The Effects of Social Capital on Family Caregivers Caring for Children Who Required Chronic Respiratory Support

Jeifuu Chen, National Taiwan Normal University, Taipei, 106, Taiwan, jeffchen@ntnu.edu.tw

Evidence suggests that in online communities, social ties can positively affect health outcomes. However, the different types of resources within networks of relationships require additional investigation. This study used a survey and conducted a 4-month health intervention. We recruited 81 family caregivers of children on home ventilation. The empirical results show that measures of the relational dimension of social capital positively and significantly affected perceived life control and negatively and significantly affected depression status. However, cognitive dimensional of social capital negatively and significantly affected their perceived life control.

■ SB11

201D, 2nd Floor

R&D Management: Competitors and Contractors

Sponsored: Technology Management

Sponsored Session

Chair: Pascale Crama, Singapore Management University, Singapore, 178899, Singapore, pcrama@smu.edu.sg

1 - Sourcing Innovation: Integrated System or Individual Components?

Zhi Chen, INSEAD, 1 Ayer Rajah Avenue, Singapore, Singapore, zhi.chen@insead.edu, Jurgen Mihm, Jochen Schlapp

Many purchasing projects involve buying complex systems, which require the suppliers to perform some custom product or technology development regardless of whether they win the project or not. Viewing such a procurement setting through the lense of contest, we study under which circumstances a buying firm should source an integrated system or individual components.

2 - New Technology Capacity Expansion under Perfect Competition

Wanshan Zhu, Tsinghua University, Dept of Industrial Engineering, Shunde Building #613, Beijing, 100084, China, zhuws@tsinghua.edu.cn, Yuguang Wu, Pascale Crama

We consider a technology innovation leader who just develops a new generation of technology that reduced production cost significantly. With this low cost technology, the leader needs to decide the optimal capacity expansion decision. We formulate this innovation leader's capacity expansion problem as a dynamic game to capture the competitive decisions over multiple periods and multiple generations of technology. Theoretical properties allow us to reduce this complex problem to an equivalent game of only one stage, which is easier to solve. We characterize the equilibrium strategies of both the leader and its followers in a competitive and dynamic industry. The research results show the distribution of the old technologies plays an important role in determining the leader's equilibrium strategies. And interestingly, the leader's equilibrium new technology capacity is independent of the leading period, even though net present value of the capacity expansion depends on it.

3 - Moral Hazard Problem and Incentive Contract in Engineering Procurement and Construction Project

Pascale Crama, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, pcrama@smu.edu.sg, Zhenzhen Chen, Wanshan Zhu

In Engineering Procurement Construction (EPC) projects, the End User contracts with the main contractor on the overall quality of the project, while the main contractor further subcontracts with other firms. We study the optimal incentive contracts between the main contractor and a representative sub-contractor, when both exert effort subject to a random shock. If quality falls short of the client's requirement, costly rework is done. The cost can be shared between both parties. We study how the main contractor uses incentives to ensure high quality and profit. In the presence of limited liability, the sharing of rework cost becomes an important instrument for the main contractor to increase profit.

4 - Managing Public-Private Partnerships for the Development of Drugs for Neglected Diseases

Rongrong Luo, Singapore University of Technology and Design, 59 Changi South Avenue 1, Singapore, 485999, Singapore, rongrong_luo@mymail.sutd.edu.sg, Niyazi Taneri

Neglected diseases disproportionately affect developing countries. Privately held firms in the biopharmaceutical sector lack adequate financial incentives to invest in the development of drugs for these diseases. In this paper, we analyze optimal contractual arrangements in a neglected disease research and development (R&D) partnership between three parties: A funding agency with a social objective such as a non-governmental organization (NGO) or government agency; an innovation specialist that is privately held; and a marketing specialist that is privately held. The NGO has a limited budget to allocate to both firms to incentivize their participation in the drug development process. We characterize the conditions under which a disease should be labeled as a neglected disease and needs funding support from external socially-minded agencies. We also analyze the efficacy of different outcome-based contracts offered by the NGO in providing adequate incentives to the privately held firms designated as an innovator and marketer to invest in the treatment of neglected diseases. Our results indicate that marketers should be offered contracts that are designed around royalty payments, and milestone payments should be used only to induce the marketer to participate in the drug development process. Innovators can be offered a mix of milestone and royalty payments. The use of upfront fixed fees can also in place of milestone payments to the marketer can make the allocation of resources from the limited budget of the NGO more efficient.

■ SB12

201E, 2nd Floor

Recent Advances in Public Transit Scheduling

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Yong-Hong Kuo, PhD, The University of Hong Kong, Hong Kong, yhkuo@hku.hk

1 - Multi-objective Design of Train Timetable with Consideration of Customer Satisfaction

Andy Chow, City University of Hong Kong, Room P6624, 6/F, Purple Zone, Yeung Kin Man Academic Building (AC1), Kowloon Tong, Hong Kong, andychow@cityu.edu.hk

This talk presents a multi-objective optimisation framework for mainline train timetabling with consideration of customer satisfaction. The customers' perspectives considered include their perception of service punctuality, waiting times, and comfort of the journeys. The optimisation formulation subject to constraints representing operational requirements and signalling systems. The optimisation model is applied to the Brighton Main Line network in Southeast England as a case study, and the results demonstrate how the proposed optimisation framework can help government and train operators to derive more effective and equitable timetable with consideration of customer satisfaction.

2 - Real-time Integrated Re-scheduling for Tramway Operations

Yong-Hong Kuo, The University of Hong Kong, Department of Industrial and Manu. Sys. Eng., The University of Hong Kong, Pokfulam Road, Hong Kong, yhkkuo@hku.hk, Henry Cheung, David Lai, Janny M.Y. Leung

In this talk, we will present our proposed mixed-integer linear program that utilizes historical and real-time locational data for real-time rescheduling of trams. A simulation model of the tram network has been developed to examine the benefits of our approach. Computational experiments demonstrate the practicality and effectiveness of our method.

3 - Models for Re-engineering the Suburban Transit Networks

Yu-Tzu Kao, Research Assistant, National Dong Hwa University, Hualien, Taiwan, 610637003@gms.ndhu.edu.tw, Cheng-Chieh Chen, Chih-Peng Chu

Public transit systems are key contributors to entire regional transportation performance, which can effectively improve the utilization of existing transit transportation infrastructure, reduce the usage of private vehicles, decrease traffic accidents, and reduce greenhouse gas emissions. This paper aims to improve the existing public transport routes and schedules by minimizing the total system costs. A K-means method is first applied to determine the suitable clusters of service bus stops and then we re-organize and re-design those stops to various transit service routes within the studied area, through the proposed location-allocation techniques and revised TSP algorithms.

4 - Solving the Integrated School Bus Routing and Scheduling Problem with Decomposition Approach

Zhongxiang Wang, PhD Candidate, University of Maryland, 406 Ridge Rd, Apt 7, Greenbelt, MD, 20770, United States, zwxwang25@umd.edu, Ali Shafahi, Ali Haghani

The integrated school bus routing and scheduling problem (SBRs) have been studied as separate problems. But the integrated problem is lack of research. This paper provides a MIP model to solve the SBRs, which uses a fewer number of variables and constraints because it uses the trip-to-school compatibility other than the trip-to-trip compatibility in the literature. A novel compatibility decomposition algorithm (CDA) is proposed to solve the SBRs. The CDA considers the information from the next step into the previous step. This 'look ahead' strategy is proved to be effective. The experiments on randomly generated problems show that CDA can find solutions with high quality in much shorter time.

SB13

201F, 2nd Floor

Innovative Business Operations

Invited: Operations and Economics Interface

Invited Session

Chair: Long He, National University of Singapore, longhe@nus.edu.sg

1 - Incentive-driven Two-sided Matching and Spatial Capacity Allocation in Shared-mobility Systems

Qiao-Chu He, University of North Carolina, Charlotte, 9213 Glenwater Dr., Apt 919, Charlotte, NC, 28262, United States, qhe4@uncc.edu, Tiantian Nie, Zuo-Jun Max Shen

Motivated by free-float shared-mobility systems, we propose an integrated model of two-sided stochastic matching platforms, wherein agents on both sides respond to incentive instruments. From the platform's perspective, we formulate a strategic double-ended queueing model and operationalize it by jointly considering the optimal incentives as well as the spatial allocation of capacity. We identify an operational regime wherein the systems performance is competitive in almost all dimensions. We implement this optimization problem in a real case study, using a data set from a leading free-float bicycle-sharing system. Interestingly, we find that the hourly operational costs are lower in the rush hours, when the market thickness (transient service availability) is higher. Both stylized results and computational studies generate insights about fundamental trade-offs and triangular relationships among operational costs, capacity utilization rates and service levels.

2 - Strategic Switcher: The Unique Feature of Ridesharing

Yini Gao, Singapore Management University, 50 Stamford Road, #04-10, Lee Kong Chain School of Business #4031, Singapore, 178899, Singapore, yngao@smu.edu.sg, Rowan Wang, Saif Benjaafar

In this paper, we analyze the dynamics of ridesharing systems such as BlaBlaCar and DiDi Hitch. One unique feature of these ridesharing systems is the existence of a pool of users who can be both drivers (supply side) and riders (demand side) when they have a trip need. We call these users the strategic switchers. Depending on the possibility and time to be matched as well as the fare and wage, the strategic switchers make the decision on whether to take a ride or to drive and offer a seat. Using equilibrium analysis, we capture the system dynamics of such ridesharing systems and show the benefits of having such strategic switchers.

3 - Demand Forecasting and Inventory Control for Intermittent Demand

Sheng Bi, United States, bisheng@u.nus.edu, Long He, Chung-Piaw Teo

We consider the demand forecasting and inventory control problem under intermittent demand, where the firm experiences many periods of zero demand. Instead of estimating the non-zero-demand and demand occurrence probability separately as in the classical literature, we construct a two-dimensional histogram in this paper, as a representation of the joint distribution of non-zero demand and its inter-arrival time. Furthermore, we show that a state-dependent base stock policy is optimal under the joint distribution. Finally, we demonstrate its performance in the numerical study.

4 - Spatial Pricing and Product Allocation in Online Retailing

Long He, National University of Singapore, Mochtar Riady Building, BIZ1 8-73, 15 Kent Ridge Drive, Singapore, 119245, Singapore, longhe@nus.edu.sg, T. Tony Ke

We study how an online retailer should allocate its multiple products to facilitate spatial price discrimination. We consider two most commonly used spatial pricing policies: free on board (FOB) pricing that charges each customer the exact amount of shipping cost, and uniform delivered (UD) pricing that provides free shipping. Under centralized product allocation, the FOB pricing will essentially create bundles of multiple products sold at discount, due to cost savings via shipment pooling. We first propose a stylized model and find that centralized product allocation is preferred when demand localization effect is relatively low or shipment pooling benefit is relatively high, under both spatial pricing policies. We further extend the model to incorporate a more general class of spatial pricing policies as well as inventory pooling effects in the presence of stochastic demand. Our analytical results are also validated in numerical experiments under a general setting, using real fulfillment center location data and synthetic demand data.

SB18

North Lounge, 3rd Floor

Data-driven Healthcare Operations

Invited: Healthcare Systems and Applications

Invited Session

Chair: Joel Goh, NUS Business School, 15 Kent Ridge Drive 08-04, Singapore, 119245, Singapore, joelgoh@nus.edu.sg

Co-Chair: Shasha Han, National University of Singapore, Singapore, Singapore, shashahan@u.nus.edu

1 - Designing Incentives to Increase Treatment Adherence

Sze-chuan Suen, University of Southern California, 3715 McClintock Avenue, GER 24, Los Angeles, CA, 90089-0193, United States, ssuen@usc.edu, Diana Maria Negoescu, Joel Goh

Treatment for many diseases can be both lengthy and costly for patients, leading to patient loss-to-follow-up. However, incomplete treatment may lead to poor health outcomes and development of drug-resistant disease, so public health departments are considering methods to reduce treatment non-adherence. One such method is to offer resources (financial or in-kind) to reduce the cost to patients to complete the treatment. However, public health resources may be limited and it is unclear how these resources should be offered to different patients. In this problem, we consider the problem of patient non-adherence in tuberculosis, a transmissible disease. We study an optimization model that reduces the long-run number of infections across the population by offering incentives to patients with heterogeneous preferences on treatment adherence and examine numerical results.

2 - Allocating Inpatient Beds to Off-service Patients: Tradeoffs and Consequences

Hummy Song, The Wharton School, University of Pennsylvania, 3730 Walnut Street, 560 Jon M. Huntsman Hall, Philadelphia, PA, 19104, United States, hummy@wharton.upenn.edu, Anita L Tucker, Ryan Graue, Sarah Moravick, Julius Y. Yang

Given a highly variable patient census at the service level yet a fixed allocation of inpatient beds to services, a significant portion of admitted patients become "off-service" patients. These patients are physically located in a bed that belongs to a different service (e.g., general surgery) while still being cared for by a physician of the service (e.g., cardiac medicine). We examine the tradeoffs and consequences of assigning incoming patients to an off-service bed as opposed to an on-service bed.

3 - A Robust Approach to Study Multiple Treatments: Hierarchical Contrast-Specific Propensity Score

Shasha Han, National University of Singapore, NUS Business School, Biz 2 Building B1, 1 Business Link, Singapore, Singapore, shashahan@u.nus.edu, Joel Goh, Donald Rubin, Fanwen Meng

The worldwide rise in number of patients with diabetes and the consequent secondary complications is faicting human population globally. In alignment with the government's urgent call to manage this growing epidemic of diabetes, we study the medications treatment effect for diabetes using a database recently conglomerated in Singapore, aiming to facilitate physicians to prescribe medicaitons with firsthand evidence. Our results from the diabetes data not only provide firsthand information for physicians to prescribe medications for their patients, but also steer towards more personalized medication prescription than the one recommended by current guidelines in Singapore.

4 - Data Analysis of Vascular Sounds of the Fistula Stenosis

Chun Ching Wu, Tsing Hua University, Beijing Shi, China, cuteslord@gmail.com, W.M. Tina Song, Pin-Hao Huang

Taiwan is known to have the greatest number of dialysis patients total compared to other countries. Also, unlike other countries, National Health Insurance pays 100 percent of the cost of dialysis. Motivated by the above two facts, the government of Taiwan and researchers have conducted many studies with the aims of increasing the quality of dialysis service and reducing the corresponding cost. This research focuses on developing an algorithm that can detect stenosis formation in arteriovenous fistulae based on audio recordings. 24 patients with a mature arteriovenous fistula were examined. Feature extraction was carried out using wavelet transformation and independent component analysis. Results show that the proposed approach has both sensitivity and specificity beyond 95%.

SB19

South Lounge, 3rd Floor

Healthcare Operations Management

Invited: Healthcare Management

Invited Session

Chair: Cynthia Kong, Erasmus Research Institute of Management, Netherlands, q.kong@rsm.nl

1 - Routing Mobile Screening and Vaccination Teams to Minimize Disease Burden for Infectious Diseases

Joris Van de Klundert, PhD, Prince Mohammad Bin Salman College of Business & Entrepreneurship (MBSC), KAEC, Saudi Arabia, Jklundert@mbsc.edu.sa, Harwin de Vries, Albert P.M. Wagelmans

We consider the problem of deploying mobile screening and vaccination teams to minimize disease burden for infectious diseases. We present analytical results based on previously developed models to estimate the disease burden, which take screening and vaccination into account. Moreover, we develop and analyze a variety of dynamic deployment heuristics for the mobile screen and vaccinations teams and present a performance comparison based on real-life case study on sleeping sickness in the Democratic Republic of Congo.

2 - Operating Room Scheduling with Variable Surgery Times: More Information is Better

Rodrigo A. Carrasco, Universidad Adolfo Ibáñez, Diagonal Las Torres 2640, Of. 532, Edificio C, Santiago, 7941169, Chile, rax@uai.cl, Macarena Azar

The operating room scheduling problem has been tackled from many different perspectives. In this work, we propose the use of chance constraints, related to the surgery duration probability distribution for each surgeon, to improve the scheduling performance. Through data analysis of real instances, we develop specific constraints that improve the schedule, reducing the need of overtime without affecting the utilization significantly. Finally, we show the importance of using historical data and adding the variability of surgery times.

3 - Efficacy of Renal Replacement Therapy for Patients with Acute Kidney Injury in a Cardiothoracic Intensive Care Unit

Zhichao Zheng, Singapore Management University, 50 Stamford Road, Lee Kong Chian School of Business, Singapore, 178899, Singapore, danielzheng@smu.edu.sg, Jiayi Liu, Jingui Xie, Haidong Luo, Oon Cheong Ooi

We aim to establish the effect of renal replacement therapy (RRT) on in-hospital mortality of patients with acute kidney injury (AKI) by using more rigorous statistical methods to account for patient heterogeneity, both observed and unobserved. We conducted retrospective study using a recursive bivariate probit model to evaluate the efficacy of RRT on patients with risk of AKI, controlling for additional variables of nursing assessments. RRT showed an effect of reducing in-hospital mortality in our study population, and the efficacy was more salient for patients with a high creatinine value upon ICU admission. This result emphasizes the need for further well-designed clinical trials to obtain more definitive conclusions.

4 - Dynamic Appointment Scheduling for Priority Queuing Systems with Access Time Service Level Standards

Ka Yuk Carrie Lin, Associate Professor, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon Tong, Kowloon, Hong Kong, China, mslinky@cityu.edu.hk

This paper explores variants of an online appointment system including real-time scheduling with or without rescheduling to evaluate the degree of improvement. Performances are measured by the proportion of requests that can access the service within a target time specific to their priority class. A linear goal programming model is formulated for the service level objective. Rolling schedules for a one-year arrival horizon are developed from the deterministic model for solving the dynamic problem. Experiments are designed based on several high-demand specialist outpatient clinics. Results are compared with the deterministic model and the annual reported performance statistics.

Sunday, 2:00PM - 2:50PM

■ Sunday Keynote

103, 1st Floor

Keynote: The Services Industries: Some Insights Provided by Operations Research (Video)

Keynote Session

1 - The Services Industries: Some Insights Provided by Operations Research

Richard C. Larson, Massachusetts Institute of Technology, E40-233, Cambridge, MA, 02139, United States, rclarson@mit.edu

Over the past 100+ years, economies of the developed world have moved seismically from agriculture (over 50% of US employment in 1900), to manufacturing and now to services (typically 80% of current jobs). Operations Research (OR), often aided by IT and data analytics, has played and continues to play a vital role in policy and decision making in services. Presenting recent examples, we range broadly from (1) urban OR, to (2) pandemic influenza and vaccine allocation modeling, to (3) modeling the process of science/engineering PhD production and academic employment; to (4) queue performance inference made possible by recent results in data analytics. Two illustrative surprises: (a) We identify and interpret the high "birth rate" of university professors, the numbers of PhD students produced over a faculty lifetime; (b) We present an improved vaccine allocation policy that would have reduced the number of USA influenza cases by 5,000,000 in 2009, the year of H1N1 flu pandemic. We conclude with a discussion of needs to erase traditional academic silos when addressing the services industries, as most real problems are difficult and multi-faceted, requiring inter-disciplinary if not trans-disciplinary approaches, not unlike the multi-person teams put together in the 1940's by our OR founders!

■ Sunday Keynote

101C/D, 1st Floor

Keynote: Multiple Application Domains from Biological to Social

Keynote Session

1 - Multiple Application Domains from Biological to Social

John R. Birge, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States, John.Birge@ChicagoBooth.edu

Multiple application domains from biological to social sciences and humanities have gained new insights through network analysis of relationships among individuals and groups. Networks have also formed a core modeling and computational platform for operations research (OR), but OR's role in the rapid expansion of interest in biological, physical, and social networks has been limited. Some of these limitations result from a focus on purely descriptive characteristics and common assumptions of static or exogenous network configurations. OR, however, can play a prominent role in extending network analysis beyond these initial descriptors by contributing to understanding of network formation and evolution and by increasing value for networked agents through improved decision making. This talk will discuss these opportunities for OR and illustrate the potential through examples in energy markets, supply chains, and matching markets.

■ Sunday Keynote

101 A/B 1st Floor

Keynote: Smart Production of Smart Vehicles

Keynote Session

1 - Smart Production of Smart Vehicles

Oleg Gusikhin, Ford Motor Company, Dearborn, MI, United States, .

Today the automotive industry is undergoing the most profound change since the invention of the moving assembly line. Connected, electric, and autonomous vehicles, new smart mobility business models, Internet of Things, Additive Manufacturing and Big Data are disruptive innovations that will create the opportunity and the need for industry transformation. In a series of recent announcements, Ford Motor Company outlined its strategy to become the world's most trusted mobility company, building smart vehicles for a smart world and redesigning the company's factories of the future. Data, analytics, AI and machine learning are at the forefront of this transformation. Specifically, the emerging application of connected vehicle analytics enables new vehicle features and services, such as mobility personalization, prognostics and ambient intelligence. Analytics are also fundamental in accelerating introduction of factory-of-the-future technologies and enabling a more efficient supply chain. This presentation will review examples of innovative applications that demonstrate the critical role of analytics in the automotive industry transformation.

■ Sunday Keynote

102, 1st Floor

Keynote: Integrated Risk-Hedging and Production Planning

Keynote Session

1 - Integrated Risk-Hedging and Production Planning

David D Yao, Columbia University, Department of IE & OR, 302 Mudd Bldg, Mc4704, New York, NY, 10027-6699, United States, yao@columbia.edu

Traditional production planning is primarily a quantity or capacity decision, which must be made at the beginning of a planning horizon before production starts. Adding a real-time control, a risk-hedging strategy, throughout the horizon can better mitigate the risk involved in demand volatility. We demonstrate how this can be done in terms of jointly optimizing both the capacity and the hedging decisions. The problem formulation addresses a shortfall risk measure and subjects the hedging strategy to partial information and a budget constraint. The results lead to a complete characterization of the improvement in risk-return tradeoff achieved by the hedging strategy. (Joint work with Liao Wang.)

Sunday, 3:45PM - 5:15PM

■ SC01

101A, 1st Floor

Risk Analysis

Contributed Session

Chair: Jeremy Jordan, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States, jjordan810@gmail.com

1 - Design of an Options Contract for Backup Supply Used for Mitigating Risks of Supply Disruption

Ashutosh Sarkar, Associate Professor, Indian Institute of Management-Kozhikode, IIM Campus, Kunnamangalam, Kozhikode, 673570, India, asarkar@iimk.ac.in, Stefan Minner

In this paper, we consider the design of an options contract for a manufacturer using backup supply who is facing risks of supply disruption. We derived optimal parameters of the options contract and carried a numerical analysis which mainly focussed on the manufacturer's choice between 'responsive' and 'low-cost' supplier, and supplier opportunism and incentives. We observed that uncertainty of any kind forces the manufacturer to utilize more of its backup options, however, the extent of such influence varies based on the nature of the uncertainty. The backup supplier exploits the situation by increasing its prices.

2 - Quantitative Risk Analysis of Project Schedules

Lev Virine, President, Intaver Institute Inc., 400, 7015, Macleod Trail S.W., Calgary, AB, T2H 2K6, Canada, lvirine@intaver.com

The goal of schedule risk analysis is to identify and prioritize project risks, create risk adjusted project schedules, and identify risk mitigation and response plans. The paper discusses different approaches to project schedule and cost risk analysis using Monte Carlo simulations: "traditional" and event-based quantitative risk analysis. Event chain methodology is an uncertainty modelling and schedule network analysis technique that is focused on identifying and managing events and event chains that affect project schedules.

3 - A New Methodology for Modelling Operational Risk using Skew Copulas and Bayesian Inference

Betty Johanna Garzon Roza, University of Edinburgh, 29 Buccleuch Place, Edinburgh, EH8 9JS, United Kingdom, johanna.garzon@ed.ac.uk, Jonathan Crook, Fernando Moreira

We present a general methodology based on skew t-copulas and Bayesian inference for modelling extreme multivariate dependent losses and the regulatory capital for operational risk. Current approaches fail to model both asymmetric dependence and accurate extreme upper tail dependence. This paper addresses this gap. The method is applied to SAS® Operational Risk Global Data to model operational risk at big U.S. banks. We compare the impact of established multivariate copulas and the multivariate skew t-copula for estimating total regulatory capital. We show that the skew t-copula can be used effectively and yields asymmetric measures of tail dependence in the very extreme tails.

4 - New Exceedance Counter with Application to Network Optimization

Jeremy Jordan, Assistant Professor of Statistics, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States, jjordan810@gmail.com, Stan Uryasev

We consider a new characteristic for counting the number of large outcomes in a data set, called cardinality of the upper average (CUA). CUA not only counts the number of outcomes larger than some threshold, but also the largest outcomes that are less than the threshold such that the average of these outcomes is equal to x . CUA has superior mathematical properties, being a continuous function w.r.t. the threshold parameter, piecewise linear in its reciprocal, and directly optimizable via convex and linear programming. We apply CUA to create new formulations of network optimization problems involving node failures.

5 - How Should an Assembler Cope with Information Asymmetry?

Daewon Sun, Professor, University of Notre Dame, 359 MCOB, Notre Dame, IN, 46556, United States, dsun@nd.edu

Assembly systems, in which multiple components are sourced from independent suppliers and combined by the buyer into a final product, are found in a variety of industries. In many practical settings, the assembler will possess incomplete information regarding the marginal costs of the suppliers. This incomplete information can make it challenging for the assembler to design good contracts to offer to the suppliers, where the contract offered to each supplier must specify the price paid to that supplier, as well as the quantity to be procured. We investigate the assembler's contract design problem and propose a contracting mechanism.

■ SC02

101B, 1st Floor

Modelling Real-life Inventory Systems

Invited: Supply Chain Inventory Management

Invited Session

Chair: Ton de Kok, Eindhoven University of Technology, Eindhoven, 5600 MB, Netherlands, a.g.d.kok@tue.nl

1 - Analysis of Capacitated Multi-echelon Inventory Systems

Ton de Kok, Eindhoven University of Technology, Paviljoen E4, PO Box 513, Eindhoven, 5600 MB, Netherlands, a.g.d.kok@tue.nl

The analysis of real-life capacitated multi-item multi-echelon inventory systems is notoriously complex. We propose alternative policies to control these systems and compare their performance using discrete event simulation. We consider serial systems and divergent systems. We show that the performance of capacitated systems with given average item inventories and given item lot sizes can be determined by a model for uncapacitated systems. This shows that capacity constraints eventually result into average inventory levels that drive supply chain performance.

2 - Empirical Evidence for Behavioral Biases in Order Decisions

Kai Hoberg, Kuehne Logistics University, Hamburg, 20457, Germany, Kai.Hoberg@the-klu.org, Christina Imdahl

This study examines different behavioral biases in ordering decisions using empirical data. We compare human orders to orders from an automated system, allowing us to compute the size of the biases for each human with respect to system-induced errors. The influence of different product properties, e.g. price or demand fluctuation, is analyzed accordingly.

3 - A Heuristic to Optimize Reorder Points in a Large Distribution Network for More than 100,000 Skus

Christopher Grob, Dr., Volkswagen, Kassel, Germany, christopher.grob@volkswagen.de, Andreas Bley

Research on multi-echelon optimization during the last decade has sparked a multitude of different approaches for all types of supply chains. However, the numerical examples given in most papers usually focus on very small problem sizes regarding the network as well as the demand size. We present insights on the real-world supply chain of the after sales division of Volkswagen, highlight the challenges caused by problem size and present a heuristic solving problem faster. The heuristic decreases runtime by almost 60% while we deviate less than 1% from the optimal value.

4 - Optimal Control Policies for an ATO System with Commitment Lead Time

Taher Ahmadi, Eindhoven University of Technology, Eindhoven, Netherlands, T.Ahmadi@tue.nl, Ton de Kok, Zumbal Atan, Ivo Adan

We study an ATO system consisting of two suppliers and one assembler. Each supplier has a deterministic replenishment lead time and uses a base-stock policy. Customers place their order before their actual need and receive a bonus. The time from placing an order until the time the product is needed called commitment lead time. The ATO manager aims to find a control policy such that a long-run average systemwide cost is minimized. We show that the optimal commitment lead time is either zero or equal to one of the supplier replenishment lead times and its corresponding optimal base-stock levels can be computed by minimizing two nested convex functions, recursively.

■ SC03

101C, 1st Floor

Data-driven Decisions

Invited: Machine Learning and Big Data Analytics

Invited Session

Chair: Masaaki Suzuki, Tokyo University of Science, Chiba, Japan, m-suzuki@rs.tus.ac.jp

1 - Classification of User's Interest on Topics in Chat Dialog

Hikari Handa, Tokyo University of Science, Chiba, Japan, 7414118@ed.tus.ac.jp, Ryo Hatano, Hiroyuki Nishiyama

In this paper, we propose a method to determine whether a subject has interest of a topic of a dialog with a conversation agent based on machine learning using multi-modal information. We conducted an experiment called Wizard of Oz and obtained features of the subject using a three-dimensional camera. In particular, we focused on the features of the face, created a classifier and evaluated that.

2 - Proposal of a New Survival Prediction System for Terminal Patients Using Machine Learning

Tatsuki Hirozawa, Tokyo University of Science, Chiba, Japan, 7414122@ed.tus.ac.jp, Takeshi Yamada, Hayato Ohwada

Survival prediction systems such as the Palliative Prognostic Index (PPI) are used to predict survival time of terminal patients. In recent years, prediction of long-term survival has been required. However, PPI is not suitable for this. In this study, we will create a new system that can predict long-term survival time by improving PPI using machine learning.

3 - Identifying Crucial Genes of Lung Cancer in Interstitial Lung Disease by Machine Learning

Min-Wei Hsieh, Tokyo University of Science, Chiba, Japan, 7417626@ed.tus.ac.jp, Sheng-I Chen, Hayato Ohwada

Machine learning has become more and more widely used in the development of science and technology and various areas of research, bioinformatics is one of the field. To obtain better understanding of diseases, genetic research in bioinformatics is a credible direction. With the information of gene mutation from surgical specimens through next-generation sequencing (NGS), we identified risk genes of lung cancer in interstitial lung disease by machine learning methods. The mutation state of the crucial genes will also be discussed in this study.

4 - CSR Taxonomy and Analysis of CSR Activities Affecting Corporate Value

Kazuya Uekado, Tokyo University of Science, 2641, Noda, 2780022, Japan, 7417602@ed.tus.ac.jp, Masayuki Okamoto, Masaaki Suzuki, Ling Feng, Hayato Ohwada

Corporate social responsibility (CSR) activities have an good impact on corporate value. However, CSR is ambiguous and it is not clear what CSR activities contribute to corporate value. We propose a method that CSR activities of each companies convert into numerical by using text mining and term frequency; then, random forest method shows effective CSR activities for corporate value.

■ SC04

101D, 1st Floor

Operations/Marketing Interface II

Invited: Operations/Marketing Interface

Invited Session

Chair: Jiong Sun, Purdue University, West Lafayette, IN, United States, sun664@purdue.edu

Co-Chair: Yingchen Yan, Tianjin University, Tianjin, 300072, China, ychyan@tju.edu.cn

1 - Block Ownership in Vertical Relationships in the Presence of Downstream Competition

Jiong Sun, Purdue University, 812 W State St, West Lafayette, IN, 47907, United States, sun664@purdue.edu, Fang Fang, Baojun Jiang

Block ownership plays an increasingly important role in aligning the incentives of firms involved in vertical relationships. We examine the economic impacts of block ownership on channel members in the presence of different formats of downstream competition. Moreover, we study the influence on consumer welfare, providing regulation insights for policy makers.

2 - Strategic Introduction of the Marketplace Channel under Dual Upstream Disadvantages in Sales Efficiency and Demand Information

Yingchen Yan, Tianjin University, No.92 Weijin Road, Nankai District, Tianjin, 300072, China, ychyan@tju.edu.cn, Ruiqing Zhao

The increasing prevalence of online retailing has recently given rise to a novel marketplace channel, in which upstream manufacturers can sell their products directly to consumers by paying a fee to e-tailers. While it endows upstream manufacturers with direct access to consumers, it also requires them to personally perform sales work, which is not their strength, especially in the form of sales efficiency and demand information. In this paper, we apply a stylized theoretical model to examine whether the manufacturer and e-tailer should agree to introduce the marketplace channel by considering these dual upstream disadvantages.

3 - Operational Efficiency in the Presence of Asymmetric Retail Channels and Store Brands

Ehsan Bolandifar, Assistant Professor of Operations Management, Chinese University of Hong Kong, 9/F, Cheng Yu Tung Building, No., 12, Chak Cheung Street, Shatin, N.T., Hong Kong, ehsan@baf.cuhk.edu.hk, Zhong Chen, Fuqiang Zhang, Kaijie Zhu

We construct a multi-stage model to study the strategic interaction between a national brand manufacturer, a dominant and a weak retailer in the presence of competing national and store brands. We consider a national brand manufacturer that sells its product through a dominant and a weak retailer. The dominant retailer, in addition to the national brand, sells its own store brand. We study how improvement in the operational efficiency of the weak retailer and procurement efficiency of the dominant retailer affects all supply chain firms.

4 - Procurement Contract with a Supplier with Private Information about His Reliability and Effort for its Improvement

Suresh P Sethi, University of Texas at Dallas, Jindal School of Management, SM30, 800 W. Campbell Rd, Richardson, TX, 75080-3021, United States, sethi@utdallas.edu, Xi Shan, Chenglin Zhang

We consider the problem where one retailer and one supplier face supply chain disruption risk. The supplier has private information of his initial reliability and is able to improve that reliability with a hidden action, which we call an effort. Under both deterministic and stochastic demand, we find the contract menu to reveal the supplier's true type and the supplier's effort level that most benefits the retailer. We also show that it is never optimal to let the suppliers be perfect reliable.

■ SC05

102, 1st Floor

Practice II

Sponsored Session

Chair: Yuehwern Yih, Purdue University, West Lafayette, IN, 47907, United States, yih@purdue.edu

1 - Artificial Intelligence for Medical Image Analyses and Applications

Wei-Chung Wang, National Taiwan University and NTU Hospital, Taipei, Taiwan, to come later

We lay out our plan to build a platform called Artificial Intelligence for Medical Image Analysis (AIMIA). The AIMIA platform consists of Artificial Intelligent Engine (AI Engine) and Augmented Intelligence Workflows (AI Workflows). The AI Engine consists of high-performance algorithms and software modules aiming to extract insightful information from a large volume of medical image datasets accurately, efficiently, and robustly. In particular, the AI Engine includes Image Processing, Quantitative Analytics, Deep Learning, Machine Learning, and High Dimensional Data Analysis Toolboxes to analyze medical images. By taking these algorithms and software modules as the building blocks, we further build up innovative AI Workflows in various clinical applications. AI Workflows examples include precision cancer treatments in a lung, hypopharyngeal, hepatocellular carcinoma, digital pathology whole slide image analysis for prostate cancers, pancreatic masses classification and detection, radiotherapy treatment planning in lung cancer, and psychiatric disorders phenotyping. These examples illustrate how we apply the AI Engine to configure AI Workflows in clinical medical cares and biomedical research. AIMIA is also a platform allowing international experts from academia and industry in medical, mathematical, statistical, computational, and information sciences to work together to ensure the research and development efforts can benefit the society broadly.

2 - Health Supply Chain for improving Maternal and Child Health: A Case Study in Uganda

Yuehwern Yih, Purdue University, West Lafayette, IN, 47907, United States, yih@purdue.edu

Many healthcare systems, such as in Uganda, implementing standardized data capture registers, lack responsiveness due to paper-based reporting and requisition systems, which impede access to data for timely decision-making. At the district level, a lack of such data results in pharmaceutical supply stock-outs and expired medications and negatively impacts system responsiveness to the needs of lower-level health facilities. In this scenario, one of the key vulnerable populations is pregnant women. The UN has identified 9 commodities that could potentially save 6 million lives through timely availability and use across the MCH 'continuum of care'. This project is targeting this area. We proposed a Diagnosis-Based Demand sensing and Digital tracking (DBDD) approach to use last mile data, which is currently captured in paper-based formats, to improve the availability and reduce stock-outs of essential maternal health supplies in primary care facilities. DBDD will triangulate patient data, consumption data and laboratory data to optimize ordering practices in primary care facilities. This includes the digitization of those data so as to greatly simplify its capture and management at primary care facility level. In this talk I will present our current work and the challenges and barriers we encounter so far.

■ SC06

Tutorial: Healthcare Informatics and Analytics – II

Tutorial Session

1 - Healthcare Informatics and Analytics

Rema Padman, Carnegie Mellon University, The H. John Heinz III, College, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States, rpadman@cmu.edu

The significant advances in clinical and consumer health technologies combined with the rapid developments in advanced analytics of high dimensional, high volume, and complex healthcare data is powering a transformation of healthcare delivery worldwide. Innovative analytical techniques are being developed to support a range of decisions that include predicting responses to different treatment regimens, individual and population level risk assessments, detecting anomalies, and preventing deterioration in the health status of the patient. Supporting patient - provider communication and shared decision making via intelligent reminders, notifications and informed guidance, and providing smart healthcare delivery operations to increase satisfaction, efficiency and quality of care are further capabilities being architected using informatics tools. Learning current and potential best practices from data using quantitative methodologies, such as statistical machine learning and operations research, and translating the new evidence to the frontlines of care via efficient software implementations and institutional deployments, offer both major challenges and opportunities for researchers and practitioners alike. This tutorial will highlight some of the methods and tools to address these issues with illustrative examples drawn from clinical, consumer self-care and public health domains.

■ SC07

105, 1st Floor

Simulation Optimizations

Sponsored: Simulation

Sponsored Session

Chair: Guangxin Jiang, PhD, Shanghai University, Room 426, School of Management, No. 99 Shangda Road, Baoshan District, Shanghai, China, gxjiang@shu.edu.cn

1 - Constructing Surface for Derivative Pricing and Sensitivity Analysis

Guangxin Jiang, Shanghai University, Shanghai, China, gxjiang@shu.edu.cn

In financial industries, practitioners often need to know the derivative price and its Greeks in real-time trading. The analytical formula of the price surface is often unavailable and Monte Carlo simulation is used to estimate the price and Greeks at fixed values of the market parameters. However, simulations are often time consuming and cannot be used in making real-time decisions. In this paper we propose a new simulation regime, called offline-learning-online-application, in derivative pricing. It utilizes the time of the market close to learn the price surface of a derivative. The enhanced stochastic kriging is proposed to learn the price surface, then the Greek surfaces are obtained by taking partial derivatives directly on this price surface. We show that the obtained price and Greek surfaces are accurate and consistent. Numerical examples illustrate the effectiveness of the new simulation regime and the appropriateness of enhanced stochastic kriging in learning the surfaces.

2 - Chance Constrained Programs with Mixture Distributions

Wenjie Sun, Tongji University, Shanghai, China, r13381638770@sina.com, Zhaolin Hu

Chance constrained programs (CCP) are important models in stochastic optimization. In conventional literature on CCPs, the underlying distribution modeling the randomness of the problem is usually assumed to be given in advance. However, in practice, such a distribution needs to be specified by the modelers based on the information available, which is called input modeling. In this paper we consider input modeling in CCPs. We propose to use mixture distributions to the data available and to model the randomness. By considering several scenarios and conducting numerical experiments, we demonstrate the merits of using mixture distributions and show how to handle the CCPs with mixture distributions.

3 - MISE-Optimal Grouping for Piecewise-Constant Rate Estimators

Huifen Chen, Chung-Yuan University, Dept of Industrial and Systems Engineering, 200 Chung-Pei Rd., Chung-Li District, Taoyuan City, 320, Taiwan, huifen@cycu.edu.tw, Bruce W. Schmeiser

Given a set of arrival times, the underlying rate function can be estimated by a piecewise-constant rate function. The problem is to determine the number of intervals for grouping the event times into count data from equal-width time intervals. Our motivation is to smooth the resulting piecewise-constant rate function using one of our two existing methods I-SMOOTH and MNO-PQRS. We determine the optimal number of intervals by minimizing the mean integrated squared-error (MISE) function. The optimal number of intervals increases with the mean number of arrivals at a cubic-root rate if the true rate function is smooth. We propose estimators of the MISE function. Minimizing the MISE estimator yields the estimator of the optimal number of intervals. Numerical results show that the MISE estimators work well.

■ SC08

201A, 2nd Floor

Meet the Editors Panel

Invited: Practice/Industrial Applications

Invited Session

1 - Meet the Editors Panel

Moderator: Mabel Chou, National University of Singapore,
360 Pasir Panjang Rd, #01-11, Singapore, 118699, Singapore,
mabelchou@nus.edu.sg

This session is a panel discussion with Editor-in-Chief and Department Editors from journals in the field of Management Science and Operations Research. The session provides attendees an opportunity to learn about the journals in the field to understand more about the field of Management Science and Operations Research, editorial visions, what kinds of papers they are looking for, editorial policies and practices, and to discover the journals' reviewing and publishing opportunities. Each Editor will present a short description of their journal or department, both in what they are looking for in submissions and how they handle the editorial process. They will also talk about the new initiatives from their journal or department. After these brief statements by the editors, we will take questions from the audience. The editors who will participate are: John Birge (currently Editor-in-Chief of Operations Research), J. George Shanthikumar (currently Department Editor of Management Science in the Department of Big Data Analytics; Department Editor of Production and Operations Management in the Department of Special Responsibilities), and Jayashankar M. Swaminathan (currently Department Editor of Management Science in the Department of Operations Management; Department Editor of Production and Operations Management in the Department of Supply Chain Management).

Panelists: John R Birge, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States John.Birge@ChicagoBooth.edu; J. George Shanthikumar, Purdue University, Krannert School of Management, West Lafayette, IN, 47907, United States, shanthikumar@purdue.edu; Jayashankar M. Swaminathan, University of North Carolina, Kenan-Flagler Business School, Operations, Chapel Hill, NC, 27599-3490, United States, msj@unc.edu; Chris Tang, Editor of Manufacturing & Service Operations, msomeditor@informs.org

■ SC09

201B, 2nd Floor

New Developments in Design, Manufacturing, Health and Productivity

Invited: At the Nexus of Technology, Health and Productivity

Invited Session

Chair: Chuck Zhang, Georgia Tech Manufacturing Institute, Atlanta, GA, n/a, United States, chuck.zhang@gatech.edu

1 - A Data Fusion Framework for Historical and Prototype Experimental Data with Applications to Personalized Heart Surgery

Chuck Zhang, Georgia Tech Manufacturing Institute, Atlanta, GA, n/a, United States, chuck.zhang@gatech.edu

This paper presents a study of augmenting the historical patient data with experimental data based on 3D printed prototypes to develop more reliable predictive models for physicians and surgeons to use to make more informed decisions. This method is demonstrated through an application case of outcome prediction of transcatheter aortic valve replacement (TAVR) surgery.

2 - Progress and Perspective in Three-dimensional Bioprinting

Chia-Che Ho, China Medical University, Taichung, Taiwan, sfoxi1223@gmail.com

Due to the growing demand for organ transplantation and the deficiency of the donors, a number of efforts have been made in the realm of tissue engineering which aim on developing substitutes with the capacity to maintain or restore biological and physiological functions of injured or diseased tissue and organs. Although several groups have reported exciting results by using an autologous cell-loaded scaffolds for guiding the regeneration of malfunction organs, a number of challenges is still existing in this area which hinders the clinical practice of tissue engineering strategies. Recently, the advances of techniques have been a breakthrough in tissue engineering and regenerative medicine through precisely manufacturing tissue and organ substitutes with high degree of structural and componential complex in three dimension. This session will focus on the progress in the 3D bioprinting and its potential applications in clinical medicine.

3 - Customer Experience Evaluation on Innovative Shopping Mall Services

Yu-Chi Lee, Nanyang Technological University, Singapore, Singapore, liyuchi1113@gmail.com

This paper conducted an innovative shopping mall service system including "Your AR pocket", "Smart inform wall" and "Buying smart" service modules which designed through the SERVQUAL model and TRIZ theory. The case study data from a real shopping mall were used to evaluate the customer experience. This study provided evidence to validate the usability of new service concept of the innovative service.

■ SC10

201C, 2nd Floor

Energy Operation Analytics and Optimization

Invited: Operations Analytics and Optimization for Manufacturing, Logistics and Energy Systems

Invited Session

Chair: Yanyan Zhang, Northeastern University, Shenyang, 110819, China, zhangyanyan@ise.neu.edu.cn

Co-Chair: Yang Yang, yangyang@ise.neu.edu.cn

1 - Coordinated Optimization of Energy Supply and Demand in Iron and Steel Industry by ADP

Yanyan Zhang, Northeastern University, Heping District, 11-3 Wenhua Road, Shenyang, 110819, China, zhangyanyan@ise.neu.edu.cn, Guilin Feng, Lixin Tang

This research investigates the problem of coordinated optimization of energy supply and demand in iron and steel industry. The goal of the study is to make the best of the energy available and the secondary energy generated along with the production process to minimize total energy cost. Considering the dynamic characteristics of energy demand caused by frequently adjustment of production scheduling, and the system changes with time forward, we formulate the energy allocation problems as a Markov Decision Problem. Approximate Dynamic Programming algorithm with linear value function approximation is designed for solving the problem.

2 - Coil Scheduling in Continuous Annealing Line with Consideration of Energy Consumption

Yang Yang, Northeastern University, No. 3-11, Wenhua Road, Heping District, China, yangyang@ise.neu.edu.cn, Lixin Tang

This paper studies the coil scheduling problem with concerns of energy consumption, which is derived from continuous annealing production. The problem is characterized by the large setup time and changeover costs between two adjacent coils due to energy and device adjustments. A mixed integral programming model is formulated. To solve it, dynamic programming algorithm is developed. For the case with uncertain processing time, sample average approximation method is adopted. Finally, the proposed solution method is evaluated by experiments.

3 - Carbon Content and Temperature Prediction of BoF Based on Adaptive Kalman Filter

Dongying Song, Northeastern University, shenyang, China, sdyasw@126.com, Lixin Tang

For the converter steelmaking process, the system equations of carbon content and temperature change are established based on the reaction mechanism. An adaptive Kalman filter filtering model is proposed, and filter performance is analyzed. Then the proposed filter method is applied to dynamic correction of carbon content and temperature simultaneously with measured data. Since the change of two indexes is coupled, compared with the methods, which predict the two indexes respectively, the purpose of the proposed method is to improve predicted accuracy.

4 - Unit Commitment Problem in Power System with Wind Turbines

Gelegen Che, Northeastern University, Shenyang, China, 1220333633@qq.com, Jin Lang, Lixin Tang

In this paper, the scheduling problem of power system with wind turbines is studied, and the uncertainty caused by wind power is quantitatively described by scenario probability. Then in view of the characteristics of the model, approximate dynamic programming algorithm is designed for effectively solving the stochastic unit commitment problem. Numerical case studies illustrate the effectiveness of the proposed model and algorithm, compared with the standard optimization software, the algorithm can obtain satisfactory approximate optimal solution in a shorter time.

■ SC11

201D, 2nd Floor

Managing Partnerships and Innovation Adoption

Sponsored: Technology Management

Sponsored Session

Chair: Tian Chan, Emory University's Goizueta Business School, Atlanta, GA, 30322, United States, tian.chan@emory.edu

1 - Rights of First Negotiation and First Refusal in R&D Partnerships

Shantanu Bhattacharya, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, shantanub@smu.edu.sg, Guangyu Wan, Sameer Hasija, Niyazi Taneri

This paper considers a partnership between a biotech and pharmaceutical firm on a drug with uncertain valuation early in the R&D process. We consider the use of rights of first negotiation (ROFN) and rights of first refusal (ROFR) in the partnership, and show where these control rights yield good results.

2 - A Simulation Model for Healthcare Technology Adoption

Mohsen Songhori, mj2417@gmail.com, Erik Koffijberg

Understanding how unproven new technologies are evaluated and gradually adopted by medical practitioners is critical phenomenon. In this work, based on the previous models in network science and sociology literature, we develop a simulation model of healthcare technology adoption. The results illustrate how social influence heterogeneity of ties among potential adopters as well as social network features impact overall technology adoption pattern.

3 - The Effect of Typicality and Temporal Distance on the Value of Product Design

Tian Chan, Emory University, 1300 Clifton Road, Atlanta, GA, 30322, United States, tian.chan@emory.edu, Yonghoon Lee

Typicality—the degree to which an object is similar to other objects of the same category—is an important feature of the form (or design) of a product. In this paper, we examine the effect of typicality on a focal design's market value, incorporating the view that the category itself (and hence what is considered typical) undergoes change over time. To study this question, we compiled a unique dataset combining US design patent data from the US Patent and Trademark Office, a dataset of category (i.e., style) identifiers for each design, and stock market reactions in the days subsequent to the design patent grant. We show that a focal design's value falls when it is typical with respect to designs in the same style that are concurrently on the market. However, we also show that its value rises when it is typical with respect to designs released in the near past. Finally, we show that the relationship systematically varies across industries, such that industries with short product lifecycles exhibit no positive effect of typicality on value.

■ SC12

201E, 2nd Floor

Scheduling and Logistics

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Xiangtong Qi, Hong Kong Univ of Science & Technology (HKUST), Kowloon, Hong Kong, ieemqi@ust.hk

1 - Real-time Scheduling and Rescheduling in Liner Shipping Service with Regular Uncertainties and Disruption Events

Chen Li, Tianjin University, Building 25-A, No 92 Weijin Road, Tianjin, 300072, China, cliad@connect.ust.hk, Xiangtong Qi, Dongping Song

This paper studies real-time schedule recovery policies for liner shipping under various regular uncertainties and the emerging disruption event that may delay a vessel from its planned schedule. The aim is to recover the affected schedule in the most efficient way. One important contribution of this work is to explicitly distinguish two types of uncertainties in liner shipping, and propose different strategies to handle them. The problem can be formulated as a multi-stage stochastic control problem that minimizes the total expected fuel cost and delay penalty. We develop the properties of the optimal control policy; then we show how an emerging disruption may change the control policies.

2 - Grand Coalition Stabilization Funded via Taxation for Machine Scheduling Games

Lindong Liu, University of Science and Technology of China, School of Management, Room 705A, University of Science and Technology of China, HeFei, 23 China, njulld@gmail.com, Xiangtong Qi

In this work, we will propose a mechanism to stabilize an unbalanced cooperative game by taxing the resources. This mechanism applies to cases where

the outside party has certain legal power or authority so that he can tax the resource to be used. By doing this, it increases the cost for non-cooperating players, thus enhancing the incentive for collaboration. We will use the classic machine scheduling games for illustration.

3 - Pedagogical Expositions of Moore's Algorithm

Tim T.C. Huang, National Chiao Tung University, Hsinchu, Taiwan, tim956956a@gmail.com, Edwin Cheng, Bertrand M t Lin

Moore's algorithm is one of the pioneering works that inaugurate contemporary scheduling theory. The algorithm determines a schedule that attain the minimum number of late jobs in a single-machine environment. We elaborate on the algorithm, its proof and several implementation issues to address their pedagogical implications in classes of scheduling theory, data structures and computer algorithms.

4 - Service Matching with Uncertainty

Xiangtong Qi, Hong Kong Univ of Science & Technology (HKUST), Dept of IELM, HKUST, Kowloon, Hong Kong, ieemqi@ust.hk

Under the emerging sharing economy, a platform coordinates multiple service providers and users to match supply and demand. In this process the platform has no full control of either the suppliers or the users. Hence the matching results are subject to uncertainty. In addition the platform has an objective which may not be consistent with other parties. Such issues call for new models for matching. We will present some approach to formulate and solve such problems. (The work is supported by Hong Kong RGC 16225316).

5 - The Establishment of New Retail in E-commerce under Competition with the Traditional Online Retail

Xuan Wang, The Hong Kong Polytechnic University, Kowloon, 999077, Hong Kong, 14901300r@connect.polyu.hk, Chi To Daniel Ng

New retail in e-commerce is to establish an offline channel and combine it with the online channel. We present a duopoly model of a new retail firm and a traditional online firm, who compete for the market share with behavior/history-based pricing, or without the consideration of consumer behaviors/histories. The equilibriums show different decisions of the new retail firm.

■ SC13

201F, 2nd Floor

MSOM Energy and Sustainability

Invited: Operations and Economics Interface

Invited Session

Chair: Yangfang Zhou, Singapore Management University, Singapore, 178899, Singapore, helenzhou@smu.edu.sg

1 - Charging Electric Vehicle Sharing Fleet

Long He, National University of Singapore, Mochtar Riady Building, BIZ1 8-73, 15 Kent Ridge Drive, Singapore, 119245, Singapore, longhe@nus.edu.sg, Guangrui Ma, Wei Qi, Xin Wang

In this paper, we jointly optimize the sites and sizes of charging stations, along with the coupled fleet charging and repositioning operations. It is motivated by challenges faced by car2go, which ceased its EV sharing operations in California. We characterize the fleet dynamics using a queueing network and consider a first-in first-out charging policy. We closely track EV energy levels and explicitly depict stochastic charging operations in forms of chance constraints. We then propose a certainty equivalent approach to formulate a tractable optimization model and provide probability bounds on stochastic charging duration. When the operator sets a target on charging duration, we further derive the optimal number of chargers required at each charging station. It ultimately allows us to reformulate the problem as a mixed integer linear program. After learning from real data sets of car2go's operations in San Diego, we conduct retrospective and futuristic case studies.

2 - Distributed Renewable Power Generation and Implications for Strategic Consumer Behavior, Capacity Investment, and Electricity Markets

Alexandar Angelus, Texas A&M University, Mays School of Business, 320 Wehner, Bldg. 1510, College Station, TX, 77845, United States, aangelus@mays.tamu.edu

We propose a continuous-time model of electricity markets, in which heterogeneous consumers can invest in their own renewable-energy generators, such as solar panels, and thus reduce their electricity consumption from the local utility. The optimal time to install distributed generation follows a threshold policy on consumer's demand. We derive explicit expressions for the threshold level and optimal size distributed generation to install, and evaluate implications for electricity markets and carbon emissions.

3 - Integrated Optimization of Fertilizer Procurement, Cultivation, and Harvesting

Yangfang Zhou, Singapore Management University,
50 Stamford Road Singapore, 178899, Singapore,
helenzhou@smu.edu.sg, Onur Boyabatli, Lusheng Shao

We consider the integrated optimization of three key operational decisions in farm planning: fertilizer procurement via both contract and spot markets; cultivation and harvesting with limited respective resources (e.g., land and machinery) in the presence of uncertain farm yield and labor cost. We model this problem as a three-stage stochastic program and characterize the optimal decisions in each stage. Using a numerical study calibrated to real data, we characterize the value of the integrated optimization over the optimization in isolated stages, commonly seen in literature, and we examine how the farm profitability and cultivation decision are affected by the uncertainties in the farm yield and labor cost. We also examine how these uncertainties affect two measures of food loss: un-harvested yield and the yield gap, the difference between the actual yield and the highest yield with limited resources.

4 - Responsible Sourcing: Production Scale and Monitoring in the Nike Supply Network

Hsiao-Hui Lee, University of Hong Kong, K.K. Leung Building,
Room 814, Pok Fu Lam, Hong Kong, hhlee@hku.hk, Qiang Fu,
Jie Gong, Ivan Png

Multinational brands monitor their suppliers to enforce responsible sourcing. Here, we emphasize that brands can influence suppliers through the scale of production. The larger the scale, the more would the supplier infringe laws, regulations, and codes of conduct. The higher is the cost of monitoring, the more the brand should temper production as a way to induce suppliers to behave responsibly. Analysis of data on Nike contract factories in China between 2013-16 provides evidence consistent with these propositions. Scale of production is negatively correlated with monitoring cost and the rule of law positively moderates the negative relation. The managerial implication is that scale matters in responsible sourcing—to a degree that increases with monitoring cost, moderated by the rule of law.

■ SC18

North Lounge, 3rd Floor

Healthcare Management

Invited: Healthcare Systems and Applications
Invited Session

Chair: Huiyin Ouyang, The University of Hong Kong, oyhy@hku.hk

Co-Chair: Eric Park, University of Hong Kong, Hong Kong,
ericpark@hku.hk

1 - Solve the Waiting Time Puzzle: Doctor's Choice of Patients in the Emergency Department

Zhankun Sun, City University of Hong Kong, 7-268, 7/F,
Academic 3, Tat Chee Avenue, Kowloon, Hong Kong,
zhanksun@cityu.edu.hk, Jeff Hong, Wenhao Li

In the emergency department (ED), priority scores are assigned to patients at triage based on their acuity levels. However, using operational data from more than 150,000 patient visits, we find that doctors may deviate from this priority sequence, and within each priority class, patients may not be served in a first-come-first-serve manner. Our analysis shows that when selecting the next patient to treat, doctors prioritize patients who are more likely to be discharged after treatment at ED when many ED beds are occupied by boarding patients, in an effort to avoid further access block to the ED.

2 - Does Limiting Time on Ambulance Diversion Reduce Diversions? A Simulation Study Based on a Policy Intervention in Los Angeles County

Eric Park, Assistant Professor, University of Hong Kong,
Room 810, K.K.Leung Building, Pokfulam Road, Hong Kong,
ericpark@hku.hk, Sarang Deo, Itai Gurvich

We study the effect of a policy change that was intended to reduce ambulance diversions in LA County, CA. We find that the new policy succeeded in its purpose of reducing the time emergency departments (EDs) spent on diversion but did not reduce the fraction of ambulances being diverted. A possible explanation for this outcome, identified by our empirical analysis, is a combination of the change in the ambulance operator's level of compliance to the ED diversion signals in response to the policy change and the decrease in frequency of ambulances facing EDs on diversion. We build a simulation model to investigate the efficiency of such policy intervention limiting ED time on diversion in ED networks with varying level of congestion.

3 - Allocation of Intensive Care Unit Beds in Periods of High Demand

Huiyin Ouyang, The University of Hong Kong, oyhy@hku.hk,
Nilay T Argon, Serhan Ziya

The objective of this paper is to use mathematical modeling and analysis to develop insights into and policies for making bed allocation decisions in Intensive Care Units (ICUs) during periods when the patient demand is high. We first develop a stylized mathematical model in which patients' health conditions change overtime according to a Markov chain. The ICU has limited bed availability and therefore when a patient arrives and no beds are available, a decision needs to be made as to whether the patient should be admitted to the ICU and if so which patient in the ICU should be transferred to the general ward. With the objective of minimizing the long-run average mortality rate, we provide analytical characterization of the optimal policy under certain conditions. Then, based on these analytical results, we propose heuristic methods and with a simulation study we show that these heuristic methods work well under more "realistic" conditions.

4 - EMS Protocols Impact on Stroke Care in Indiana

Yuehwern Yih, Purdue University, West Lafayette, IN, 47907,
United States, yih@purdue.edu

In stroke care, we commonly understand that 'Time is Brain.' Several states including California and Illinois, implemented new protocols for EMS agencies to bypass hospitals that are not accredited as stroke centers. This study evaluates the impact of EMS protocols in varying urbanicity in Indiana, on patient treatment time delay.

■ SC19

South Lounge, 3rd Floor

Data Analytics and Technology in Healthcare for Efficiency, Quality, and Privacy

Invited: Healthcare Management

Invited Session

Chair: Calvin Kalun Or, PhD, University of Hong Kong,
Pokfulam, Hong Kong, klor@hku.hk

1 - RFID Analytics for Hospital Ward Management

Yong-Hong Kuo, The University of Hong Kong, Department of
Industrial and Manufacturing System Engineering, Pokfulam
Road, Hong Kong, yhkuo@hku.hk, Chun Hung Cheng

We present an RFID-enabled platform for hospital ward management. The platform keep tracks of the real-time information about the locations of the tagged objects. This platform has the capabilities of real-time monitoring and tracking of individuals and assets, reporting of ward statistics, and providing intelligence and analytics for hospital ward management. All of these capabilities benefit hospital ward management by enhanced patient safety, increased operational efficiency, and mitigation of risk of infectious disease widespread. A prototype developed based on our proposed architecture of the platform was tested in a pilot study, which was conducted in two medical wards of the intensive care unit of one of the largest public general hospitals in Hong Kong. This pilot study demonstrates the feasibility of the implementation of this RFID-enabled platform for practical use in hospital wards. Furthermore, the data collected from the pilot study are used to provide data analytics for hospital ward management.

2 - A Novel Cell Transmission Model for Multi-departmental Health Care Systems

Chengye Zou, The University of Hong Kong, zcypaul@hku.hk,
Junwei Wang

With the development of people's material life, health care service plays an increasingly important role in today's society. However, the health care resources remain insufficient to satisfy the large demand of people, especially in the multi-departmental health care systems, such as the large-scale hospitals. A system level method is desired to model the whole multi-departmental systems, instead of single department. Therefore, this study proposes a novel cell transmission model to examine the performance of the multi-departmental health care systems. A case study is also provided to validate the proposed model, which can support managers for better resources allocation.

3 - Association Rule Mining with Search Constraints and Validation for Cervical Cancer Screening

Carmen Kar-Hang Lee, PhD, The University of Hong Kong,
Hong Kong, leekh@hku.hk

Cervical cancer has no symptoms in the early stage and regular screening is critical to detect it in time. Despite that association rules are promising in identifying high-risk patients and suitable screening tests, two problems exist when rules are discovered from big data: (i) the number of rules obtained is extremely large; and (ii) rules without validation are with poor generalisation potential. This paper introduces constraints in the rule learning algorithm, followed by rule validation on a real data set. The medical significance of rules is evaluated in terms of support, confidence and lift. The rules represent useful knowledge for improving the quality of cervical cancer screening programs.

4 - Robust Optimization for Home Care Services

Eman Leung, City University of Hong Kong, 83 Tat Chee Avenue,
5216 Lau Ming Wai Building, Hong Kong, 999077, Hong Kong,
emaleung@cityu.edu.hk

We apply robust optimization to address uncertainty in home care service delivery. An illustrative case study provides insight into the effect of the user's chosen level of conservativeness on the solutions of a meals-on-wheels vehicle routing problem. Service durations are uncertain and a distinction is made between frail and non-frail elderly, the former having longer service durations with larger variations. A Mixed Integer Program minimizes the maximum time spent by any worker, ensuring workload fairness. Continuity of care is incorporated through a utility (penalty) in the objective function for workers serving familiar (unfamiliar) clients.

5 - Protecting Data Privacy in Healthcare Research

Amanda Man-Ying Chu, Hang Seng Management College,
Sha Tin, Hong Kong, amandachu@hsmc.edu.hk

Healthcare research often involves sensitive or confidential information from respondents or patients. How to prevent response distortion when collecting data and maintain the confidentiality of the data if they have to be released to third party for research or analysis are extremely important. In this talk, we will consider an advanced randomized response technique which can protect respondents' privacy and that can be applied not only to a single sensitive question but also multiple sensitive questions in structural equation modeling. We will also discuss a statistical disclosure control method to mask the data and thus protect patients' information before releasing the data.

Monday, 8:00AM - 9:30AM**■ MA01**

101A, 1st Floor

Modeling and Computations in Financial Engineering

Invited: Pricing and Revenue Management

Invited Session

Chair: Ning Cai, Hong Kong University of Science & Technology,
Kowloon, Hong Kong, ningcai@ust.hk

1 - Valuation of Asset Loans with Regime Switching:**A Unified Analytical Approach**

Ning Cai, Hong Kong University of Science & Technology,
Room 5559D, Industrial Engineering, and Logistics Management,
Kowloon, Hong Kong, ningcai@ust.hk

Asset loan services collateralized by various assets are actively offered by many banks and financial institutions nowadays and have gained great popularity among investors. We propose a unified analytical approach to the valuation of asset loans within a general framework with regime switching, i.e., under general regime switching exponential Levy models, by solving the associated optimal stopping problems. This is joint work with Wei Zhang from HKUST.

2 - xVA: Definition, Evaluation and Risk Management

Lixin Wu, The Hong Kong University of Science and Technology,
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The majority of multi-curve interest-rate models are at odd with the stylized pattern of basis swap curves: smooth and monotonically decreasing in terms (or maturities), which cannot be retained if forward rates of different tenors were driven by different random factors in any usual way. The multi-curve modeling has served to legitimize, undesirably, sector segregation in pricing and hedging. In this article, we decompose a LIBOR rate into an OIS forward rate and an "discrete loss rate", which represent the risk-free component and the default-risk component, respectively, and model them simultaneously using some popular dynamics for interest rates. In particular, we adopt the lognormal and CEV dynamics with stochastic volatility and establish the dual-curve versions of the LIBOR market model and the SABR model, respectively. Closed-form pricing formulae are developed for caplets and swaptions under the dual-curve SABR model, along the approach of heat kernel expansion.

3 - Order Estimation of Regime-switch Time Series Model and Herd Behavior Modeling of A-share Market

Lan Wu, Peking University, Beijing, China, lwu@pku.edu.cn

Theoretically, we proved the consistency result of the penalized maximum likelihood order estimation. In application, we propose a regime-switching AR for cross-sectional standard deviation of asset returns (CSSD) to examine time-varying herd behavior. We implement a thorough empirical analysis in the Chinese A-share market from 1999 to 2016 and found that herding is prominent in volatile regimes while adverse herding is prevalent during tranquil regimes. We apply our model to factor-based portfolios and industry sectors and found that the regimes exhibit some rotation patterns and participants in the volatile regime are frenetically to buy the "winner".

4 - Optimal Redeeming Strategy of Stock Loans under Drift Uncertainty

Zuoquan Xu, The Hong Kong Polytechnic University, Kowloon,
Hong Kong., maxu@polyu.edu.hk

One must recognize the inevitable presence of information incompleteness when making decisions. This paper considers the optimal redeeming problem of stock loans under incomplete information due to the uncertainty of the trend of underlying stock (called drift uncertainty). Due to the unavoidable estimating of the trend, the HJB equation turns out to be a degenerate parabolic PDE which is very hard to obtain its regularity by standard approaches, making the problem distinguish from the existing models without drift uncertainty. We provide a thorough and delicate probabilistic and functional analysis to the value function to obtain its regularity and the optimal redeeming strategies.

■ MA02

101B, 1st Floor

Frontiers in China's Largest E-commerce Supply Chain

Invited: Supply Chain Inventory Management

Invited Session

Chair: Rong Yuan, JD.com, Santa Clara, CA, United States,
rong.yuan@jd.com

Co-Chair: Di Wu, JD.com, JD.com, Santa Clara, CA, United States,
di.wu@jd.com

1 - Solving Warehouse Item Assortment Problem Using Deep Learning

Di Wu, JD.com, Santa Clara, CA, United States, di.wu@jd.com,
Yuhui Shi

E-commerce companies use regional distribution centers (RDC) to fulfill orders placed by customers from different geographical locations in a timely manner. However, due to the capacity of the warehouses, it is not possible to store every possible items in the RDC. Missing items from the RDC inventory in a customer order requires leads to longer fulfillment time and cost. We propose a method which reduces the number of split orders by choosing carefully a subset among all items being vended, to store in the RDC, by considering the popularity of items and the relationship between them.

2 - Optimal Inventory Allocation with Regional Transshipment

Xiaohui Zhang, Beijing, China, zhangxiaohui5@jd.com,
Chen Chen

Given a specific SKU, which distribution center should be chosen for storing it and how much demand should be covered by each DC? In order to answer the questions, we developed an approach to minimize the total cost that will be affected by inventory allocation.

3 - Fresh Goods Inventory Management and Pricing

Xin Chen, UIUC, 216C Transportation Building, 104 S. Mathews
Avenue, Urbana, IL, 61801, United States, xinchen@illinois.edu

Recent years witnessed phenomenal growth of successful deployments of innovative strategies in e-retailers and active academic research on inventory management and pricing of fresh goods. In this talk, we present some industrial practice at JD.com and our progress collaborating with JD.com.

4 - Online Retailers Opening Offline Stores: An Integrated Approach to Location, Assortment and Inventory Planning

Hao Shen, Tsinghua University, Beijing, China, chen hao14@
mails.tsinghua.edu.cn, Yong Liang, Zuo-Jun Max Shen

Online-offline retailing has been increasingly adopted by companies nowadays. Consumers' purchase decisions depend on not only their preferences across products, but also hassle costs such as offline transportation cost and online disutility cost. Consequently, the products offered in a local retail store affect the demand in both the online channel and the retail stores at other locations. We address how companies should determine the offline assortment and the associated inventory level in each retail store to maximize profits across both channels. We propose a mixed-integer nonlinear program, and develop a tractable mixed-integer second-order conic program reformulation.

■ MA03

101C, 1st Floor

Supply Chain Analytics in Developing Markets

Invited: Stochastic Inventory Theory

Invited Session

Chair: Joel Goh, NUS Business School, 119245, Singapore, joelgoh@nus.edu.sg

1 - Characterizing Material Convergence: Inventory Management under Limited Storage and Depletion

J. Lemuel L. Martin, Nanyang Technological University, 50 Nanyang Avenue, Singapore, 639798, Singapore, MART0019@e.ntu.edu.sg, Fang Liu

We consider an inventory model for a firm that faces stochastic demand and supply, with only a portion of supply being usable and the rest classified as non-priority. Furthermore, the firm has limited storage and depletion capacity. This is connected to the humanitarian operations phenomenon known as material convergence. To our knowledge, this is the first model that addresses material convergence from the perspective of control theory. We use stochastic control to characterize the inventory dynamics and generate some managerial insights for mitigating material convergence.

2 - Intermediation in the Supply of Agricultural Products in Emerging Economies

Joel Goh, NUS Business School, Mochtar Riady Building, 15 Kent Ridge Drive, 08-04, 119245, Singapore, joelgoh@nus.edu.sg, Kris Johnson Ferreira, Ehsan Valavi

This study seeks to derive insights into the structural drivers of farmer and supply chain profitability in emerging markets and to understand the impact of an “e-intermediary” — a technology-enabled posted price supply channel — in such supply chains. To do this, we develop a stylized model of a supply chain that captures distinctive features of supply chains operating in emerging markets. Our results provide insight into drivers of inefficiency in such supply chains, and a more balanced view of the merits of e-intermediation in these chains relative to the generally positive view advanced by case studies.

3 - Fulfillment by Amazon Versus Fulfillment by Seller: A Data Driven Approach

Chung-Piaw Teo, National University of Singapore Business School, 15 Kent Ridge Drive, BIZ 1 #8-69, Singapore, 119245, Singapore, bizteocp@nus.edu.sg, Guodong Lyu, Libo Sun, Yugang Yu

With dual-channel choices, E-commerce retailers fulfill their demands by either the inventory stored in third party distribution centers, or by in-house inventory. In this paper, using data from a wedding gown E-retailer in China, we analyze the difference in two fulfillment choices - Fulfillment by Amazon, or Fulfillment by Seller, from the perspective of sales, return rates, etc. and use a data driven approach to develop a decision model to help E-commerce retailers to make choices on the fulfillment channel.

■ MA04

101D, 1st Floor

Optimization Involving Advertising, Promotions and Branding

Invited: Operations/Marketing Interface

Invited Session

Chair: Candace Arai Yano, University of California-Berkeley, Berkeley, CA, 94720-1777, United States, yano@ieor.berkeley.edu

1 - Optimizing Pricing for Multiple Substitutable Products

Kevin Li, University of California, Berkeley, 7710 Melrose Avenue, Berkeley, CA, 94709, United States, kbl4ew@berkeley.edu

We address a retailer's problem of setting prices, including promotional prices, over a multi-period horizon for substitutable products within a category, considering the effects of reference prices on customers' strategic buying behavior, including stockpiling. We utilize an embedded model in which customers make purchasing and consumption decisions over multiple periods to maximize utility. We present structural results and examples that provide insight into the properties of optimal policies.

2 - Optimal Advertising in Markets with Asymmetric Peer Influence

Ashutosh Prasad, University of California Riverside, 900 University Ave, Riverside, CA, 92521, United States, aprasad1234@gmail.com, Gila E Fruchter, Christophe Van den Bulte

We examine optimal advertising for a product sold in a segmented market with peer effects between elite and follower segments. Followers are positively influenced by elites whereas elites may be repulsed by followers (attraction/repulsion dynamics). We develop a continuous time, optimal control model and propose a solution algorithm. We find that managing advertising and entry delay together markedly increases profits. Also, the optimal advertising strategy in the elite segment may be U-shaped.

3 - How Firms Co-brand: Principles of Effort Decision, Cost Allocation and Partner Selection for Co-branding

Yongquan Lan, Xiamen University, Simin South Road 422, Xiamen, China, yongqlan2@xmu.edu.cn, Yanzhi David Li

We employ a Stackelberg differential game to model the co-branding partners' self-branding and co-branding decisions and to demonstrate its feedback equilibrium. Our solution helps interpret players' decision rules for optimal self-branding and co-branding efforts as well as co-branding cost allocation schemes and partner selection principles.

4 - Differential Pricing in Social Networks with Strategic Consumers

Biying Shou, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong, biying.shou@cityu.edu.hk, Rui Zheng

Social networks have been fast growing and playing an increasingly important role in consumers' purchasing decisions. We analyze a monopolistic seller's optimal pricing problem with strategic consumers connected in social networks. The consumers who purchase in the later period can get positive externality from her friends who have purchased in the early period, but they have to bear a utility discount for the delayed consumption. We consider networks with general structures, which means that the influences (connections) between consumers can be different and asymmetric. We address three research questions: (1) How do social networks influence consumers' strategic purchasing decisions? (2) How can the sellers design the optimal differential pricing strategy? (3) How much can the sellers gain from using network-dependent differential pricing, compared to using uniform pricing?

■ MA05

102, 1st Floor

Practice III

Sponsored: Practice/Industrial Applications

Sponsored Session

Chair: Chi-Yi Kuan, LinkedIn, 640 Curtner Rd, Fremont, CA, 94539, United States, chiyi2@yahoo.com

1 - Better Machine Learning Models by Derivative-free Optimization

Yan Xu, SAS Institute, Inc., 1075 Upchurch Farm Lane, Cary, NC, 27519, United States, yan.xu@sas.com

Optimization is a key component in many machine learning (ML) or artificial intelligence algorithms. Optimization is not only used to fit ML models, but also help to create better models in terms of accuracy and complexity. In this tutorial, we first introduce a number of derivative-free optimization (DFO) methods, which have been successfully used to improve ML models by optimizing their hyperparameters. We then present several real-world ML applications that significantly benefit from those DFO methods.

2 - AI is here: Turning Advanced Analytics into Business Advantage

Chi-Yi Kuan, LinkedIn, 640 Curtner Rd, Fremont, CA, 94539, United States, chiyi2@yahoo.com

Data is driving business transformation. Advanced technologies are reshaping the business with new discoveries, better customer experiences, and improved products and services - enabled by AI. Chi-Yi Kuan shares examples of how LinkedIn unleashed intelligent & scalable insights to make better decisions, and explores best practices for incorporating data, advanced analytics and talent into your organization.

■ MA06

103, 1st Floor

Tutorial: Research and Teaching Opportunities in Project Management

Tutorial Session

1 - Research and Teaching Opportunities in Project Management

Nicholas G. Hall, Ohio State University, 658 Fisher Hall,
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One-quarter of the world's economic activity, with an annual value of \$18 trillion, is organized using the business process of project management. This process has exhibited dramatic growth in business interest in recent years, with a more than 1000% increase in Project Management Institute membership since 1996. Contributing to this growth are new applications, for example IT implementations, research and development, software development, corporate change management, and new product and service development. However, the very different characteristics of modern projects present new challenges. The partial resolution of these challenges by industry over the last 15 years presents numerous interesting opportunities for academic researchers. These research opportunities make use of a remarkably broad range of methodologies, including robust optimization, cooperative and non-cooperative game theory, predictive analytics, and behavioral modeling. Furthermore, the \$4.5 trillion that is annually at risk from a shortage of skilled project managers, and the 15.7 million new jobs in project management expected by 2020, provide great opportunities for contributions to project management education. These educational opportunities include the integration of case studies, analytics challenges, online simulations, in-class games, self-assessment exercises, videos, and guest speaker presentations, which form an appealing course for both business and engineering schools.

■ MA07

105, 1st Floor

Data Science in Manufacturing

Invited: Operations and Decisions in Smart Manufacturing and Logistics

Invited Session

Chair: Chia-Yen Lee, cylee@mail.ncku.edu.tw

1 - Data Mining for Price Forecasting of Petrochemical Raw Material

Bai-Jian Chou, National Cheng Kung University, Tainan City,
Taiwan, allan811118@gmail.com, Chia-Yen Lee

In petrochemical industry, butadiene is one of the key materials for producing synthetic rubber. Thus, a precise forecast of raw materials price would effectively support the company to reduce costs. This study proposes a data science framework to predict the weekly price of butadiene by using the historical price and other related information. It includes two models. One is the price prediction model with time series decomposition method. The other model applies the deep learning technique to predict prices for the purchasing decision. An empirical study was conducted to validate the prediction models. The results show that the proposed model supports the company in raw materials procurement.

2 - Quality System Implementation of Machine Tool using Data Mining and Statistical Quality Control Methods

Bo-Kai Jang, National Cheng Kung University, Tainan City,
Taiwan, P96051042@mail.ncku.edu.tw, Chia-Yen Lee

In machine tool industry, it's critical to maintain high-quality products during the process while the variance in the process shows significantly impact on quality issue. This study develops control charts via data mining framework. First, data was divided into many groups by cluster, and the baseline of product can be defined for each cluster. Second, univariate control charts were developed based on the baselines of qualified products. Control charts were based on time series and profile monitoring since the center-line will constantly change over time. The result shows the quality system embedded with data mining technology significantly enhanced the monitoring reliability of control charts.

3 - Data Mining for Time-series Bandwidth Signal Analysis of Electric Motor

Ting-Syun Huang, National Cheng Kung University, No.1,
Daxue Rd., Tainan City, Taiwan, P96054040@mail.ncku.edu.tw,
Chia-Yen Lee, Meng-Kun Liu, Chen-Yang Lan

Electric motors are used in a variety of applications. The failure of the electric motors will cost enormous capacity loss. One of the rotating components inside motors called bearings is the main factor of failure. In this study, we propose a research framework embedded with data mining and machine learning algorithms to reach the purpose of prognostics. The aim is to predict the remaining useful life (RUL) of bearings by observing the unstable signal revealed in the early stage and taking the selected features. Finally, based on the results, the predictive maintenance (PdM) policy or mechanism can be developed for replacing or fixing bearings at the right moment to avoid the equipment failure.

4 - Efficient Heuristic Algorithm of Forward-and-Backward Production Scheduling for Fastener Manufacturer

Chin-Yi Tseng, National Cheng Kung University, No.45,
Chongde 15th St., East Dist., Tainan City, 701, Taiwan,
P96054032@mail.ncku.edu.tw, Cheng-Man Wu, Chia-Yen Lee,
Shun-Chieh Lin, Yi-Lin Chiang, Chih-Yu Chen

In fastener industry, different kinds of specifications and many combinations of molds for products leads to the complex manufacturing process. Therefore, the scheduling needs to focus on not only due date but also changeover times. This study considers forward-scheduling and backward-scheduling simultaneously, and develops two efficient heuristic algorithm combined with engineering experiences to solve the multi-objective production scheduling problem. The proposed two algorithms are applied to the case factory, and the results show that both algorithms have their own advantages respectively.

■ MA08

201A, 2nd Floor

Building and Deploying Real World Optimization and Machine Learning Models

Invited: Fusions of Big Data, AI, Blockchain and FinTech Applications

Invited Session

Chair: Yan Xu, SAS Institute, Inc., SAS Institute, Inc., Cary, NC, 27519, United States, yan.xu@sas.com

1 - Using SAS/OR for Price Optimization across the Product Lifecycle

Sherry Xu, June Field Plaza 19F, 10 Xuanwumen Out Street,
Beijing, China, Sherry.Xu@sas.com

The talk introduces the uses of SAS/OR product to optimize the promotion price and markdown price across the product lifecycle for each location. Both the promotion pricing and markdown pricing are modeled and solved in one Mixed Integer Linear Optimization model while considering various business rules. The pricing system was implemented at an American worldwide clothing and accessories retailer for its thousands of products and stores last June.

2 - Real-Time Prediction of Sepsis in Hospitalized Adults Using Continuous Bedside Physiological Data Streams

Anahita Khojandi, University of Tennessee, 521 Tickle Building,
Knoxville, TN, 37996, United States, khojandi@utk.edu,
Franco van Wyk, Robert Davis, Rishikesan Kamaleswaran

Sepsis is an acute, life-threatening condition that results from bacterial infections, often acquired in the hospital. Undetected, sepsis can progress to severe sepsis and septic shock, with a risk of death as high as 30% to 80%. Early detection of sepsis can improve patient outcomes. In this work, we use machine learning algorithms to analyze continuous, high-frequency physiological data, such as vital signs, to identify at risk patients before sepsis onset. The models achieve F1 scores of up to 75% and 79% half-hour and ten minutes before sepsis onset. On average, the models are able to predict sepsis 210 minutes (3.5 hours) before onset, primarily using commonly captured physiological data.

3 - A Platform for Deploying Optimization, Machine learning and Artificial Intelligence Solutions

David Burgess, SAS Institute Pte Ltd, Singapore, Singapore,
David.Burgess@sas.com

Artificial Intelligence and machine learning techniques are increasing the scope of opportunities to benefit from analytics. Whether you are looking for commercial opportunities in the Analytics Economy or applying Analytics for Good, the SAS Platform provides an open environment on which to deploy your solutions.

4 - Improving Transportation for Boston Public Schools through Optimization and Machine Learning

Yan Xu, SAS Institute, Inc., 1075 Upchurch Farm Lane, Cary, NC,
27519, United States, yan.xu@sas.com

Boston Public Schools (BPS) is the oldest public school system in the United States. It provides transportation for thousands of students through over 600 buses. In this talk, we present the analytics models used to optimize the student bus-stop assignments and bus schedules for bus routes, and also show the results of applying those models in term of increasing service quality and reducing costs.

■ MA09

201B, 2nd Floor

Applications of Additive Manufacturing for Healthcare and Clinical Applications

Invited: At the Nexus of Technology, Health and Productivity
Invited Session

Chair: Evin Chen, China Medical University, Tunghai University, Taichung, Taiwan, evinchen@gmail.com

1 - 3D Printing Integrated Solution for Healthcare Systems

Evin Chen, China Medical University, Tunghai University, Taichung, Taiwan, evinchen@gmail.com

China Medical University Hospital 3D Printing Medical Research Center (CMUH 3DP MRC) is the first 3DP center which fully integrated with a medical healthcare system. Its vision is to be a world's premium organization to develop and deliver advanced and affordable 3D printed medical care including biomedical devices, implants and therapeutics to improve the quality of life of the general public. 3DP MRC leverages the strengths of China Medical University Hospital/Asia University/Georgia Tech and external partners, deploys multidisciplinary project teams, and integrate R&D, education and practice for innovative solutions. One of 3DP MRC goal is to develop personalized in vivo regenerative engineering, scaffold & scaffold-less cell products. Bioprinting technology applies in forefront of medicine such as bone tissue engineering, cartilage regeneration, artificial vessel, nerve conduit medical device development based on 3DP MRC's roadmap. Therefore, not only bio-materials design, development and manufacturing is most crucial to bioprinted tissue engineered products, the mechanism of cell-landed, -proliferation, -differentiation is highly challenge to the regeneration medicine. 3DP MRC carries on its tasks and missions to input huge resource in bioprinting research and moreover, expecting to involve high-tech medical application translation and lifesaving action.

2 - Additive Manufacturing for Dentistry Application: From Tradition to Digital

Ming-You Shie, China Medical University, Taichung, Taiwan, eric@mail.cmu.edu.tw

In the past years, the traditional treatment program in the dental, from the imaging of the patient to the medical device needed for treatment, whether dental bridge or denture, will take a lot of time to get it. With the advancement of science and technology, the technology of digital dentistry is changing with each passing day. Rapid advancements are being made in the field of additive manufacturing (3d printing) in the compass of dentistry application. In the current, the distinctive 3d printing processes in combination with various materials are being used for the manufacture of customized 3D parts for the prosthetic or surgical reconstruction of the dentally and maxillofacial compromised patient. In addition, one of these new applications of 3d additive manufacturing technologies in the area of implantology is the creation of the pre-emptive titanium custom-made root analogue implant for immediate implant cases. The adoption of digital technology at the dental application in the world is growing steadily. As these new skills, products and techniques continue to be introduced to use in dentistry, both the dentist and the patients can gather the benefits.

3 - Images Super-resolution of Computed Tomography Using Convolutional Neural Networks

Cheng-Ting Shih, China Medical University, Taichung, Taiwan, ctshih21@gmail.com

In computed tomography (CT) images, the visibility of anatomical structures and lesions is highly dependent on the spatial resolution. However, several factors, such as image reconstruction kernels, applied rebinning methods on sinograms, and the most important the size of detector crystal, limit the spatial resolution of CT images. Sufficient spatial resolution could lower the diagnosability of CT images, thereby reducing the detectability of lesions. To improve the spatial resolution of CT images, super-resolution convolutional neural network (SR-CNN) was applied. In the applied SR-CNN, convolution layers were applied to extract image features from low-resolution images and to transfer the features to reconstruct high-resolution images. In each layer, activation function of a sigmoid function was used to remove low gradient features. In this study, 30000 CT images from 100 patients were retrospectively retrieved using picture archiving and communication system. In these images, 25000 images were used for the training and 5000 images were used for the validation of the SR-CNN. The original images were employed as high-resolution output, and the low-resolution input images were obtained by down-sampling of the original images. The performance of the SR-CNN was evaluated by computing a peak signal-to-noise ratio (PSNR) and a mean structure similarity (MSSIM) between original and super-resolution images. After image super-resolution, the blurred boundaries and fine structures were recovered with improved visibility, especially bone structures. Comparing with the blurred inputs, the PSNR and MSSIM of the validation images were improved from 33.3 to 43.8 and 0.91 to 0.98, respectively. In conclusion, we thought that the SR-CNN could be applied to clinical CT images for improving the spatial resolution.

■ MA10

201C, 2nd Floor

Intelligent Resource Allocations and Competitions in Networks and Systems with Big Data

Invited: Operations Analytics and Optimization for Manufacturing, Logistics and Energy Systems
Invited Session

Chair: Wanyang Dai, Nanjing University, nan5lu8@nju.edu.cn

1 - Resource Allocations and Dynamical Pricing for Quantum-cloud Computing Services with Ai-blockchain and Big Data

Wanyang Dai, Nanjing University, 22 Hankou Road, Dept of Math, Nanjing, 210093, China, nan5lu8@nju.edu.cn

We study resource allocations and dynamical pricing for quantum-cloud computing services systems with Blockchain and Big Data. The allocations and pricing are interactively and dynamically realized via a myopic and game-theoretic policy aided with artificial intelligence (AI), which is proven to be an asymptotic Pareto minimal-dual-cost Nash equilibrium strategy globally over the whole time horizon to a randomly evolving dynamic game problem. To be easy for readers, we will call our proposed dynamic strategy as asymptotical BestGo policy.

2 - Dedicated Service or Pooled Service: Structure Design in Large-Scale Service Systems

Junfei Huang, The Chinese University of Hong Kong, 9/F, Cheng Yu Tung Building, No. 12, Chak Cheung Street, Shatin, N.T., Hong Kong, junfeih@cuhk.edu.hk

We consider a queueing system with many servers and customer abandonment. The arrival process is Poisson, service times and patience times are exponentially distributed, and there are n servers. Each server has its own queue and customers join the shortest queue upon arrivals. Each server follows the first-in-first-out and work-conserving service discipline. We focus on the overloaded regimes and will show some interesting observations.

3 - Sensitivity-based Optimization and Threshold Control in Energy-efficient Data Center Networks

Quanlin Li, Yanshan University, China, liquanlin@mail.tsinghua.edu.cn, Jing-Yu Ma, Li Xia

As the number, size and scale of data center networks grow fast, the energy consumption is becoming one main part of the running cost of data center networks. In this situation, finding an optimal energy-efficient policy and designing a best energy-efficient mechanism are interesting, difficult and challenging topics in the study of (cloud or fog) data center networks. In this talk, we propose and develop a sensitivity-based optimization method grew out of the Markov decision processes to study an optimal threshold control policy for energy-efficient data center networks. We hope the methodology and results given in this paper are applicable in the energy-efficient study of data center networks.

4 - Approximate Analysis of Nonstationary Queueing Networks

Ronald G Askin, Professor, Arizona State University, School of Computing, Informatics Engineering, Ira A. Fulton Schools of Engineering, Tempe, AZ, 85287-8809, United States, Ron.Askin@asu.edu, Girish Jampani Hanumantha

We propose approximate analytical models for nonstationary, multiclass queueing networks. The models can estimate throughput times, throughput rates and WIP levels in production systems with time-dependent demand, product mix and resource schedules. The models provide computationally tractable approaches for setting order releases and forecasting system state and performance. Results are shown to be exact in special cases.

5 - Priority-based Congestion Control of a Network with Homogeneous Customers

Yasushi Masuda, Keio University, Faculty of Science and Technology, 3-14-1 Hiyoshi Kohoku-Ku, Yokohama, 223-8522, Japan, masuda@ae.keio.ac.jp, Akira Tsuji

We consider a game theoretic congestion model with parallel nodes and homogeneous customers. The purpose of this paper is to examine how the priority passes improve social welfare for such a system. To this end, we prove the existence of an equilibrium. The system with no priority pass has a unique equilibrium. With the introduction of priority passes, the uniqueness of the equilibrium may be destroyed. We provide a sufficient condition under which the system with priority passes outperforms the system with no priority passes. The problem is explored numerically as well.

■ MA11

201D, 2nd Floor

Financial Engineering I

Invited: Financial Engineering in China

Invited Session

Chair: Yanchu Liu, Guangzhou, 510275, China,
liuych26@mail.sysu.edu.cn

1 - A Unified Framework for Computations of Regime**Switching Models**

Ning Cai, Hong Kong University of Science & Technology,
Room 5559D, Industrial Engineering, and Logistics Management,
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Computations under regime switching models are usually challenging because of the complexities incurred by regime changes. We provide a unified analytical approximation framework for accurate and efficient computations of the distributions of several theoretically important and practically useful quantities, including first passage times, running extrema, and time integrals, under general regime switching Markov models. As an application, we derive analytical approximations to the prices of various path-dependent options such as barrier, lookback, and Asian options under general regime switching Markov models. This is joint work with Yingda Song and Steven Kou.

2 - Dynamic Investment and Financing with Internal and External Liquidity Management

Nan Chen, Chinese University of Hong Kong, William M.W. Mong
Engineering Bldg, Rm 609, Shatin N T, Hong Kong,
nchen@se.cuhk.edu.hk, Yuan Tian, Jiahui Ji

We develop a theoretical model of dynamic investments, dividend payouts, debt borrowing, external equity financing/bankruptcy, and risk management for financially constrained firms. The model characterizes the central importance of liquidity management in corporate decision making in the presence of external financing costs. The model yields rich implications in corporate financing and investments. The paper also discusses the implications of liquidity and leverage requirements in the current banking regulatory framework.

3 - When do Jumps Matter for Option Prices?

Bernd Heidergott, Prof., Vrije Univesity, De Boelelaan 1105,
Amsterdam, 1081 HV, Netherlands, bheidergott@feweb.vu.nl,
Warren Volk-Makarewicz, Svetlana Borovkova

An operational concern in model building is the balance between additional benefit against complexity. We consider a simplified scenario in quantifying the benefit of including a compound Poisson process to a diffusion price model in pricing European options. To gain insight into the relevance of the jump component for the option price model, we develop a simulation-based sensitivity estimator of the price paths to quantify the influence the jump-diffusion has on a European price. The corresponding hypothesis test is more sensitive in detecting price jumps than the t-Test for equal means in scenarios where either volatility or jump behavior is dominant.

4 - Textual Sentiment, Option Implied Information and Equity Return Predictability

Yanchu Liu, Sun Yat-sen University, Lingnan College, Haizhu
District., Guangzhou, 510275, China, liuych26@mail.sysu.edu.cn,
Cathy Chen, Matthias Fengler, Wolfgang Hardle

A growing literature shows a predictability of stock returns based on sentiment proxies. Variables implied from single stock options markets also carry predictive content for future equity returns. Where does this predictability stem from? Is it firm-specific information advantage or is it a firm-specific sentiment that is implemented in terms of option-based strategies? In this work, we aim at answering these questions by distilling sentiment from a huge bulk of NASDAQ news articles and examine the various sources of predictive power. We conclude that the predictability of options markets cannot exclusively be attributed to information asymmetry but also to sentiment.

■ MA12

201E, 2nd Floor

Transportation Safety and Traffic Control

Invited: Transportation Science & Logistics

Invited Session

Chair: Jiahong Zhao, Guangdong University of Technology, No. 100
Waihuan Xi Road, Guangzhou Higher Education Mega Center,
Panyu District, Guangzhou, 510006, China, zhaojiahong1@126.com

1 - A Dual Toll Policy for Regulating the Transportation of**Hazardous Materials**

Ginger Yi Ke, Memorial University of Newfoundland, Faculty of
Business Administration, Memorial University of Newfoundland,
St. John's, NL, A1B 3X5, Canada, gke@mun.ca, Huiwen Zhang,
James H. Bookbinder

This research proposes a dual-toll setting policy to mitigate the risk caused by the transportation of hazardous materials (hazmat) in a road network. To be specific, we use a bi-level programming formulation, where the upper and lower levels reflect the decision problems for the regulator and carrier, respectively. In addition to the total network risk considered by most literature, the regulator also minimizes the maximum link risk so that the spatial distribution of risk is well maintained. For the carrier with both regular and hazmat shipments, the equilibrium decision of balancing the traffic throughout the network is explored in light of the dual toll posed by the regulator. To solve the bi-objective bi-level non-linear model effectively, we develop a linearization approach made up of two parts to transform the nonlinear terms into linear ones, and then a genetic-algorithm-based methodology to integrate both levels.

2 - Modeling and Integrated Control of Macroscopic Heterogeneous Traffic Flow in Large Scale Urban Network using Coloured Petri Net

Hui Fu, Guangdong University of Technology, Guangzhou, China,
gdutufuhui@hotmail.com

For capturing the real characteristics of traffic dynamics, an enhanced accumulation-based traffic model is proposed in which transfer flow and travel delay are considered simultaneously using coloured Petri net. Taking the advantage of graphical structure, the gated links and junctions on the border of the protected network are modeled as buffers. A simple case study demonstrates the implementation mechanism of this proposed model and its capability of evaluating network performance. Moreover, a perimeter control framework integrated with route guidance is proposed for enhancing the ability of perimeter control on alleviating total delay out of the protected network.

3 - Two-stage Decision-making Method for Real-time Responsive Customized Bus Dynamic Scheduling

Shuang Han, Guangdong University of Technology, Guangzhou,
China, 21218051@qq.com

The key issue in real-time responsive customized bus is to dispatch vehicles to service passengers with high quality, and then achieves balance in operating costs and service level. In this research, we develop a two-stage decision-making method for real-time responsive customized bus dispatching. The initial route pre-planning model is established based on regional passenger demands, and then the route dynamic adjustment model is established. In the simulation case, the initial routes and their dynamic adjustment programs are obtained. And the parameters sensitivities in route pre-planning model, the impacts of time windows and different control modes on dispatching are also demonstrated.

4 - A Novel Model for the Dangerous Container Storage Location-allocation Problem

Jiahong Zhao, Guangdong University of Technology,
230 Waihuan Xilu, Daxuecheng, Guangzhou, 510006, China,
zhaojiahong1@126.com, Ginger Yi Ke

Dangerous containers pose increasing threats to the people and environment in vicinity of port during the offsite storage management. Minimizing the total potential risk and maximizing the total profit, a new storage allocation model is formulated to optimize multiple types of dangerous containers' storage plan: 1) which type of dangerous containers is allowed to be stored at the storage area, and 2) how many containers are allocated to each storage area in one single plan period. Also, the hazardous compatibility for each dangerous container is considered in the proposed model. To solve this bi-objective model, the solution procedure is developed from generic algorithm. Both the proposed model and method are applied to the real-life problem in Tianjin port and some hypothetical cases to demonstrate the workability.

5 - The Numerical Simulation Method for the Diffusion of Motor Vehicle Emissions

Shuang Han, Guangdong University of Technology, Guangzhou, China, hsh2007@gdut.edu.cn, Xiaoxia Wang, Jiahong Zhao

The physical model and mathematical model of vehicle emissions diffusion are established by considering the composition of different components of various emissions. The incompressible N-S equation for describing the multicomponent three-dimensional turbulent flow of emissions gas diffusion is presented. The control equation is discretized by the finite volume method, and the motion characteristics of the vehicle flow are reproduced by the CFD simulation tool.

■ MA13

201F, 2nd Floor

Operations and Economics Interface I

Invited: Operations and Economics Interface

Invited Session

Chair: Wenxin Xu, Hong Kong Polytechnic University, wenxin.v.xu@polyu.edu.hk

1 - Game of Variable Contribution to Common Good under Uncertainty

Dharma Kwon, University of Illinois at U-C, 350 Wohlers Hall, 1206 S Sixth Street Mc-706, Champaign, IL, 61820, United States, dhkwon@illinois.edu

We examine games of concession in which the players have continuous control over the degree of concession. Previously known examples of these games in the literature yield equilibria characterized by singular control strategies without any delay of concession. In contrast, we find that variable concession games with a single state variable yield equilibria characterized by gradual concessions, which naturally generalizes the results from canonical wars of attrition. We also examine the impact of stochasticity and asymmetry between the two players.

2 - Signaling Game Model that Analyze the Impact of Consumers' Social Responsibility

Xiaomeng Guo, Hong Kong Polytechnic University, M624, 6/F, Li Ka Shing Tower, The Hong Kong Polytechnic University, Kowloon, Hong Kong, xiaomeng.guo@polyu.edu.hk, Guang Xiao, Fuqiang Zhang

We develop a signaling game model to analyze the impact of consumers' social responsibility concerns on a firm's pricing decision and profit performance. The firm can be either socially responsible or irresponsible, and consumers do not have perfect information about the firm's type. We find that the existence of information asymmetry may distort some conventional wisdom and have interesting implications for the firm regarding corporate social responsibility.

3 - On the Competition of On-demand Service Platforms

Qingying Li, Donghua University, Shanghai, China, liqingying@dhu.edu.cn

In this paper we consider the competition between two on-demand service platforms, which compete for both potential customers and agents. Potential customers require immediate service. They estimate the expected waiting time and make decisions on choosing either platform or giving up the immediate service, according to the utility value of ordering the service through the platforms. We assume agents will put the first priority to serve the customers ordering from the higher-wage platform. Via a queueing formulation, we study the customers' equilibrium, the pricing competition game, and the social welfare.

4 - Location Choice in Bicycle-Sharing Industry

Wenxin Xu, University of Illinois at Urbana-Champaign, 1206 S Sixth Street, 350 Wohlers Hall, Champaign, IL, 61820, United States, wenxin.v.xu@polyu.edu.hk

In China's booming bicycle sharing industry, the two giants OFO and Mobike are both contemplating to expand into some third-tier cities. Therefore, these companies often grapple with those questions such as: When should I enter this new market that has uncertain demand? In which neighborhoods I should set up those bicycle leasing stations to increase my profits? This study examines a game theoretical duopoly market entry model to investigate the interplay of location decision and entry timing decision.

■ MA14

202A, 2nd Floor

Climate Change, Corporate Performance and Natural Resources

Invited: Environment, Energy, and Natural Resources

Invited Session

Chair: Hugo K.S. Lam, University of Liverpool Management School, Chatham Building, Chatham Street, Liverpool, L69 7ZH, United Kingdom, hugolam@liverpool.ac.uk

1 - Assessing Connection Energy Efficiency to Financial Performance of Firms in Korea

Hana Moon, Ewha School of Business, Seoul, Korea, Republic of, unihanamoon@hotmail.com, Dai-ki Min

As the number of environmental regulations has been strengthened, establishing specified and efficient energy management is unavoidable. In this research, different types of efficiency of energy-intensive firms in Korea are measured by using a two-staged DEA methodology. Since the final mission of most firms is not only to sustain a competitive position, but also to get a financial advantage from it, therefore, how the different types of efficiency and financial performance are related is checked and compared, in order to generate strategic implications.

2 - Intertemporal Fairness and the Exploitation of Nonrenewable Resources

Thomas A. Weber, Professor of Operations, Economics and Strategy, EPFL, CDM-ODY 3.01, Station 5, Station 5, Lausanne, 1015, Switzerland, thomas.weber@epfl.ch

The multitude of possible rules and the lack of justification for any single one of them renders the sharing of resources across generations difficult and subjective. We propose a notion of intertemporal fairness, in discrete and continuous time, which is robust, as it singles out an allocation that is 'simultaneously best' relative to all feasible Lorenz-undominated allocations. For exhaustible resources, the resulting fair allocation ensures positive consumption by all future generations.

3 - Does Mandatory Environmental Reporting Affect Firms' Operational Efficiency? Evidence from a Quasi-natural Experiment in the UK

Hugo K.S. Lam, University of Liverpool, Chatham Building, Chatham Street, Liverpool L69 7ZH, Liverpool, L69 7ZH, United Kingdom, hugolam@liverpool.ac.uk, Andy Yeung, Jeff Ng

While regulators around the world have started to mandate firms to report environmental performance compulsorily, little is known about the impact of such mandates on firms' operations. Our research tackles this important and timely issue based on a quasi-natural experiment in the UK, in which we utilize propensity score matching and difference-in-differences methodologies to examine whether and how mandatory environmental reporting affects firms' operational efficiency, providing important implications for both practice and research.

4 - Work Package Sizing and Project Performance

Chung-Lun Li, Chair Professor of Logistics Management, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, lgtclli@polyu.edu.hk, Nicholas G. Hall

In organizing a project's tasks into work packages, tradeoffs arise. Defining small work packages increases project complexity and reduces economies of scale, whereas defining large work packages reduces concurrent processing and adversely affects cash flow. We study this tradeoff via an optimization model with an objective of minimizing total project cost, subject to a project deadline. Solution method and lower bound procedure are discussed. Computational study shows that our method routinely delivers near-optimal solutions that substantially improve on those found by benchmark procedures.

■ MA15

202B, 2nd Floor

IT Supportive Innovative Service Design

Sponsored: Service Science

Sponsored Session

Chair: Shih-Chieh Jack Hsu, PhD, National Sun Yat-sen University, National Sun Yat-sen University, Taiwan, jackshsu@mis.nsysu.edu.tw

1 - Interaction Quality of Human-Robot Collaboration- A Case Study of Da Vinci Surgical System

Shih-Yi Chien, PhD, National Sun Yat-Sen University, Kaohsiung, Taiwan, sychien@mis.nsysu.edu.tw, Po-Hung Lin

This proposed research takes the interdisciplinary point of view to systematically review the factors that influence human experience on interacting with robotic systems. More specifically, this study focuses on the interaction quality of human robot collaboration on Da Vinci surgical device. The overall objective of this research is to develop fundamental understanding of general principles pertaining to human intentions of interacting robotic systems and develop robust metrics to represent the potential attributes influencing interaction quality in various situations.

2 - The Influence of Color Online: Device as a Moderator

Fei-Fei Cheng, PhD, National Chung-Hsin University, Taichung, Taiwan, feifei.mis@gmail.com, Chin-Shan Wu, Ya-Han Wu

One of the most significant task for the online retailers is to attract more customers to buy products in one specific site. Current study focused on examining the influence of environmental stimuli (i.e., color) on consumer's emotional states of an online shop. A 2 (color: warm/ cool) x 2 (device: PC/mobile) between-subjects factorial design experiment was conducted. The result showed that: (1) Color significantly influence consumers' emotional responses. Warm color resulted in more positive responses than cool color; (2) device significantly moderated the relationship between color and emotion. Participants in warm color condition using mobile device show the most positive responses.

3 - The Imagination of Aboriginal Tribes Applying ICT to the Tourism of Service Design: A Case Study of the Inter-school Workshops Held by Laiji Tribe in Alishan Township

Shyh-Huei Hwang, PhD, National Yunlin University of Science & Technology, Yulin, Taiwan, hwangsh@gmail.yuntech.edu.tw, Hsiu-Ting SU

The development of ICT must still be built on the veins of aboriginal's traditional living wisdom, society, culture, and economy, and thus it carries its value and importance. Through a participatory action study, this study explored the potential opportunities and challenges of aboriginal tribes' development of ICT in the tourism of services design through workshops. The teachers and students from different school departments and some aborigines were grouped in an interdisciplinary way to discuss the feasibility of the combination of smart technology and aboriginal tribal tourism experience.

4 - Big Data Analysis of Travel Youtube Channel

Wei-Feng Tung, PhD, Fu-Jen Catholic University, Taipei, Taiwan, weifeng.tung@gmail.com, Jordan Griddin

Video content in today's world is now becoming significant on the Internet. YouTube is the leading social media platform for video content. Following the trends of the modern world, there is a growing connection between video content and travel, especially in the newer generations. This is important information for travel YouTubers and travel agencies to know when moving forward with building a stronger content strategy. Put simply, the main goal of this study is to figure out why and how famous personal travel channels became famous on YouTube. In this study, we can see all the key factors involved, using a social big data analysis approach for famous travel YouTubers.

■ MA16

203A, 2nd Floor

Scheduling Applications

Invited: Project Management

Invited Session

Chair: Rodrigo A. Carrasco, PhD, Universidad Adolfo Ibáñez, Ph.D., Santiago, 7941169, Chile, rax@uai.cl

1 - Approximation Algorithm for Job Shop Scheduling

Bruno Che Leon, Universidad Adolfo Ibáñez, Diagonal Las Torres 2640, Penalolen, Santiago, Chile, bcheleon@alumnos.uai.cl, Rodrigo A. Carrasco

The Job Shop Scheduling Problem is one of the most classic problems studied in the literature due to its applications in manufacturing. In this work, we propose a constant factor approximation algorithm using an interval-indexed integer formulation and the alpha-points technique. We analyze the algorithm

performance through simulations and using the instances of the OR-Library, showing that the gap between our algorithm and the optimal value is much smaller than the theoretical results.

2 - Salvage Logging After Wildfires using Mixed Integer Optimization

Magdalena Marín, Universidad Adolfo Ibáñez, Diagonal Las Torres 2640, Peñalolén, Santiago, Chile, magmarin@alumnos.uai.cl

During summer of 2017, Chile suffered from the largest wildfires in its history, affecting almost half a million hectares. In many cases, due to the speed of the fires, only the bark was burnt, leaving the majority of the tree standing and that could still be harvested. Although companies can make insurance claims on the burnt forest, they can be better off by harvesting some areas before the wood logs lose their value. We present a novel MIP, that helps make this decision, improving the cash position of the company by the end of the harvest.

3 - Resource Augmentation Algorithm for Underground Mine Production Scheduling

Rodrigo A. Carrasco, Professor, Universidad Adolfo Ibáñez, Diagonal Las Torres 2640, Of. 308, Edificio D, Santiago, 7941169, Chile, rax@uai.cl

Mine production scheduling has been historically a very manual process, but one of great importance, since it relates extraction capacity, costs, and the economical benefits of the mining process. In several extraction methods, the mine is segmented into blocks, and the planners need to determine when to extract each of them to maximize some metric, like net present value. We propose a novel modelling approach and approximation algorithm for this problem and we evaluate the performance through experiments using both simulated and real instances.

■ MA17

203B, 2nd Floor

Advanced Maritime Simulation Technologies

Invited: Maritime Operations

Invited Session

Chair: Haobin Li, PhD, National University of Singapore, 117576, Singapore, li_haobin@nus.edu.sg

1 - A Hierarchical Discrete Event Simulation Model for Mega Container Terminals

Haobin Li, National University of Singapore, 1 Engineering Drive 2, Singapore, 117576, Singapore, li_haobin@nus.edu.sg, Ph.D., Chenhao Zhou, Loo Hay Lee, Ek Peng Chew

When designing a mega container terminal, simulation plays a key role in evaluating proposed configurations and strategies in terms of the targeted key performance indicators (KPIs). To increase the scalability of the model and facilitate the integrability with optimization modules, in this work we proposed a hierarchical modelling paradigm that is suitable for simulation modelling of mega container terminals at different fidelity levels based on the O2DES.Net framework. With an open and modular structure, every terminal component with various fidelity models can be "plugged-and-played". This allows analysts from different backgrounds to conduct various types of analysis to meet their aims.

2 - Container Logistics Supported by Digital Platforms

Rob A. Zuidwijk, Erasmus University-Rotterdam, RSM Erasmus University, P.O. Box 1738, Rotterdam, 3000 DR, Netherlands, rzuidwijk@rsm.nl

We address the question of how the container logistics industry could make further use of multisided digital platforms, and what information services offered on such platforms could look like. We first discuss multisided digital platforms, the information services deployed on these platforms, and then consider container logistics services offered via the information services on the platforms. We connect with existing ongoing research to address the underlying research questions in detail.

3 - Simulation Optimization Approach on Traffic Considered Yard Allocation Problem in Automated Container Terminal

Qitong Zhao, National University of Singapore, Singapore, Singapore, isezha@nus.edu.sg

To improve the efficiency of the automated container terminals, we propose a simulation-based optimization approach to integrate the yard allocation problem (YAP) with vehicle congestion problem. YAP is formulated as a mixed integer programming model with the objective to reduce the total job travel time. A discrete event simulation model is developed to simulate the terminal operation and traffic movement within the terminal. The approach solves two models iteratively to improve the allocation decisions. Experiment results show that this approach can effectively generate yard allocation decisions which reduce the overall traffic time comparing with traditional intuitive rules.

4 - Modeling Agent-based Simulation with Event Relationship Graphs

Zhuo Sun, Dalian Maritime University, Dalian, China, mixwind@gmail.com

Agent-based simulation has been widely used in practice recently. However, it is difficult to effectively describe the system dynamics and predict behaviors of entities. On the other hand Event Relationship Graphs (ERGs) has been used as a convenient tool for analyzing discrete event simulation. This study presents how to model agent-based simulation with ERGs. A simple case is demonstrated and implemented by using the simulation framework MicroCity.

■ MA18

North Lounge, 3rd Floor

Recent Advances in Emergency Medical Service Management

Invited: Healthcare Systems and Applications
Invited Session

Chair: Yong-Hong Kuo, The University of Hong Kong, Hong Kong, yhkua@hku.hk

1 - Simulation Study on Improving Emergency Medical Service Response Time in Regions with High Population Disparity

Jiun-Yu Yu, National Taiwan University, No 85, Sec 4, Roosevelt Road, Department of Business Administration, Taipei, Taiwan, jyyu@ntu.edu.tw

This study aims to propose a dynamic resource allocation policy for Emergency Medical Service (EMS) in regions with high population disparity. Response time is one of the major key performance indicators in EMS system since rapid ambulance response provides patients better chances of recovering or surviving. Ambulances in this region used to park in separate fire stations and wait for the calls from emergency medical dispatch center (EMD). To minimize the response time without adding new ambulances, several dynamic resource allocation policies are designed and proposed by dispatching ambulance to patrol on the streets or stay at specific locations in the areas with high emergency events demand time slots. The synergy of potential hybrid models are also analyzed. A simulation model is developed to evaluate this dynamic resource allocation policy, and the results of this study show that time-region-specific ambulance cruising policy can significantly reduce the EMS response times.

2 - A Meta Algorithm for Reinforcement Learning to Solve Emergency Medical Service Resource Prioritization Problem

Kyohong Shin, KAIST, Yuseong-gu, 291 Daehak-ro, Daejeon, 34141, Korea, Republic of, hong906@kaist.ac.kr, Taesik Lee

We present a Markov Decision Process model for a patient prioritization and hospital selection problem, which is a critical decision-making problem in emergency medical service operation. Solving this model requires reinforcement learning due to its large state space. We propose a new approach, State Partitioning and Action Network, that enhances the scalability of RL algorithms. In this approach, we partition the state space into smaller subspaces to construct a reliable action network in the downstream subspace. This action network is then used in a simulation to approximate values of the upstream subspace. Experimental results show our approach can effectively address the scalability of RL algorithms.

3 - Simulation Analytics of Hospital Emergency Department Operations

Yong-Hong Kuo, The University of Hong Kong, Department of Industrial and Manufacturing Systems Engineering, The University of Hong Kong, Pokfulam Road, Hong Kong, yhkua@hku.hk, Janny M.Y. Leung, Colin Graham

This talk presents our work which uses simulation to analyze patient flows in a hospital emergency department (ED) in Hong Kong. This simulation approach provides a tool for the operations manager in the ED to assess the impact of changes in the system on the daily operations. We will discuss how simulation can be integrated into an optimization algorithm to aid decision-making. We will also present insights into managing ED operations derived from the simulation experiments.

4 - Integrated Operating Theater Scheduling with Recovery Resources for Elective and Emergent Surgeries

Hongru Miao, Institute of Systems Engineering, Dalian University of Technology, Dalian, 116023, China, mhruestc@mail.dlut.edu.cn, JianJun Wang

Operation scheduling is challenging due to the interaction of post-operative stage and uncertain arrival of emergent patients. We develop a 0-1 integer programming model and propose a single-day scheduling strategy which can 1) indicate the assignments and start times of scheduled elective operations; 2) ensure immediate transfers to PACU; 3) ensure the instant responses to emergencies. We demonstrate the effectiveness of this strategy via instances

generated from second-hand data and comparisons with common scheduling strategies. The sensitivity of this strategy for varying resources' capacity and managerial insights are also discussed.

■ MA19

South Lounge, 3rd Floor

Elderly Care Management

Invited: Healthcare Management
Invited Session

Chair: Zoie Shui-Yee Wong, PhD, St. Luke's International University, 5/F, 3-6-2 Tsukiji, Chuo-ku, Tokyo, 104-0045 Japan, Tokyo, 1040045, Japan, zoiesywang@gmail.com

1 - Future Home Care Services Usage under Japan Super-aging Society

Zoie Shui-Yee Wong, Associate Professor, St. Luke's International University, 5/F, 3-6-2 Tsukiji, Chuo-ku, Tokyo, 104-0045 Japan, Tokyo, 104-0045, Japan, zoiesywang@gmail.com

Home care (HC) is particularly important for older-aged frail elderly while they only remain restrained physical and cognitive functions. From 2008 to 2014, the rate of increase of home care services seeking was 6.7 times faster than the rate of aged population growth. This study aims to project the future demand for home care services in the coming five decades via population projection methods and secondary data analysis of national population projections and reported statistics. We assume the age-specific HC service seeking rates obtained from the baseline year remained constant and project the number of future HC services based on the change in age structure of the future Japan population. Our preliminary finding indicates that the monthly HC services usage in 2064 would reach 6.7 times more than that of in 2014. Population aging could result dramatic effects on future home care services demand, that requires research attentions for better home care services planning.

2 - Classification of Textual Patient Safety Reports using Deep Neural Network Method

Jiaqi Zhou, City University of Hong Kong, jiaqi.zhou@my.cityu.edu.hk, Zoie Shui-Yee Wong, Qingpeng Zhang

This study aims to develop an efficient framework for high-performing textual data classification via deep neural network (DNN) method. We collected 227 textual patient safety reports from Canadian Patient Safety Institute's Global Patient Safety Alerts system and developed a textual data classification framework that consists of a standard natural language processing (NLP) component and a random search component for deep learning hyper parameters tuning. The results of classification were evaluated by area under curve (AUC) of receiver operating characteristics (ROC) through 10-fold cross validation. Preliminary findings showed that this framework achieved well performance in classifying the patient safety reports and a mean AUC of above 95% was achieved. Further studies and experiments will be carried out with other textual data sets of patient safety reports in other languages. This study indicates the DNN may achieve good performance and robustness in textual patient safety reports classification.

3 - AI for Smart City Health Applications

Kylie Wall, QSPectral Systems, 2/125 Bulimba Street, Bulimba, 4171, Australia, kylie.wall@qspectral.com.au, Sanjeev Naguleswaran

As populations age, providing adequate level of services such as health care within financial and infrastructure constraints is challenging. Leveraging technology to streamline the delivery of these services is a necessary option. For example, telehealthcare over a smart city communications network would allow at-risk people to live and receive services at home with greater safety and health outcomes while alleviating the burden on hospital infrastructure. In order to accomplish this remote delivery of healthcare we propose and will demonstrate data driven methods leveraging AI. We also discuss the ability of AI to compensate for network quality disparities in order to provide equitable care.

4 - A Study on the Quality Management Strategy of Senior Day Care Centers in Tainan

Chien-Chih Liu, National Cheng Kung University, Tainan, Taiwan, ericiu1127@gmail.com, Ching-Ying Huang

"Aging in Place" refers to the elderly people who are taken care by their family and community. However, when the elderly people go back to their community, it causes another problem. A lot of family members who need to work during daytime cannot take care the elderly people by themselves. Senior day care centers become a solution for this issue. Therefore, it is important for institutions to know how to improve their service quality. The purpose of this study is to investigate the management strategy and the quality of them. The research will use a case study and in-depth interview to understand it and provide some recommendations for senior day care centers to improve their quality in the future.

■ MA20

401, 4th Floor

Behavioral Decision Making

Sponsored: Decision Analysis

Sponsored Session

Chair: Liangyan Wang, Jiao Tong University, Shanghai, 200052, China, WLY@sjtu.edu.cn

1 - Behavioral Decision Making

Liangyan Wang, Jiao Tong University, 535 Fahuazhen Road, Room 406, Shanghai, 200052, China, WLY@sjtu.edu.cn, Qin Wang, Eugene Chan, Robin Keller

In the current investigation, we examine consumers' preference and purchase intentions for genuine products after they are caught using counterfeit versions. We show in five studies that consumers with an interdependent self-construal increase their preference for genuine products when caught using counterfeit symbolic (vs. functional) products.

2 - How CEO Humility Affects Green Innovation? Lessons from China

Daxin Sun, Shanghai Jiao Tong University, Shanghai, 200030, China, sundaxin@sjtu.edu.cn, Saixing Zeng, Han Lin, Liangyan Wang, Mingchuan Yu

Grounded in the upper echelons theory, this study establishes a link between CEO humility and green innovation within Chinese context. We first develop the theoretical argument that CEO humility is positively related to a firm's green innovation. Then the mediating mechanism connecting CEO humility to green innovation is explored by studying whether CEO humility affect green innovation through the channel of green business strategy. Finally, we investigate the boundary condition of green business strategy and how these relationships are moderated by the integration of marketing and technology. Our hypotheses will be tested on the manufacturing firms located in Yangtze River Delta region in China.

3 - Conflating Temporal Advancement and Epistemic Advancement: The Progression Bias in Judgment and Decision Making

Haotian Zhou, ShanghaiTech University, Shanghai, China, zhouht@shanghaitech.edu.cn, Jessica Sim, Xilin Li

When seeking out the truth about a certain aspect of their world, people frequently conduct two or more inquiries successively over a time span. Typically, later inquiries improve upon earlier ones; thus, it is typically rational to expect the findings of a later inquiry to be closer to the truth than that of an earlier one. However, when no substantive differences exist between earlier and later inquiries, later findings should not be considered epistemically superior. Yet, we find that people continue to regard later findings as closer to the truth than earlier ones in these cases. In nine experiments, when later inquiries conflicted with - but did not epistemically improve upon - earlier inquiries, participants' inferences about the truth aligned more with later findings than earlier ones, an effect referred to as progression bias. This bias for later inquiries has serious ramifications for the well-being of society and its members.

■ MA21

Joy, 4th Floor

Best Practices in Business and Big Data Analytics

Invited: Circular Economy

Invited Session

Chair: Roger R Gung, University of Phoenix, University of Phoenix, Phoenix, AZ, 85048, United States, roger.gung@phoenix.edu

1 - Marketing Lead Prioritization

Roger R Gung, University of Phoenix, 3842 E. Windsong Dr., Phoenix, AZ, 85048, United States, roger.gung@phoenix.edu

Marketing inquiries/leads (potential customers) entering the marketing funnel that might have relatively low expected value and don't justify the marginal costs. The objective of this project was to identify these low-converting, low-retaining customers at RFI (request-for-information) stage and not pursue them, thereby driving operational cost savings while minimizing the impact to revenue. We developed advanced statistical models that predict conversion and retention using data available at RFI stage, combined them into an expected value, and integrated marginal costs to define criteria for the 'Do Not Pursue' population. About 10% of leads fall under the defined threshold and, if not pursued, will conservatively have a net impact of \$6-10M revenue with cost savings of \$25M per year.

2 - Mixture Hidden Markov Models for Sequence Analysis of Blood Donation Behavior

Dyantika Putry Mahmud, National Taiwan University of Science and Technology, Taipei, 10607, Taiwan, dyantikapm@gmail.com, Shi-Woei Lin

How to maintain stable supply of blood and to promote blood donors to donate regularly has been an important issue in a health care system. This study aims to use the sequence clustering methods based on Markov Models to investigate blood donors' donation trajectories to categorize blood donors based on their donation behaviors and to investigate the associations between donors' characteristics and their behaviors. By analyzing the data containing the donation history from year 2010 to 2014 for all donors in northern Taiwan, blood donors can be segmented based on their donation trajectories. In particular, in order to create more actionable insights, this study also tries infer from the recorded activities of the donors to those hidden states and path across those states. Through identifying the segments of blood donors and the corresponding key transition behaviors in their donation trajectories, the study can help blood centers to make better managerial interventions such as designing better reminding mechanisms or recruitment strategies.

3 - Model for Joint Decision of Pricing and Inventory Policy in Extended Dual Channel Supply

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The paper proposes a model to study about joint decision between pricing and inventory policy in extended dual channel supply chain. Two important variables, namely price and order quantity are used to coordinate an extended dual channel supply chain structure consisting of offline, online, and reseller channel. And EOQ model is added to establish the total gain of each channel and evaluate the financial performance of each scenario observed, namely non-cooperative, semi-cooperative, and fully-cooperative scenario. The result indicates that there is a positive relationship between order quantity in online channel and optimal price in offline channel. Contrarily, there is negative relationship between customer acceptance ratio of online channel and optimal price in offline channel. In addition, the demand function in online channel is higher than demand function in reseller channel in the same rate of increasing.

4 - A Multi-agent Non-rail Logistics System for Flexible In-plant Supply Chain

Chia-Ching Liang, National Dong Hwa University, No. 1, Sec. 2, Da Hsueh Rd., Hualien, 97401, Taiwan, 610132052@gms.ndhu.edu.tw, Chih-Peng Chu, Che-Ming Chen

To establish the route for the milk run is a big challenge for flexible manufacturing, especially when the in-plant space is limited. Several directions have been discussed includes internal layout design, storage assignment methods, routing methods, order batching, and zoning. This study adopts the knowledge-based auto-drive concept to propose a new multi-agent non-rail logistics system for managing the material flow among workstations.

■ MA22

Elegance, 4th Floor

Fintech and Mobile Service

Invited: Fusions of Big Data, AI, Blockchain and FinTech Applications

Invited Session

Chair: Shu-Ping Lin, CTBC Business School, Tainan City, 709 R.O.C., Taiwan, splin@ctbc.edu.tw

1 - A Comparison of Mobile-payment Models Service Quality Classification between gApple Pay and Line Pay

Wan-Ju Liang, CTBC Business School, CTBC Business School, Tainan City, 709 R.O.C., Taiwan, silvia.liang@ctbc.edu.tw, Shu-Ping Lin

With the development of FinTech, it has been investigated a considerable efforts in developing mobile payments system to increase the efficiency and effectiveness in the financial services industry. The mobile payments system refers the apps in mobile handset or social media to complete the transaction and money transfer. However, each mobile payments system may target different customers who may have various demand and expectation of service quality. This research adopt the moderated regression approach to identify the types of service demand and further explore the service demand of each mobile payments system. The managerial implication is provided for the service manager and research in the future.

2 - A Study on Exploring the Customer's Lifestyle for Catering Services Lifestyle in the Restaurant Industry

Ming-Chun Tsai, CTBC Business School, Tainan City, 709 R.O.C., Taiwan, mctsaic@ctbc.edu.tw, Ching-Chan Cheng, Ya-Yuan Chang, Cheng-Ta Chen

The restaurant consumers have often their own preferences and habits for catering services. The above information will help market segmentation for the restaurant industry, and to develop service strategies for different consumer groups. This study classifies restaurant customers based on the catering services lifestyle, and further analyze the differences in the preferences and habits for catering service among each groups.

3 - Key Determinants to the Fintech Market in Asia and its Development

Wen-Cheng Hu, CTBC Business School, Tainan City, 709 R.O.C., Taiwan, wencheng@ctbc.edu.tw, Areerats Muangkote

The development of fintech, or financial technology, has given Asia a more exciting economic future. This study aimed at the economic and technological determinants to motivate startups and entrepreneurs consider changing to revolutionize fintech. The finding implies that fintech startup formations will be the opportunity for entrepreneurs, hence the active policies can influence the emergence of fintech startup formations. In addition, the last technology will relate with fintech startups in the country and also investigates labor force in fintech industry that might have a positive impact.

4 - A Study on Kano Model and the Deficiency Identification for Mobile Service Quality of Health Clubs

Chien-Chung Teng, Chung Hua University, Hsinchu City, Taiwan, g5007@ms32.hinet.net, Ming-Chun Tsai

This study utilized the moderated regression model and KIPGA method to classify Kano two-dimensional quality for mobile service quality of health clubs. The findings showed that the Kano two-dimensional quality of mobile service quality of health clubs. Furthermore, this study identified the key deficiency of mobile service quality of health clubs. Finally, this study developed the improvement strategies of upgrading the health club service quality.

Monday, 10:00AM - 10:50AM

■ Plenary- John Buzacott

Plenary Room/Banquet Hall, 3rd Floor

Plenary: Improving Manufacturing Systems by Understanding Variability

Plenary Session

1 - Improving Manufacturing Systems by Understanding Variability

John Buzacott, York University, Toronto, ON, Canada, Buzacott

Henry Ford introduced the moving belt assembly line just over a hundred years ago. For the next fifty years the preferred way of organizing manufacture was to have tightly coupled work stations linked by a material handling system. However, gradually it became apparent that neither the moving belt assembly line, or the traditional job shop it replaced, were ideal. Since then there have been major attempts to come up other ways of organizing manufacture. Key to understanding why these developments occurred is to recognize that they attempt to overcome the impact of variability and disturbances on productivity and quality. As each new development has been tried, new insights into the nature of the variability that limits its performance have arisen and this in turn has led to new system designs. In this talk I will outline these developments and illustrate the way in which formal system models augment understanding of what limits their performance. I begin by considering the advantages of the moving belt line. I address what happens when the line consists of machines rather than people. Next, I consider group technology, extending the line concept to multi product situations. Alternatively, job shops can be improved, leading to flexible manufacturing systems (FMS). But FMS did not live up to their promise and I show why. Quality became a big issue in the 1980s leading to new system designs. However, these revealed the significance of differences between worker performance, leading to new challenges in system design and control.

Monday, 11:00AM - 12:30PM

■ MB01

101A, 1st Floor

Topics in Logistics and Transportation

Invited: Pricing and Revenue Management

Invited Session

Chair: Yihong Hu, Tongji University, Tongji University, Shanghai, 200092, China, yhh@tongji.edu.cn

1 - Joint Replenishment And Transshipment For Three Locations – Asymptotics And Bounds

Weifen Zhuang, Xiamen University, Xiamen, China, wfzhuang@xmu.edu.cn, David D. Yao, Sean X. Zhou

A common problem faced by many firms in their supply chains involved two decisions: the one-time stocking decision at the beginning of the season and the supply/transshipment decision throughout the season. Applying a stochastic dynamic programming (DP) formulation to a three-location model with compound Poisson demand processes, we identify the optimal supply/transshipment policy and show that the optimal initial stocking quantities can be obtained via maximizing a concave function. While due to the curse of dimensionality of the DP, we study two downward transshipment models and characterize the optimal policies. To overcome this handicap, we develop upper and lower bounds on the DP value function. Analysis on the bounds enables us to conclude that the error of both bounds improves as T increases, and the optimal order solutions almost coincide with the upper bound solutions.

2 - Strategic Decision of the Platform's Logistics Service Openness to the Third Party Sellers

Yihong Hu, Shengnan Qu, Tongji University, Shanghai, China. Contact: shnqu@tongji.edu.cn

We studies the strategic decision of the platform's logistics service openness to the third party sellers under both positive and negative spillovers from online sales to the traditional sale. We try to answer whether or under what conditions should the platform to provide logistics service to his competitive third-party sellers. We show that a Pareto improvement is possible for the platform and the sellers when product competition is intense and delivery service cost coefficient is moderate. The logistics service openness strength the platform's market position and ensures optimal pricing and demand is not influenced by the product competition level. Our analysis offer insights into the incentive that drive the platform to open its logistics service.

■ MB02

101B, 1st Floor

Inventory Management I

Invited: Supply Chain Inventory Management

Invited Session

Chair: Lucy Gongtao Chen, National University of Singapore, National University of Singapore, 119245, Singapore, bizcg@nus.edu.sg

1 - To Ration or Not to Ration: Availability Management with Scarcity Effects and Strategic Customers

Stephen Shum, City University of Hong Kong, Department of Management Sciences, Kowloon, Hong Kong, swshum@cityu.edu.hk, Hanqing Liu, Peng Hu

We study product availability management problem of a firm who repeatedly introduces new generations of a product over time, selling to strategic customers who are also affected by scarcity effects. In particular, customers have a higher utility for a generation if a generation is in shortage (direct scarcity effect). Customers also compare availability of the current generation to availabilities of past generations and have a higher utility if the current generation is more scarce than past generations (relative scarcity effect). We focus on whether it is optimal for a firm to intentionally induce scarcity.

2 - Optimal Periodic Flexible Policies for Two-stage Serial Supply Chains

Fang Liu, Nanyang Technological University, S3-B2a-13,
50 Nanyang Avenue, Singapore, 639798, Singapore,
liu_fang@ntu.edu.sg, Srinagesh Gavirneni

In a two-stage serial supply chain, a periodic flexible policy (PF policy) allows the retailer to receive fixed orders that may depend on demand history in one period of the ordering cycle and order freely in other periods. Existing literature has shown that certain PF policies can significantly reduce the inefficiency in a decentralized supply chain. However, these works have mostly defined and implemented ad-hoc periodic flexible policies and have not attempted to identify the optimal periodic flexible policies. In this paper, we characterize the structure of the optimal PF policy using calculus of variations. In particular, we show that under the optimal PF policy, the retailer receives shipments either according to a state dependent capacitated policy or a state dependent order up to policy. Furthermore, we can approximate the retailer's optimal restricted ordering function by a piecewise linear function and show numerically that this approximation is near optimal.

3 - A Transformation Technique to Analyze Inventory Problems with Random Supply Capacities

Xiangyu Gao, Hong Kong, xiangyu@cuhk.edu.hk, Xin Chen,
Zhan Pang

In the literature, for many inventory problems with random supply capacities, a common technical issue in the analysis is that the optimization problem derived from the dynamic programming is not convex. To deal with this technical challenge, we study a class of stochastic optimization problems with decisions truncated by random variables. We develop a transformation technique to convert the original non-convex problems to equivalent convex ones. Our transformation allows us to prove the preservation of some desired structural properties, such as convexity, submodularity, and L-natural-convexity, under optimization operations, which are critical for identifying the structures of optimal policies and developing efficient algorithms. We demonstrate the applications of our approach to several important models in inventory control.

4 - Strategic Inventory in Supply Chains With Bargaining

Lucy Gongtao Chen, National University of Singapore, NUS
Business School, Biz 1 Mochtar Riady Building, #8-60, Singapore,
119245, Singapore, bizcg@nus.edu.sg, Weijia Gu

We investigate the existence and effect of strategic inventories for a supply chain under a bargaining framework and compare the results to those under a Stackelberg game. We then introduce supply chain competition into the system and study how the impact of strategic inventories changes.

2 - Characterization of Air Traffic Management Operations Based on Large-scale Flight Tracking Data

Lishuai Li, City University of Hong Kong, Tat Chee Avenue,
P6606, AC1, Kowloon, Hong Kong, lishuai.li@cityu.edu.hk

Air Traffic Management (ATM) strategies and procedures varies significantly by region. Comparing the characteristics of ATM in different regions could help us understand what works better and how to improve. However, few studies have done so due to lack of data in the past. Operational data rarely shared between national or regional agencies due to technical and regulatory barriers. With Automatic Dependent Surveillance - Broadcast (ADS-B) adopted by many countries, it is possible for the first time to track and analyze aircraft movement data at global scale. Several flight tracking service providers can provide such data. In this talk, I will present case studies to characterize actual ATM operations, i.e. network structure and dynamics, flow patterns, etc., via a data-driven approach. The analysis result will allow Air Navigation Service Providers to understand the current operation better, identify deficiencies in procedures, and provide recommendations for improving system capacity and efficiency.

3 - A Prediction Risk Model of Colorectal Polyps for Preventive Healthcare

Chen-ju Lin, Phd, Yuan Ze University, Taoyuan, Taiwan,
chenju.lin@saturn.yzu.edu.tw, Tsung-Hsing Chen, Chieh Lee

Colorectal cancer is the second cause of cancer deaths in Taiwan. Many colorectal cancer arises from polyps. Early detection of colorectal polyps with proper treatments may interrupt the development of colorectal cancer. Colonoscopy is the most popular screening method of colorectal polyps. However, colonoscopy is invasive and may cause serious complications. This research uses random forest to build the prediction risk model of colorectal polyps based on the other noninvasive health examinations. The proposed model can assist physicians in screening the people who are at high risk of colorectal polyps and require colonoscopy examination for preventive healthcare.

4 - The Effects of Social Interactions in Online Health Communities on the Emotions of Depression Patients

Qingpeng Zhang, City University of Hong Kong,
83 Tat Chee Avenue, 6/F, Academic 1, Kowloon, 12180,
Hong Kong, qingpeng.zhang@cityu.edu.hk, Jiaqi Zhou

Social media-based online health communities (OHCs) present a new platform for patients to seek social support, particularly for depressive patients. In this talk, we will introduce our research on characterizing the effect of social interactions in OHCs. We collected the full data of a major Chinese OHC. Quantitative analyses revealed that the social interactions with other patients in OHCs could positively influence the emotion of patients with depression.

■ MB03

101C, 1st Floor

Big Data Analytics on Healthcare and Transportation Applications

Invited: Machine Learning and Big Data Analytics

Invited Session

Chair: Kwok-Leung Tsui, City University of Hong Kong,
City University of Hong Kong, Hong Kong, klttsui@cityu.edu.hk

1 - Assessing Railway Track Health via Image Data Analytics

Zijun Zhang, City University of Hong Kong, P6618, 6/F, Academic
1, 83 Tat Chee Avenue, Hong Kong, zijzhang@cityu.edu.hk

A double-layer data-driven framework for the automated vision inspection of the rail surface cracks is proposed in this paper. Based on images of rails, the proposed framework is capable to detect the location of cracks firstly and next automatically obtain the boundary of cracks via a feature-based linear iterative crack aggregation (FLICA). Extended Haar-like features are applied to develop significant features for identifying cracks in images. Built on extended Haar-like features, a cascading classifier composed of a sequence of stage classifiers trained by the LogitBoost algorithm is employed to identify cracks. Based on the developed cascading classifier, a scalable sliding window is utilized to locate cracks in images of rail tracks, which is identified by the Otsu's method. After completing the crack registration in the first layer, the FLICA is applied into discovering boundaries of cracks. The effectiveness of the proposed data-driven framework for identifying rail surface cracks is validated with the rail images provided by the China Railway Corporation. Two benchmarking methods, the Otsu's method and mean shift, are utilized to further prove advantages of the proposed framework. Results of the validation and comparative analyses demonstrate the success of the proposed framework in the rail surface crack registration and identify its boundary.

■ MB04

101D, 1st Floor

Integrated Simulation and Optimization

Sponsored: Simulation

Sponsored Session

Chair: Haobin Li, National University of Singapore, Singapore, 117576,
Singapore, li_haobin@nus.edu.sg

1 - The Convergence Analysis of an Efficient Multi-fidelity Optimization Method

Jie Song, Peking University, No 5 Yiheyuan Road, Haidian District,
Beijing, 100871, China, songjie@coe.pku.edu.cn, Yunzhe Qiu,
Fan Zhang, Jie Xu

Simulation optimization provides a generally applicable optimization method for systems that are intractable to traditional methods. However, simulation optimization faces great challenges when simulations are very time-consuming. In this paper, we study a recently proposed framework that utilizes information from multi-fidelity models to improve the efficiency of simulation optimization. We propose an optimal sampling policy that minimizes the expected optimality gap and thus optimally uses a limited computation budget. We derive an upper bound for the new optimal sampling policy and compare it with other sampling policies to demonstrate the efficiency of the new optimal sampling policy.

2 - Bits and Bytes in March Madness

Sheldon H Jacobson, University of Illinois, Department of
Computer Science, 201 N. Goodwin Avenue MC258, Urbana, IL,
61801-2302, United States, shj@illinois.edu, Douglas King, Ian
Ludden, Nestor Bermudez Sarmiento

The main bracket for the NCAA Division I Men's Basketball Championship Tournament can be modeled as a 63-bit string. We use this representation to generate sets of brackets based on historical patterns. Since this is done with no knowledge of the teams, most of the brackets in the sets are not particularly close to the actual outcome. However, simulation experiments suggest that, as the number of brackets in the set grows, these bit string generators produce "nuggets" that would rank among the ESPN Top 100 brackets, including brackets that would rank first. We reports results of this approach for recent tournaments, and compare these "nuggets" to the scores reported in the ESPN Bracket Challenge.

3 - On Finite-budget Allocation for Nested Simulation

Kun Zhang, City University of Hong Kong, Kowloon, Hong Kong, kunzhang6-c@my.cityu.edu.hk, Guangwu Liu, Shiyu Wang

The problem of estimating a risk mapping of a conditional expectation can be formulated as a nested simulation problem, which usually proceeds in two levels. In the outer-level, one simulates a number of risk scenarios, and then given each scenario, one simulates a number of samples in the inner-level which are used to approximate the conditional expectation. However, it is still a difficult issue on how to allocate a fixed amount and finite computational budget to the two levels of nested simulation. In this paper, we propose a finite-budget allocation algorithm to address this issue, so that nested simulation can be used in an efficient manner. We further study interval estimation under the nested simulation framework, and establish central limit theorems, based on which we construct confidence intervals. Numerical results illustrate that the proposed algorithms perform well in both the point estimation and interval estimation.

4 - Optimal Computing Budget Allocation for Top Designs Selection with Pairwise Comparisons

Si Zhang, Shang-Da Road No. 599, Shanghai, China, zhangsi817@sina.com, Yijie Peng, Chun-Hung Chen

In this work, we mainly consider the optimal subset selection problem under pairwise comparisons. Based on the optimal computing budget allocation framework, we model this problem and derive the respective optimal allocation rule for it.

■ MB05

102, 1st Floor

Practice IV

Sponsored Session

Chair: Ranganath S. Nugehalli, UPS, 2311 York Road, Timonium, MD, 21093-2215, United States, RNugehalli@ups.com

1 - ML/AI Analytics for Connected Equipment: An Example of Industrial IoT

Young M Lee, Johnson Controls, 5 The Pines, Old Westbury, NY, 11568, United States, young.m.lee@jci.com

With the advanced of IoT technology, more and more industrial equipment bare now connected with numerous sensors that collect the operational data in real time. Algorithms in Machine Learning (ML), Deep Learning (DL) and Artificial Intelligence (AI) are becoming easily accessible to convert these data into business values and improvement of the quality of life. Johnson Controls is a global leader in buildings, energy and security market. We are shaping the future to create a world that's safe, comfortable and sustainable. Our global team creates innovative, integrated solutions to make cities more connected, buildings more intelligent and environment safer. More and more our equipment that we sell and service around the world such as chillers, boilers, air handling unit, rooftop unit, refrigeration units, energy storage system and security systems, are being equipped with sensors and send real time data to the cloud, where ML/DL/AI tools analyze the data and make the operations safe and cost-effective. The IoT analytics we are developing include predictive asset management, operational optimization, risk analysis and energy optimization. This talk will describe Johnson Controls' IoT analytics and how they are helping our clients reducing maintenance costs, reducing energy costs, improving the life of equipment, improving service level and improving security and comfort of occupants.

2 - UPS Optimizes Delivery Routes

Ranganath S. Nugehalli, Principal Scientist, UPS, 2311 York Road, Timonium, MD, 21093, United States, RNugehalli@ups.com

UPS, the leading logistics provider in the world, and long known for its penchant for efficiency, embarked on a journey to streamline and modernize its pickup and delivery operations in 2003. This journey resulted in a suite of systems, including ORION (On Road Integrated Optimization and Navigation) optimization system. Every day, ORION provides an optimized route for each of UPS' 55,000 U.S. drivers. The system creates routes that maintain the desired level of consistency from day to day. To bring this transformational system from concept to reality, UPS instituted extensive change management practices to ensure that both users and executives would accept the system. Costing more than \$250 million to build and deploy, ORION is estimated to save UPS \$300 to \$400 million annually. ORION is also contributing to the sustainability efforts of UPS by reducing its CO2 emissions by 100,000 tons annually. By providing a foundation for a new generation of advanced planning systems, ORION is transforming the pickup and delivery operations at UPS.

■ MB06

103, 1st Floor

Tutorial: Model-Based Optimization for Operations Research: Best Practices and Current Trends

Tutorial Session

1 - Model-Based Optimization for Operations Research: Best Practices and Current Trends

Robert Fourer, AMPL Optimization Inc., 2521 Asbury Ave, Evanston, IL, 60201, United States, 4er@ampl.com

In this tutorial, we will illustrate the big data analytics lifecycle and share our practices leveraging advanced big data analytics and machine learning techniques to grow business at LinkedIn. You'll learn how to empower business partners to access insights whenever needed, how to optimize business performance by leveraging unique data, and how to innovate for sustainable business growth.

■ MB07

105, 1st Floor

Information Management in Supply Chains

Invited: Operations and Decisions in Smart Manufacturing and Logistics

Invited Session

Chair: Weixin Shang, Lingnan University (HK), SEK212/3, Lingnan University (HK), 8 Castle Peak Road, Tuen Mun, N.T., Hong Kong, wshang@ln.edu.hk

1 - Supplier Audit Information Sharing and Responsible Sourcing

Yunjie Wang, Renmin Business School, Beijing, China, wangyunjie@rmbs.ruc.edu.cn, Albert Y Ha, Weixin Shang

We develop a game-theoretic model to study the incentive for competing manufacturers to share supplier audit information in a market with some consumers who boycott a manufacturer if supplier responsibility violations occur. Based on the audit information, each manufacturer either continues to source from an existing common supplier who has uncertain responsibility risk, or switches to a new supplier who has no responsibility risk but charges a higher price. We characterize the manufacturers' equilibrium audit information sharing decisions and sourcing strategies, and show how they depend on the model parameters.

2 - Information Sharing Between Competitors with Endogenous Timing in Production

Tian Li, East China University of Science and Technology, Room 601, Building 9, JingHuaFang, No. 266 ZhuMei Road, Shanghai, 200237, China, litanust@163.com, Huajiang Luo, Weixin Shang

Two firms produce substitutable goods and compete in quantity. The routine firm's production time is fixed, while the strategic firm's production time can be before, simultaneously with, or after the routine firm. Each firm has private demand information and decides whether to disclose it. When the demand uncertainty is not high, both firms sharing information is the unique equilibrium. Exactly one firm sharing information can arise in equilibrium when the demand uncertainty is intermediate. When the competition becomes more intense, firms are more willing to share information.

3 - Duopolistic Positioning and Pricing Competition with Variety-Seeking and Strategic Customers

Weixin Shang, PhD, Lingnan University, Hong Kong, shangwx@ln.edu.hk, Shilu Tong, Yunjie Wang

We examine a duopolistic market with two firms competing on positioning and pricing for customers who are variety-seeking or non-variety-seeking, and strategic or myopic. Contrary to the conventional wisdom that variety-seeking customers are less profitable customers, we find that firms may benefit from more variety-seeking customers under both price commitment and dynamic pricing when some of these customers are myopic. Strategic customer behavior intensifies competition and hurts the firms. Under each pricing scheme, either myopic variety-seeking customers or non-variety-seeking customers can be the most profitable customer group.

■ MB08

201A, 2nd Floor

Tutorial: Machine Learning and Big Data Analytics**1 - Machine Learning and Big Data Analytics**

Eva Lee, Georgia Tech, Atlanta, GA, evakylee@isye.gatech.edu

The effect of big data is being felt everywhere, from business to science, from government to the arts. Information has gone from scarce to overabundant. This makes it possible to do many things that previously could not be done: uncover business trends, prevent diseases, combat crime, plus a multitude of other possibilities. Harnessing the data well may bring huge and innovative benefits, unlock new sources of economic value, provide fresh insights into science and provide policy makers with solid and convincing evidence to support their stands. Yet critical challenges lie ahead, including data security, privacy, and yet-to-be-discovered technology to effectively and efficiently analyze the data for business innovation. Multi-source data system modeling, machine learning and big data analytics play an increasingly important role in modern business enterprise. Many problems arising from multi-source data can be formulated into mathematical models and can be analyzed using sophisticated optimization, decision analysis, and computational techniques. In this tutorial, we will discuss various machine learning technologies, and share some of our successes in healthcare, defense, and service sector applications through innovation in predictive and big data analytics.

■ MB09

201B, 2nd Floor

Cyber-physical Systems and Industry 4.0 for Manufacturing and Service Industries

Invited: At the Nexus of Technology, Health and Productivity

Invited Session

Chair: Ta-Cheng Chen, Asia University, Taichung, Taiwan, tchen@nfu.edu.tw

1 - A Deep Consumer Analysis System Over the Mobile Communication Industry

Ta-Cheng Chen, Asia University, Taichung, Taiwan, tchen@nfu.edu.tw

Due to the evolution of mobile device and the impact of online shopping, the sales of different brands of consumer electronics products in the market have become quite competitive with each other. Therefore, a deep learning based consumer behavior analysis approach has been proposed for the telecom retail industry in this study. It is to help these companies understand their customers, as the general online store will do. The analysis system can provide various significant information, such as customer experience, browsing times, customer revival and the product popularity.

2 - Streaming Data Analysis Framework for Cyber-Physical System of Manufacturing Processes

Chao-Lung Yang, National Taiwan University of Science and Technology, Taipei, Taiwan, clyang@mail.ntust.edu.tw

Online monitoring and offline batch analyzing the data stream obtained from manufacturing site are the core technology of Cyber-Physical System (CPS). In this research, the data analysis framework consist of supervisory control and data acquisition is proposed. By integrating signal smoothing and anomaly pattern detection techniques, the significant patterns can be discovered and stored for further usage in CPS application.

3 - A High-capacity Tamper Detection Algorithm for Authenticating 3D Models

Yuan-Yu Tsai, Asia University, Taichung, Taiwan, yuysai@asia.edu.tw

This study proposes an effective tree-based authentication algorithm for 3D models. First, we adopt a binary partitioning tree to subdivide the bounding volume of the input model into voxels. Each vertex can then be encoded into a series of binary digits, denoted as its authentication code, by traversing the constructed tree. Finally, above authentication code is embedded into the corresponding vertex based on the message-digit substitution table. Extensive experiments demonstrate the feasibility of the proposed algorithm.

4 - Microstructure Control via the Help of Thermal Field Simulation by Electron Beam Melting

Yao-Cheng Wu, National Sun Yat-Sen University, Taipei, Taiwan, Yao-Cheng Wu

Electron beam melting (EBM) technology is one of the powder bed fusion 3D printing technologies. However, it is hard to control the microstructure of the EBM sample due to the thermal history is hard to link with the complex process parameter. In this study, a thermal field simulation model was built and applied to help the prediction of the EBM Ti64 microstructure.

■ MB10

201C, 2nd Floor

Logistics Operation Analytics and Optimization

Invited: Operations Analytics and Optimization for Manufacturing, Logistics and Energy Systems

Invited Session

Chair: Gongshu Wang, Northeastern University, Shenyang, Liaoning, 110819, China, wanggongshu@ise.neu.edu.cn

Co-Chair: Defeng Sun, Northeastern University, China, Shenyang, 110819, China, cdfsun@gmail.com

1 - Solving Order Batching Problem in Aluminum Industry

Gongshu Wang, Northeastern University, NO 11, Lane 3, Wenhau Road, Heping District, Shenyang, Liaoning, 110819, China, wanggongshu@ise.neu.edu.cn, Shucheng Zhao, Lixin Tang

The market demand for aluminum products tends to be diversified and customized. To meet customer's special requirements on product quality, the aluminum manufacture company traditionally designs a dedicated ingot type for each order. The increase in the number of ingot types presents new challenges to the production planning. To resolve the contradiction between the customization requirement and the batch production mode of the large equipment, the aluminum manufacture companies have to transit to the mass customization production mode. Using a fewer number of standard ingot types to satisfy the requirement of product diversity is a key issue for production planning under mass customization. This paper address a batching problem encountered in aluminum industry that is to select a pre-specified number of standard ingot types from the candidate pool to fill current orders and combine items of different orders into batches. A column generation based exact algorithm is developed to solve the problem.

2 - Locomotives Routing of Molten Iron Transportation to Minimize the Energy Consumption

Baobin Huang, Northeastern University, Shenyang, China, huangbaobinyc@163.com, Defeng Sun, Gongshu Wang, Lixin Tang

The transportation of molten iron is an important part which influences the consecutiveness of production in iron and steel enterprises, consists of the pickup and delivery of loaded or empty torpedo cars by locomotives. We focus on finding a good route for each locomotive with minimum energy consumption and no violating of time window constraints. We first create a heuristic to obtain a feasible solution. Then we use a bounding procedure to get a lower bound and a better feasible solution. According to the result of the first bounding procedure, the second bounding procedure is performed to strengthen the lower bound. At last, a branch and price algorithm is used to get optimal solution.

3 - Material Handling Problem in Bulk Material Yard

Defeng Sun, Northeastern University, China, No.11, Lane 3, Wenhua Road, Heping District, Shenyang, 110819, China, cdfsun@gmail.com, Lixin Tang

This paper studies the bulk material handling problem (BMHP) in the bulk material yards of steel enterprises, which usually suffer from the computational complexity arising from the interference between various items of associated transport equipment such as reclaimers and belt conveyors. We establish a discrete-time mixed integer model to address the BMHS problem, and then reformulate it into set partitioning model and solve it through column generation. The pricing sub-problems are solved by a dynamic programming procedure.

4 - Optimizing a Double-load Crane Scheduling Problem using a Heuristic Algorithm

Guodong Zhao, Northeastern University, Shenyang, 110819, China, gascoigne_0509@163.com, Ren Zhao, Yun Dong, Lixin Tang

This paper studies a double-load crane scheduling problem(DLCSP). For a given set of crane tasks, the problem to decide the crane route and operation sequence of all tasks, the scheduling problem is to allocate the tasks to double-load operations and determine the schedule for the crane to perform the tasks so as to minimize the makespan. We formulate a mixed integer programming model. Successively, we adopt a heuristic algorithm to solve the DLCSP. The experiment results on practical data can show that the heuristic algorithm is valid and effective for solving the DLCSP.

■ MB11

201D, 2nd Floor

Optimization and Risk Management in Financial Applications

Invited: Financial Engineering in China

Invited Session

Chair: Jianjun Gao, PhD, Shanghai University of Finance and Economics, Room 515, School of Information Management and Engineering, 100 Wudong Road, Yangpu District, Shanghai, China, gao.jianjun@shufe.edu.cn

1 - Probability Weighting and the Risk Premium of Coskewness

Yun Shi, Shanghai University, Shanghai, China, y_shi@shu.edu.cn, Xiangyu ShiCui, Xunyu Zhou

Recent developments document a strong and robust negative relationship between skewness and average return in both stock and option market. In this work, we consider a one-period economy with rank-dependent utility agents. After deriving the equilibrium asset pricing formula under probability weighting, we show that in the derived three-moment-CAPM model, the existence of probability weighting would increase the risk premium of coskewness. The reason is that through probability weighting, rank-dependent utility agents could overweight the tail events and thus develop a preference for coskewness. The empirical analysis further confirms our findings.

2 - Explicit Solution for Constrained Optimal Execution Problem with Random Market Depth

Jianjun Gao, Shanghai University of Finance and Economics, Room 515, School of Information Management and Engineer, Shanghai, China, gao.jianjun@shufe.edu.cn

This work studies the constrained optimal execution problem with a random market depth in the limit order market. Motivated from the real trading activities, our execution model considers the execution bounds and allows the random market depth to be statistically correlated in different periods. Usually, it is difficult to achieve the analytical solution for this class of constrained dynamic decision problem. Thanks to the special structure of this model, by applying the proposed state separation theorem and dynamic programming, we successfully obtain the analytical execution policy. The revealed policy is of feedback nature. Examples are provided to illustrate our solution methods. Simulation results demonstrate the advantages of our model comparing with the classical execution policy.

3 - Portfolio Optimization with Nonparametric Value-at-risk: A Block Coordinate Descent Method

Rujun Jiang, PhD, Fudan University, Shanghai, China, rjjiang@fudan.edu.cn

We investigate in this paper a portfolio optimization methodology using nonparametric Value-at-Risk (VaR). In particular, we adopt kernel VaR and quadratic VaR as risk measures. As the resulting models are nonconvex and nonsmooth optimization problems, albeit with some special structures, we propose some specially devised block coordinate descent (BCD) methods for finding approximate or local optimal solutions. Computational results show that the BCD methods are efficient for finding local solutions with good quality and they compare favorably with the branch-and-bound based global optimal solution procedures. From the simulation test and empirical analysis which we carry out, we are able to conclude that the mean-VaR models using kernel VaR and quadratic VaR are more robust compared to those using historical VaR or parametric VaR under the normal distribution assumption, especially when the information of the return distribution is limited.

4 - Dynamic Mean-VaR Portfolio Selection: Equivalence with Mean-Safety-First Formulation and Best Stagewise Nested VaR Structure

Ke Zhou, PhD, Hunan University, Hunan, China, hustzhke@163.com

For long investment horizon, dynamic control of value at risk (VaR) is indispensable to achieve high performance of risk management. Unfortunately, the resulted dynamic mean-VaR portfolio selection formulation is time inconsistent, which also leads to a non-tractability in deriving optimal investment policy. We tackle this long-standing challenge from a new angle. We first prove an equivalence between the mean-VaR and the mean-safety-first formulations when the risk parameters in the two formulations satisfy certain relationship. Solving the time-consistent dynamic mean-safety-first formulation using either dynamic programming or martingale approach enables us to identify corresponding optimal investment policy for the time-inconsistent mean-VaR problem formulation. Furthermore, investigating the property of the induced confidence level in truncated mean-VaR problems gives rise to the stagewise nested VaR structure, which guides us adjusting the VaR level dynamically and adaptively during the investment process such that the global mean-VaR goal is attained.

■ MB12

201E, 2nd Floor

Intelligent Transportation Systems I

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Sundaravalli Narayanaswami, Indian Institute of Management Ahmedabad, Wing 15 B, Indian Institute of Management, Vastrapur, Ahmedabad, 380015, India, sundaravallin@iima.ac.in

1 - Revolutionizing Urban Transport through a New Mode Called Ctrain

Ashwani Kumar, Ministry of Railways Government of India, Rail Bhavan, New Delhi, India, upadhyaya.ashwani@gov.in, Emil Jacob

This paper introduces and explains an innovative, award-winning design for a low-cost, flexible, elevated mass transit mode, called Caterpillar train or Ctrain. It requires minimal land and can be built quickly even on narrow streets. This innovation has tremendous potential to revolutionize mass transport in our cities.

2 - Electric Future for Buses? Influence of Size, Battery Capacity, and Route Length

Gitakrishnan Ramadurai, Indian Institute of Technology Madras, BSB 229, Department of Civil Engineering, Chennai, 600036, India, gitakrishnan@iitm.ac.in, Manju Manohar, Surendra Reddy Kancharla

Electric buses are expected to significantly enhance the 'sustainability quotient' of public transit buses. However, critical issues on their technological and economic viability need to be addressed. We study the effect of size, battery capacity, and route length on viability using carefully designed experiments. We determine optimal combinations of diesel-electric fleets on hypothetical single routes by formulating and solving a MILP with an objective of minimising overall cost. Sensitivity analysis is carried out to draw insights on electric bus feasibility in the near future.

3 - A Better World through Autonomous Driving? Responsibilities and Moral Dilemmas

Katrin Merfeld, EBS University, Gustav-Stresemann-Ring 3, Wiesbaden, 65189, Germany, katrin.merfeld@ebs.edu, Karin Kreutzer

Autonomous driving rapidly approaches market readiness. While it increases safety by reducing the human factor in driving, this takeover of artificial intelligence disrupts our understanding of machine responsibilities. Consequently, the human role in driving and the question of responsibility should be re-evaluated. We identify different stakeholders in autonomous driving and attribute respective responsibility for the machine's actions. Further, we introduce five moral dilemmas resulting from the establishment of autonomous vehicles as a part of society and discuss them.

4 - Digital Social Media: Enabling Performance Quality of Indian Railway Services

Sundaravalli Narayanaswami, Indian Institute of Management Ahmedabad, Wing 15 B, Vastrapur, Ahmedabad, 380015, India, sundaravallin@iima.ac.in

Indian Railways (IR) is the single largest organization that operates a mammoth of transportation services in the World's largest democracy. Scale of operations translates to humongous everyday challenges. Customer dissatisfaction is prevalent, in spite of subsidized travel fares. Recently IR has become very active in the digital social media space to provide real-time and dynamic service improvements. We discuss the beginning of technology intervention in IR, managerial challenges in exploiting technology advancements and the current status in managing a large scale public transport operations. We also discuss the insights, deployability in comparative segments and the way forward.

■ MB13

201F, 2nd Floor

Operations and Economics Interface II

Invited: Operations and Economics Interface

Invited Session

Chair: Xuan Wang, Hong Kong University of Science and Technology, Kowloon, Hong Kong, xuanwang@ust.hk

1 - Estimation and Assortment Optimization for a Random Consider Set Model

Anran Li, Hong Kong University of Science and Technology, Department of IEDA, Room 5568, The HKUST, Sai Kung, Hong Kong, anranli@ust.hk, Guillermo Gallego

Manzini and Mariotti (2014) propose a consideration set based choice model that postulates a full preference ordering as well as exogenous attention probabilities from which consideration sets are formed. The model assumes that consumers select the highest ranked product in their consideration set and the heterogeneity among choices are due to randomness in the formation of consideration sets. We operationalize the model by providing efficient estimation and assortment optimization algorithms. Empirical testing on our airline partner's data shows that the model outperforms the Mixture of MNLs model on 67.0% of the markets. We show that an assortment that maximizes expected revenues can be found in $O(n)$ time where n is the number of products. We extend the model to allow ties in preferences and show that a revenue-ordered assortment has a 1/2 performance guarantee relative to the optimal assortment. We also study the pricing problem where the preference ordering are price aware.

2 - Assortment Optimization for a Multi-stage Choice Model

Zizhuo Wang, University of Minnesota, Minneapolis, MN, 55414, United States, zwang@umn.edu, Yunzong Xu

Motivated by a practical selling scenario that requires previous purchases to unlock future options, we consider a multi-stage assortment optimization problem, where the seller makes sequential assortment decisions with commitment, and the customer makes sequential choices to maximize her expected utility. We show that this problem is polynomial-time solvable when the customer is fully myopic or fully forward-looking. The optimal policy entails that the assortment in each stage is revenue ordered and a product with higher revenue always leads to a wider range of future choices. We also show that the problem is NP-hard in general and give precise/approximation algorithms for various scenarios.

3 - Carpool Services for Ride-sharing Platforms

Xuan Wang, Hong Kong University of Science and Technology, School of Business and Management, LSK 4079, Kowloon, Hong Kong, xuanwang@ust.hk, Renyu Zhang

There has been rapid growth in on-demand ride-hailing platforms that serve as an intermediary to match individual service providers with consumer demand. Within the on-demand ride-hailing market, several major players have introduced carpool services that enable multiple passengers to share a ride at a discounted price. In this talk, we develop a model to study the operational issues faced by ride-sharing platforms in the presence of carpool services, and the economical and social implications as a result of the carpool service option.

4 - Direct or Indirect Outsourcing? The Effects of Outsourcing Knowledge on the Dynamics of Outsourcing Modes

Qiong Chen, University of Science and Technology of China, School of Management, Hefei, 230026, China, qcchen@ustc.edu.cn, Gulru F Ozkan-Seely, Shouqiang Wang, Aleda Roth

We evaluate buyer's dynamic choice of outsourcing channels: directly through in-house procurement department or indirectly through an intermediary. Using a two-period game theoretic model, we demonstrate the critical yet interesting role of outsourcing knowledge and highlight effects of direct and indirect learning on the change of buyer's strategies over time.

■ MB14

202A, 2nd Floor

OR Applications in Sustainable Energy

Sponsored: Environment, Energy, and Natural Resources

Sponsored Session

Chair: Yihsu Chen, University of California-Santa Cruz, Santa Cruz, CA, 95064, United States, yihsuchen@ucsc.edu

1 - A Oligopoly Power Market Model in Presence of Strategic Presumers

Yihsu Chen, University of California Santa Cruz, 1156 High Street, M/S SOE3, Santa Cruz, CA, 95064, United States, yihsuchen@ucsc.edu, Sepehr Ramyar

A presumer, depending on his/her net position, who acts with a dual role as a consumer and a producer, is believed to provide considerable benefit to the wholesale power market. A presumer typically owns a non-dispatchable capacity, subject to exogenous resource constraint, coupled with a dispatchable resource to mitigate market risk. This talk presents a oligopoly market model that considers the presence of presumers. We explicitly model the buyer or seller market power that can be exercised by a presumer and highlights some counterintuitive outcomes that might arise.

2 - Regulatory Jurisdiction and Policy Coordination: A Bi-level Modeling Approach for Performance-based Policy

Makoto Tanaka, National Graduate Institute for Policy Studies (GRIPS), 7-22-1 Roppongi, Minato-ku, Tokyo, 106-8677, Japan, mtanaka@grips.ac.jp, Yihsu Chen, Afzal S. Siddiqui

This study discusses important aspects of policy modeling based on a leader-follower game of policymakers. We specifically investigate non-cooperation between policymakers and the jurisdictional scope of regulation via bi-level programming. Performance-based environmental policy under the Clean Power Plan (CPP) in the U.S. is chosen for our analysis. We argue that integration of policymakers is welfare enhancing. Somewhat counterintuitively, full coordination among policymakers renders performance-based environmental policy redundant. We also find that distinct state-by-state regulation yields higher social welfare than broader regional regulation.

3 - Real Options in Renewable Portfolio Standards

Ryuta Takashima, Tokyo University of Science, 2641 Yamazaki, Noda-shi, Chiba, 278-8510, Japan, takashima@rs.tus.ac.jp, Makoto Goto

In order to promote renewable energy generation, the schemes as renewable portfolio standards have been introduced. Thus the power generators make investment decisions allowing not only for uncertain demands and competitors' strategies but also for the schemes. In this work we model an equilibrium investment strategy of generators to analyze an effect of the schemes on the investment in competitive electricity market. The market is composed of non-renewable and renewable sectors. We show how the uncertainty affects the investment timing for both generators with the scheme.

4 - Energy-water Nexus Modeling and Analysis: From Cooling Tower Process, Cooling Efficiency, and Electric Grid Operation Perspectives

Zhi Zhou, Argonne National Laboratory, 9700 South Cass Avenue, Bldg 221, Argonne, IL, 60439, United States, zzhou@anl.gov, Ying Wang, Yupo Lin, Getnet Betrie, Eugene Yan

Most electricity generation needs large amounts of cooling water, which is extensively demanding in hot and arid areas. We propose a model to estimate the cooling efficiency in the power plants operation based on practical operation data. The cooling efficiency model reflects the impacts of environment temperature, electricity generation and cooling technologies, et al. The cooling efficiency and water availability constraints are integrated into the power system operation model. The model is validated with data from the US Illinois region under various water availability scenarios. The results show that water availability and temperature have significant impact on power grid economics.

■ MB15

202B, 2nd Floor

Managing Services Online

Sponsored: Service Science

Sponsored Session

Chair: Tuck Chung, PhD, ESSEC Business School, Singapore, chung@essec.edu

1 - A Heuristic-analytic Perspective on the Helpfulness of Online Consumer Reviews

Tuck Siong Chung, Essec Business School, 5 Nepal Park, 139408, Singapore, chung@essec.edu

We argue that consumers form an initial mental model about the expected performance of a product, and the certainty of this assessment, based on the quality and uncertainty signals derived from overall product ratings. The quality and uncertainty signals affect the likelihood of consumers reading the review texts and whether the initial mental model will be updated. Moreover, the signals influence how consumers evaluate the helpfulness of a review that they have read by affecting the importance they assign to the different review textual characteristics. Using a probabilistic text-mining algorithm and a Hierarchical Bayesian model we show that the relative impact of various textual characteristics is significantly moderated by the overall rating environment. Our model enables us to reconcile some of the conflicting findings reported by earlier studies and it helps us to explain the apparent sparsity of helpfulness votes often found across online platforms.

2 - Optimal Design of Content Samples for Digital Products and Services

Hong shuang (Alice) Li, PhD, Ohio State, Columbus, OH, 43210, United States, li.815@osu.edu, Sanjay Jain, Pallassana Kannan

We develop a framework to understand how the design of free samples can influence the revenue generation of creative content. We first develop an analytical model that determines the conditions under which it is optimal for content providers to provide free samples, and how the quality and other design parameters of samples affects the sales of content. Then we empirically determine the conditions under which free samples increase sales using data from a field experiment. Our research finds that, rather than being substitutes, free samples of entire content can be very effective in increasing revenues. Furthermore, we find higher quality samples have a greater impact on the sales of popular content.

3 - Multi-Step Matching in Peer-to-Peer Sharing Markets

Dai Yao, National University of Singapore, Singapore, dai.yao@nus.edu.sg

Peer-to-peer (P2P) sharing marketplaces afford individuals a unique opportunity to rent their own properties such as apartments, cars, etc. to their peer customers. In this paper, we develop an empirical model of various decisions of players in the context and apply it to a unique data from a large P2P car sharing platform in China. We uncover several novel findings owing to the multi-step matching process. At the early stage, renters concern about car attributes and owner characteristics, but following owners' acceptance, they shift their focus to own needs such as when and for how long they will use the car, and become more price sensitive. As decisions of the two participants are asynchronous, we discover that renters strategically anticipate the action of the other party, but not vice versa. Last, we find owners in general favour the young and the female renters. These findings highlight the complex decision making process in P2P sharing platforms. We discuss the marketing implications of our findings in this and similar business contexts.

4 - The Trust Paradox: An Experimental Research of the Consumers Perspective on Blockchain-based Sharing Services

Christopher Grossmann, EBS Universitaet fuer Wirtschaft und Recht, Wiesbaden, Germany, christopher.grossmann@ebs.edu

The sharing economy experienced a promising growth in recent years. However, the adoption rate appears to slow down for different services. Platform incompatibilities and a lack of trust mark significant adoption barriers. The integration of distributed ledger technology (DLT) theoretically reduces these hurdles. Paradoxically, consumers have negative associations with DLTs such as the darknet and crime. Consequently, adequate communication towards consumers seems essential for successful diffusion. To address the future establishment of sharing services based on DLTs, we conducted a series of experiments to assess implementation strategies from a consumer's perspective.

■ MB17

203B, 2nd Floor

Advances and Applications of Scheduling Theory

Invited: Maritime Operations

Invited Session

Chair: Ming Liu, PhD, Tongji University, No. 1239, Siping Road, Shanghai, 200092, China, mingliu@tongji.edu.cn

Co-Chair: Feifeng Zheng, Prof., Donghua University, Shanghai, 200230, China, ffzheng@dhu.edu.cn

Co-Chair: Dehua Xu, Prof., Nanjing University of Finance and Economics, Nanjing, China, 9120171025@nufe.edu.cn

Co-Chair: Yunqiang Yin, Kunming University of Science and Technology, Kunming, China, yinyunqiang@126.com

1 - Distributionally Robust Disassembly Line Balancing Problem with Ambiguous Task Processing Times

Xin Liu, Tongji University, Shanghai, China, liuxin9735@126.com, Ming LIU

Disassembly line balancing problem (DLBP) is to selecting disassembly process, opening workstations and assigning selected tasks to opened workstations to minimize the total cost. Most related works address the uncertain processing times with known probability distribution. This paper investigates the DLBP with partial uncertain knowledge, i.e., the mean and covariance matrix of task processing times. For the problem, a new distributionally robust formulation is proposed. In order to solve the problem more efficiently, a parameter-adjusting heuristic is developed.

2 - Two Yard Crane Scheduling with Real Time Reshuffle and Safety

Xiaoyi Man, PhD, Donghua University, Changning Qu, China, manxiaoyi8996@13.com, Feifeng Zheng, Ming LIU

In this paper, we investigate two yard crane scheduling with storage and retrieval tasks in a container block. The main contributions of the paper are (1) container reshuffling operations and inter-crane interference constraint are both considered; (2) the dynamic processing times for retrieval containers are taken into consideration; (3) the safety between any two stacks are considered. In the study, we focus on minimizing the maximum tardiness of container task and establishing an integer linear programming model. Regarding the NP-hardness nature of the problem, we develop a promising heuristic and a genetic algorithm (GA) based on the characteristics of the problem.

3 - A Two Stage Production Research in Textile Industries

Junkai He, PhD, Donghua University, China, hejunkai@163.com, Ming LIU

This paper studies a multi-stage hybrid flow shop problem on yarn-dyed textile production, mainly including a dyeing and a weaving stage. Different constraints are incorporated: (i) color-cross interference is prohibitive, (ii) sequence dependent changeover is required, and (iii) family jobs are considered. In order to make full use of production resources, we construct a bi-objective integer programming model. The objectives are to minimize total tardiness and changeover cost, with the purpose to satisfy the demand of customers and reduce production burden of industries, respectively.

4 - Extract Market Information from Strategic Inventory in New Product Launch

Chang Dong, HKUST, China, cdongad@ust.hk

In the literature of new product launch and product rollover, it's usually assumed that the manufacturer has perfect control towards the rollover strategy. However, this is not always valid in reality. In this study, we consider a manufacturer introducing a new product via a retailer who might deviate from the rollover strategy designed by the manufacturer, through strategic inventory. In the setting with asymmetric demand information, we find that the strategic inventory can serve as a signal devices for retailer to credibly delivery the market potential. Contrary to the existing literature, a higher inventory holding cost can be beneficial to both manufacturer and retailer.

■ MB18

North Lounge, 3rd Floor

Stochastic Modeling and Optimization in Healthcare Operations

Invited: Healthcare Systems and Applications

Invited Session

Chair: Xiaolei Xie, Tsinghua University, Beijing, 100084, China, xiexiaolei0209@gmail.com

1 - Managing Advance Admission Requests

Na Geng, Shanghai Jiao Tong University, 800 Dongchuan Road, Mechanical Building A618, Shanghai, 200240, China, gengna@sjtu.edu.cn, Xiaolan Xie

This paper is devoted to the problem of managing advance admission requests. There are a fixed number of identical resources serving one type of customers. Customers arrive and request for the admission. Each admitted customer takes a random amount of time, called customer arrival lead time, to arrive and is served immediately without delay. Serving a customer requires a random amount of the resource during a random number of periods. Analytical and numerical results are derived for this advance admission control problem.

2 - The Analytics of Bed Shortages: Coherent Metric, Prediction and Optimization

Jingui Xie, University of Science and Technology of China, School of Management, 96 Jinzhai Road, Hefei, 230026, China, xiejingui@gmail.com, Gar Goei Loke, Melvyn Sim, Shao Wei Lam

In practice, healthcare managers often use bed occupancy rates (BOR) as a metric to understand bed utilization, which is insufficient in capturing the risk of bed shortages. Based on the riskiness index of Aumann and Serrano (2008), we propose the entropic bed shortage metric, which captures more facets of bed shortage risk than traditional metrics such as the occupancy rate, the probability of shortages and expected shortages. We also propose optimization models to control the risk of bed shortages and plan for bed capacity via this metric. These models have linear program re-formulations which can be solved efficiently on a large scale.

3 - Tele-ICU for Better Critical Care Delivery: Modeling, Analysis and Improvement

Xuanjing Li, Tsinghua University, Room 519, ShunDe, Beijing, China, lixj15@mails.tsinghua.edu.cn, Muer Yang, Xiaolei Xie, Dacheng Liu, Michael Fry, Corey Scurlock

Since the capacity of most ICUs can not meet growing demand, tele-ICU is introduced a new way to provide intensive care for a large number of ICU patients in disparate geographical locations for multiple hospitals while ensuring provider engagement. We introduce an analytical model to study tele-ICU operations including the optimal staff level and scheduling policies. System properties are investigated. A case study is conducted using both analytical and simulation approaches. Extensive numerical experiments are performed to investigate different scheduling policies. In addition, the performance of dedicated staff and flexible staff are evaluated and managerial insights are discussed.

4 - Physician Staffing for Emergency Departments with Time-varying Demand: Models and Approach

Ran Liu, Shanghai Jiao Tong University, dongchuan 800, Shanghai, China, liuran2009@sjtu.edu.cn, Xiaolan Xie

Fluctuations in Emergency Department (ED) patient arrivals during a day are one of the main causes of the long waiting times that are frequently encountered, and ED staffing is one of the key drivers of ED service quality improvement. We propose discrete-time models for approximating the patient waiting times for any given ED staffing. The resulting waiting time approximations are then integrated into ED staffing optimization models. Algorithms are developed to solve the ED staffing models. Numerical experiments with real-life data are performed to validate the proposed models and algorithms.

■ MB19

South Lounge, 3rd Floor

Data Driven Approach in Healthcare

Invited: Healthcare Management

Invited Session

Chair: Yung-Chia Jasmine Chang, National Chiao Tung University, Hsinchu, 30050, Taiwan, jasmine.chang@nctu.edu.tw

1 - A Proactive System Framework for Blood Inventory Management

Phongchai Jittamai, Suranaree University of Technology, Nakhon Ratchasima, Thailand, jittamai@sut.ac.th, Wijai Boonyanusith

In general, blood inventory system has limited data analytics and technologies, and its functions are unable to support the complex inventory procedures. This study aims to explore advanced analytics method, which can be applied to support decision making in the blood inventory operations. Real-time data insights and ubiquitous technologies can be integrated as a proactive approach to manage blood resources in order to reduce the shortage and the outdated rates. A proactive system is proposed to demonstrate the application of the data driven approach in the blood inventory operations. This framework is developed based on the synthesis of the expert knowledge in the blood service organizations and the improvement of the blood inventory operations in order to analyze the system specifications and to construct the prototype of the blood inventory system. The proposed framework could manage the blood inventory system more proactively, leading to better resource management, and minimize the blood shortage and the outdated rates in the network.

2 - Prediction of Stroke Onset through a Classification Model Based on Data from 3D Vascular Imaging, Blood Flow Simulation, and Medical History

Yung-Chia Chang, National Chiao Tung University, Dept of Industrial Engineering & Mgt, 1001 Da Hsueh Road, Hsinchu, 30050, Taiwan, yungchiachang@mail.nctu.edu.tw, Yu-Chen Chen, Masaaki Suzuki, Hayato Ohwada

This paper proposed a classification to predict the risk of stroke onset based on the curvature features of three-dimensional vascular imaging, the simulations of blood flow and patients' medical history. The data used to build the model was provided by a Japanese medical institution. Since the cases with ruptured aneurysm are much fewer than the ones without, Synthetic Minority Oversampling Technique (SMOTE) were applied to generate synthetic instances based on original ones to help model building. Decision Tree algorithm was applied for selecting important features and a classifier based on Support Vector Machine (SVM) were developed for stroke onset prediction. The results of the numerical experiment showed that the use of SMOTE can improve the effectiveness the classifier when compared with the situation of without. Moreover, the proposed approach could successfully predict stroke onset and could be used to assist doctors in making diagnosis.

3 - Predicting Short-term Survival after Liver Transplantation using Machine Learning

Chien-Liang Liu, National Chiao Tung University, HsinChu, Taiwan, cliu@mail.nctu.edu.tw

Liver transplantation is the only curative treatment for end-stage liver disease, but the demand for livers is much higher than the number of available donor livers, so patients on the waiting list for a liver transplant have to be prioritized. This work devises a new scoring system to estimate postoperative survival rate based on the patient's preoperative physiological measurement values. We use patients' blood test data within 10 days before surgery to construct a predictive model. The experimental results indicate that the proposed model could achieve comparative results.

4 - Data Driven Design for a University Hospital Cashier Service

Surapong Sirikulvadhana, Assistant Professor, Chulalongkorn University, Industrial Engineering Department, 254 Phayath, Pathumwan, 10330, Thailand, surapong.s@chula.ac.th

We use data analysis to simulate and propose renovation plan for a cashier service in a large university hospital's outpatient departments which cover 6-stories. Our suggestion is to combine some previously separate cashiers and assigns non-constant active cashiers to meet non-stationary demand through the day. The dynamics of staff allocation results in average utilization less than 85% and average waiting time less than one minute. This results in better customer satisfaction as well as staff working environment.

■ MB20

401, 4th Floor

Consumer Decision Analysis

Sponsored: Decision Analysis

Sponsored Session

Chair: Leona Tam, Leona.Tam@uts.edu.au

1 - Pro-environmental Waste Receptacle Labeling can Increase Recycling Contamination

Yitong Wang, University of Technology, Sydney, Marketing DG, UTS Business School, Haymarket NSW, 2077, Australia, yitong.wang@uts.edu.au, Jesse R. Catlin, Rommel J. Manuel

A critical challenge to recycling is the growing contamination rate by consumers disposing of unrecyclable materials incorrectly. We propose that a contributing factor to this problem could be the pro-environmental labeling used on many waste receptacles. For example, a growing number of public garbage receptacles across the U.S. feature the term "landfill" instead of "trash", aiming to encourage consumers to recycle by heightening the negative impact of garbage. However, this labeling may also motivate consumers to dispose of unrecyclable materials in recycling receptacles, which we refer to as "wishful recycling". In a series of field and online studies, we found that multiple variations of pro-environmental receptacle labeling led to this unintended wishful recycling effect and the behavior seemed to be driven by anticipated emotions evoked by the labeling. Additionally, pictorial guides illustrating accurate item disposal showed potential to counteract the "wishful recycling" effect.

2 - Values Driving Consumer Preferences in Emerging Markets

Nancy Wong, University of Wisconsin-Madison, Madison, WI, United States, nywong@wisc.edu

Preferences in emerging markets are changing, due to growth in disposable income, and changes in geo-demographic, socio-cultural factors. Yet we lack insights on what drives these changes at a more fundamental level - an understanding on which to draw forward-thinking marketing and branding strategies. Using survey data from seven South-East Asian emerging markets with over three thousand consumers, we examine how economic development impacts the effects of religious and traditional values, materialistic consumer values, and collectivistic values on important consumption-related variables such as the types of brands preferred and attribute weights for those brands. Our analysis shows how these relationships change or remain invariant against the backdrop of increasing income, education, and internet use, as well as the growth of youth demand

3 - Political Ideology and Intertemporal Choice

Eugene Chan, Senior Lecturer, Monash University, 26 Sir John Monash Dr., Caulfield East, 3145, Australia, ehchan@outlook.com, Leona Tam

Across four studies, this research reveals that political conservatism decreases preference in reward delay (that is, increases preference for near future reward). This effect is mediated by debt aversion. The political ideology effect is moderated by power. When individuals perceive themselves to be powerful, the difference between conservative ideology and liberal ideology disappears that the present preference of conservative ideology on intertemporal choice is significantly reduced.

4 - Open Innovation and Financial Performance

Yen-Ju Chiang, National Cheng Kung University, Tainan City, 423, Taiwan, r48031016@mail.ncku.edu.tw, Shuang-Shii Chuang

Open innovation has played more and more important roles recently. However, Most previous studies have investigated empirical research in marketing field but few studies have conducted empirical studies to examine the causal relationships of open innovation and financial performance. In this study we examine the relationship of open innovation and financial performance of information and communication technology stock in Taiwan by using multiple regression analysis from January 1, 2009 to December 31, 2017. The results show that open innovation can affect financial performance. This phenomenon could also offer the company ideas to improve their innovation and marketing strategy.

■ MB21

Joy, 4th Floor

Energy Management

Invited: Circular Economy

Invited Session

Chair: Ming-Chuan Chiu, National Tsing Hua University, Taiwan, mcchiu@ie.nthu.edu.tw

Co-Chair: Reza Nadimi, Tokyo Institute of Technology, Tokyo, Japan, rn.nadimi@gmail.com

1 - The Equilibrium Contract for Power Buyback in Peak Hour Based on Demand Response Concept

Ying-Lien Chen, Master Student, National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu, 30013, Taiwan, elaine20628@gmail.com, Ming-Chuan Chiu, Hsin-Wei Hsu, Yu-Ching Lee

Along with the deterioration of global warming, the temperature in summer is increasing significantly in Taiwan. Therefore, the peak load of power repeatedly reached new records year by year. Due to limited power reserve margin, power supply in peak hours has drawn attention in recent years. At present, there are mechanisms such as time pricing and bidding mechanism for demand response can adjust the peak load of electricity consumption, but how to formulate a suitable purchasing price and create a win-win situation between power companies and industries under demand response mechanism remain absent. Therefore, this study proposes a Game theory based model for power provider (Taiwan Power Company) and industrial customers to negotiate power usage during the peak hours with proper rewards. This achieves a balance of profits between both parties such that Taipei Power Company (TPC) can reduce power shortage without additional power plants and industrial consumers can also be benefited with compensation from TPC.

2 - Evaluation of the Energy System through Data Envelopment Analysis: Assessment Tool for Paris Agreement

Reza Nadimi, PhD Student, Tokyo Institute of Technology, Tokyo Institute of Technology, Tokyo, Japan, rn.nadimi@gmail.com, Koji Tokimatsu

Data envelopment analysis (DEA) approach is usually used to measure the efficiency of decision making units (DMUs). However, heterogeneous DMUs and either inappropriate input or output-oriented DEA model lead to unreasonable results. K-Mean clustering method was applied to select homogenous countries from energy data perspective. The overall energy efficiency was calculated by multiplying the efficiency of demand and supply side. The results of the paper specified that the highest potential energy saving (PES) source in the supply side belongs to the non-renewables in power stations, followed by refineries, and finally deployment of renewables. Demand side analysis identified that the highest PES belongs to countries with high population, and high-income economy. In conclusion, the results of overall energy efficiency suggested an allowance for non-renewables deployment in countries with low economic and low population. The allowance was proposed to support energy poverty, health improvement, and promotion of education.

3 - An Optimal Power Mix and Dispatch Model Considering Climate and Environmental Impacts: A Case Study in Taiwan

Min-Ching Wu, Master Student, National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu, 30013, Taiwan, zxc800093@gmail.com, Ming-Chuan Chiu, Hsin-Wei Hsu, Meng-Ying Lee

Taiwan's air pollution has been a critical issue to residents' health. Despite Taiwan Government has set an energy transition policy of nuclear-free homeland and 20% of power generation for renewable energy in 2025, thermal power generation is still the main source, which occupies 80% of power generation. This results in bad air condition that is known as PM 2.5. Further, the high atmospheric pressure brings more polluted air from China in winter. How to mitigate air pollution in the period of energy transition becomes a critical issue.

Therefore, the aims of this study is to develop a mathematical model that describes power mix and dispatch under seasonal and air pollution factors. With empirical data, we will discuss and compare the configurations of power generation source through Goal Programming (GP). Under different weight allocation of various scenarios, this model expects to provide advices to Ministry of Economic Affairs and Taiwan Power Company on power dispatch and control.

4 - Using Dynamic Parallel Machine Scheduling Technique to Reduce Frequency of Washing of Dyeing Machines

Kang-Ting Ma, National Tsing Hua University, Neihu District, 1F, No 57, Ln 132, Hsinchu, 30013, Taiwan, ktma@ie.nthu.edu.tw, Chien-Chun Ku, Chen-Fu Chien

In this paper, an algorithm is established for dynamic parallel machine scheduling in the textile industry. Dyeing is the bottleneck in the dyeing and finishing process, because dyeing machine is capacitated. As orders tending to be small-Volume/multiple-types of products, setup time for variety need increases. While different colors and fabrications between two consecutive lots, washing is necessary to avoid color nonmatching. In other words, time of washing is regarded as the setup time of dyeing machines. The objective is to increase the utility of dyeing machines, and to reduce the consumption of water for washing accordingly.

■ MB22

Elegance, 4th Floor

Multidisciplinary Applications of MCDM I

Sponsored: Multicriteria Decision Making

Sponsored Session

Chair: Kao-Yi Shen, Chinese Culture University, Department of Banking & Finance (SCE), Chinese Culture, Taipei, Taiwan, atrategy@gmail.com

1 - Exploring Investors' Risk Preferences And Sell-out Decisions By Using A Hybrid Approach For Technical Analysis

Kao-Yi Shen, Associate Professor, Chinese Culture University, Taipei, Taiwan, atrategy@gmail.com, Gwo-Hsiung Tzeng

Technical analysis (TA) has been broadly applied in financial markets, ranges from equity market to various derivatives. However, the topic of investors' risk-return preference is usually ignored in the mainstream research of TA. Thus, this study proposed an integrated approach to address this issue by collecting investors' opinions through a risk-return preference questionnaire and make classifications by the fuzzy clustering technique. Three groups of investors are expected to be classified. Furthermore, the present study attempts to propose a hybrid approach to emulate the three groups' sell-out behavior. A fuzzy inference system is incorporated to complete this hybrid decision model.

2 - Evaluating Green Technology Portfolio Implementation: Using Hybrid Madm Approach

James J.H Liou, National Taipei University of Technology, Taipei, Taiwan, jamesjhlou@gmail.com, Bo-Cheng Chen, Huai-Wei Lo, Yu-i Lai, Ming-Tsang Lu

Management of the green technology portfolio is becoming an increasingly significant issues to manufacturing firms, yet managers are also challenged to implement changes that improve competitiveness. To meet this challenge, we proposed a hybrid MADM model. Using the literature review and interview with experts, we identify the criteria related to actual practices of manufacturing firms' appraisal and the hybrid MADM techniques to suggest the efficient improvement models. The BWM and VIKOR are implemented to evaluate the strategic weights and the gaps to the aspiration value. The results are helpful to those who associated with the manufacturing industry management and implementation.

3 - Network Decision Process for Determining Subjective Weights of Criteria by Pseudo Nodes

Jih-Jeng Huang, Soochow University, Taipei, Taiwan, stee.huang@gmail.com

Weight determination is a popular research issues in the field of multi-criteria decision making. One of the hardest problems is to determine the weights of the network relationships between criteria. The analytic network process was proposed to handle the complicated weight relationships between criteria. However, the theoretical background of the ANP-based approaches was developed from Markov chains, and they cannot reveal the steady-state distribution when in- or out-linked criteria exist. Here, we propose a novel way to overcome the problems of ANP-based approaches and provide a way to determine the weights of criteria using forward and backward transition matrices with pseudo nodes.

4 - Integrating Ahp Method and Cluster Analysis to Explore College Student's Subjective Consciousness About Love: Taking an Example Regarding a Class in Sanming University

Hui Lu, Sanming University, Sanming city, China,
luhui_aloe@yeah.net

"Love" is usually compulsory credit for college students. However, making decision's process between men and women often has a degree of information asymmetry. How to understand the mentality of the target is an important matter. AHP (Analytic Hierarchy Process) method is a technique of measuring personal value. Simultaneously, cluster analysis technique is focus on grouping all cases. Thus, this paper combines these two methods to analyze college students' subjective consciousness of love and further analyze the tendency of male college students in selecting girls and the preference of female college students in selecting boys.

5 - E-trust Institutional Mechanisms: Cross-cultural Customer Online Purchasing Decisions In The Uk And Jordan

Amer Al Shishany, The Hashemite University, Management Department, Zarqa, 13133, Jordan, asalsha@hu.edu.jo

E-trust is designed to encourage customers' purchasing decisions in online environment as a safe and convenient method for fulfilling their needs and/or wants. Creating and maintaining e-trust between customers and e-vendors is a significant factor that encourages customers to adopt online purchasing behaviour. Therefore, organizations created institutional mechanisms that may increase their customers' trust towards online purchasing environment.

Monday, 12:30PM - 1:30PM

■ Posters

South Foyer, 3rd Floor

Poster Session

1- Large Scale Spatio-temporal Demand Prediction in Logistics

Benyu Wang, SF Technology Co., Ltd., Software Industry Base 1B, Shenzhen, 518000, China, wangbenyu@sf-express.com

SF Express is a delivery service company based in Shenzhen, China. Established in 1993, SF has extended its services to all over Mainland China with more than 13,000 service points approximately 15,000 operating vehicles. Rapid expansion of the business has posed challenges to SF and necessitated innovations. In order to make staffing decisions and build work schedules for SF express, we have initiated a forecasting project for different types of delivery services and three different time units. Various time series, deep learning and machine learning models were utilized to solve the problems.

2 - Governance of the Integrated North Sea Offshore Grid: Simulation of Expansion Planning Constraints

Joao Gorenstein Dedecca, Delft University of Technology, Jaffalaan 5, Delft, 2611MP, Netherlands, jdedecca@gmail.com, Sara Lumbreras, Andres Ramos, Paulien M Herder, Rudi Hakvoort

Deploying an integrated offshore grid in the European North Seas offshore grid faces significant governance barriers, the grid being a multi-actor, multi-level system. Our myopic mixed-integer linear programming model for expansion planning includes governance constraints representing the interests of North Sea countries and cooperation barriers. We analyze the generation and transmission expansion pathways up to 2050 with detailed data of the European power system, to support planning policies for the North Sea offshore grid. Governance constraints impact the welfare negatively. They also impact how integrated the offshore grid topology is, and the use of transmission technologies.

3 - Some Dimension Reduction Strategies for the Analysis of Survey Data

Jiaying Weng, University of Kentucky, 300 Alumni Drive, Apt 179, Lexington, KY, 40503, United States, jiaying.weng@uky.edu, Derek Young

In the era of big data, researchers interested in developing statistical models are challenged with how to achieve parsimony. Usually, some sort of dimension reduction strategy is employed. Classic strategies are often in the form of traditional inference procedures, such as hypothesis testing; however, the increase in computing capabilities has led to the development of more sophisticated methods. In particular, sufficient dimension reduction has emerged as an area of broad and current interest. While these types of dimension reduction strategies have been employed for numerous data problems, they are scantily discussed in the context of analyzing survey data.

4 - Analysis of Time Series Data for Monitoring Local Variations

Youngeon Jeong, Associate Professor, Chonnam National University, 77 Yongbong-ro, Buk-gu, Gwangju, 61186, Korea, Republic of, youngeonjeong@gmail.com

This research presents an analysis of time series data for local variations obtained from diverse applications such as semiconductor manufacturing or automobile manufacturing process. The wavelet-based local-random-effect model for

individual observations is proposed and the integrated mean and variance thresholding procedure is developed to address the large number of parameters. Evaluation with real-life data sets shows that the proposed procedure shows much smaller average run length (ARL) for detecting the changes of local variations than existing techniques.

5 - Integrating Natural Language Processing and Fuzzy Logic to Address Contract Ambiguity

Mehdi Asadabadi, The University of New South Wales, Campbell, Canberra, Canberra, 2600, Australia, rajabi689@yahoo.com, Morteza Saberi, Elizabeth Chang

In the procurement process, a set of requirements for the product and obligations for the vendor and purchaser are defined and the vendor is then committed to provide the product. Since the buyer does not get involved in the process, avoiding vagueness in the determination of the requirements and obligations is a crucial factor in the success of the procurement process. The aim of this research is to expose contract ambiguity in the context of the procurement process and propose a semi-automated framework combining Natural Language Processing (NLP) and fuzzy logic to address the issue.

6 - The Impact of R&D Network Flexibility on Innovative Performance under Uncertain Perspective

Guo Min, School, shaanxi, xi'an, China, vanish258903@163.com

Due to the dynamic environment, R&D networks have become increasingly vulnerable and influenced by the risk of disruption. R&D network flexibility can effectively mitigate the risk. However, the specific definition of R&D network flexibility and its related empirical research are still rare. This paper analyzes the path of interdependence between enterprises, and how R&D network flexibility contributes to innovation performance based on the dynamic capability perspective. This study contributes to its flexibility and risk management literature by providing measurement of R&D network flexibility and empirically verifying how it enhances innovation performance.

7 - Uncertainty Quantification and Scenario Generation of Future Solar PV Costs for Use in Energy System Models

Hansung Kim, Postech, Cheongam, Pohang, Korea, Republic of, willhomehs@postech.ac.kr, Hyungkyu Cheon, Hyungjun Park, Dong Gu Choi

There are studies to develop methodologies to account for uncertainty in utilizing energy system models, generally using stochastic programming-based methodologies. These methodologies require a probability distribution of future values and scenarios for input parameters under uncertainty. In this study, we show that the scenario tree of the future value of the technological input parameter for energy system model can also be generated by quantitative methodology based on historical data. To this end, using the historical data of solar PV module price, we estimate the future module price based on the multivariate AR model and generate the scenario tree using the moment matching method.

8 - Policy Change Analysis According to Learning Effects Implementation Methodology in Energy System Models

Hansung Kim, Postech, Cheongam, Pohang, Korea, Republic of, willhomehs@postech.ac.kr, Dong Gu Choi

It has become important to establish an optimal energy portfolio to reduce greenhouse gas emissions after the Paris Agreement. The investment cost, which is an important factor when establishing energy portfolio by energy system model, is modeled by applying the learning effect. In order to apply the learning effect to the energy system model, the MILP method is mainly used. However, MILP has computational problem with a large system. New implementations have been suggested to overcome the disadvantages of the MILP method. In this study, we build up a bottom-up energy system model that follows South Korea's 8th power expansion plan and apply the new implementation methods and compare the differences.

9 - Hub and Spoke Network Design in Congested Third Party Logistics Systems

Lu Hu, Southwest Jiaotong University, Chengdu, China, hulu@swjtu.edu.cn, Bin Zhao, Juanxiu Zhu, Yangsheng Jiang

This paper describes third-party logistics (3PL) systems with consolidation hubs as a hub-and-spoke network. We propose a multiple assignment model for the joint design of the fleet size and the number, locations and capacities of hubs. We explicitly model the road congestion by formulating the route travel time as an increasing function of the number of trucks. We consider two types of trucks to model economies of scale. We derive the asymptotic behavior as design variables grow and show that the 3PL system throughput is bounded by that of the bottleneck routes. We develop an approximation algorithm to solve our problems. We prove that the two subproblems may be linearized.

10 - Artificial Intelligence and the Supply Chain

Reika Narita, Purdue University, 430 Wood Street, West Lafayette, Indiana, IN, 47906, United States, reikanarita@gmail.com, Jiong Sun

Companies are increasingly adopting Artificial Intelligence (AI) technologies to enhance productivity and profitability. Manufacturers use AI to automate production activities, allocate budgets, evaluate and select suppliers, procure materials, manage warehouses, and assist with logistics and shipping. Retailers apply AI technologies (e.g., visual search and Chatbots) to improve consumer shopping experience. In this poster, we use case studies to discuss how the emerging AI technologies will reshape the vertical relationships.

11 - Return Policy and Purchase Intention in an Ecommerce Environment

Jing Zhu, Associate Professor, Southwestern University of Finance and Economics, Chengdu, China, zhuj@swufe.edu.cn, Qinghong Xie, Yi-Bin Chiu

This paper explores relationships between consumer perceived leniency of an online return policy, perceived risk, trust, and consumer purchase intention. The findings suggest that consumer perceived return policy is directly related to online purchase intention and trust. Positive and significant correlation between trust and online purchase intention has also been identified. Moreover, this study reveals the negative correlations between consumer perceptions of the leniency of a return policy and perceived risk.

12 - A Fast Method to Calculate Linear Energy Transfer Distribution

Xiaoning Ding, Assistant Professor of Radiation Oncology, Mayo Clinic, 5777 E Mayo Blvd, Phoenix, AZ, 85054, United States, ding.xiaoning@mayo.edu, Wei Liu

To integrate radiobiological modelling with clinical treatment planning for proton radiotherapy, we developed a semi Monte-Carlo (MC) code that calculates proton linear energy transfer (LET) in voxelized patient geometries. The code was implemented for the dose calculation. The code is much faster than the traditional MC code with similar accuracy. The code has also been implemented in the inverse treatment planning optimization, allowing us to create LET-based objectives in inverse planning.

13 - Open-source-based Quality Management Software for Small and Medium-sized Enterprises

Seung Min Baik, Postech, Cheongam-Ro 77, Engineering Build. #4 LST lab, Pohang, 37673, Korea, Republic of, seungmin.baik@lslab.org, Dongyeon Jeong, Young Myoung Ko, Yong-Ju Cho, SeHwan Ahn

Despite the recent advances in data science technologies, their penetration level to the quality management in small and medium-sized enterprises (SMEs) is very low. In order for SMEs to take advantage of quality management tools, we are developing open-source-based quality management software with our collaborators. Our goal is to make it easier to utilize basic but essential techniques. Basic tools such as graphs, control charts, and data mining techniques are modularized (called "module") and are combined to form a "template" for a specific purpose. Our software is currently available for free. We hope that our open-source-based software will help SMEs achieve quality improvement.

14 - iFuseOPT: Predictive-optimization Based Framework for Business Analytics

Garima Gupta, TCS, ASF Insignia, Gwal Pahari, Gurugram, 122003, India, gupta.garima1@tcs.com, Gunjan Sehgal, Gautam Shroff, Geetika Sharma

We present iFuseOPT, a web based framework that combines predictive models and optimization, by exploring the solution space of decision making variables subject to constraints to optimize an objective function that depends on decision variables as well as other environmental factors via multiple predictive models. In addition to prescribing an optimal model-driven strategy for future unseen data, our tool also computes and visualizes the counterfactual objective functions, i.e. what values would have been observed had model-driven optimal decisions been made on past data. We demonstrate the utility of iFuseOPT on two real-life business applications.

15 - Decision Tree Based on Rao-stirling Index

ChulHee Lee, Dohyun Kim / Myongji University, Industrial and Management Engineering, Yongin, ASI KR KS009 Yongin, Korea, Republic of, cjgml6763@gmail.com, SangYong Lee, Dohyun Kim

Decision tree (DT) are one of the datamining methods commonly used for classification and regression. Decision tree repeatedly divides a dataset into pure subsets based on impurity measurements such as gini. Gini index is one of the representative indices to measure impurity of data. However, the Gini index does not take into account distances between classes. In this study, a new decision tree algorithm based on Rao-Stirling index is proposed considering distances between classes.

16 - Deep Neural Networks with Small Data

Seungyeon lee, Industrial and Management Engineering, Myongji University, 116, Myongji-ro, Cheoin-gu, Yongin-si, Korea, Republic of, yeonon.lee@gmail.com, Sangheum Hwang, Dohyun Kim, Eunji Jo

Deep neural networks (DNNs) have been attracting attention in the field of machine learning. DNNs have two or more hidden layers between the input layer and the output layer. Through their hierarchical architecture, DNNs can model complex non-linear relationships in high dimensional data. DNNs require huge amounts of data in order to tune the millions of parameters. DNN training using a small number samples of high-dimensional data can suffer from the overfitting problem. This study proposes an inner product based DNN, which can reduce the number of parameters in network.

17 - Compete with Service in E-retailing: The Impact of Safety Stock

Yi Ding, Southeast University, Sipailou 2, Jiangsu Province, Nanjing, 210096, China, drdingyi@outlook.com

This study aims to examine service and price competition in an online retailing system comprised of two suppliers and one e-retailer. A Stackelberg game is formulated with the suppliers as the leaders who determine wholesale prices and service times and the e-retailer as the follower who sets the retail prices. Changes of service time affect safety stock which is characterized by the guaranteed service model. We find that the "service first" strategy should be pursued when suppliers face increasing safety stock cost, and the influence of one supplier's service can be spilled over to the competing product's wholesale and retail prices, depending on the difference between consumer transfer ratios.

18 - Simulation of Value Creation Through Wood Supply Chain

Mika Yoshida, Dr., University of Tsukuba, Tsukuba, Japan, mika.science98@gmail.com, Hideo Sakai

Wood production and full use of wood material support sustainable forest management economically and ecologically. To clarify the value of a standing tree, the current flow of wood material and value of wood products were simulated quantitatively in a typical model region according to five strategies and we further discussed on sustainable forest management. It was clarified that it is important to promote the use of logging residues as a basic strategy and to support the supply of high-quality timber to the right demand by supply chain management (SCM).

19 - Customer Behaviors Comparing Between Firm Dominated and Customer Dominated Online Brand Communities

Xuehua Liao, Sun Yat-sen Business School, 135 Xingang East Road, Guangzhou, 510275, China, liaoxueh@mail2.sysu.edu.cn, Kang Xie, Jinghua Xiao

This research aims to address deeply on how brand community participation behavior affect purchase behavior. We gather data from an online brand community initiated by an online women's clothing enterprise in China, and also the background transaction data in the database. The dataset cover all the users' online brand community participant behavior and their purchase behavior during the last three years. This research puts forward a fresh analytical perspective into the intrinsic action mechanism of online brand community, and provides empirical evidence to shed light on the answers to unlock the participation-purchase effect confusion.

20 - Characterizing Interacting Mechanism and Behaviors of Multi-attribute Individuals: Precision Intervention Design and Implementation

Shiyong Liu, Professor, Southwestern University of Finance and Economics, Guanghuacun St 55, Chengdu, 610074, China, shiyongliu2006@gmail.com, Konstantinos P Triantis, Kun Hu

This research attempts to investigate how individuals characterized by multiple linguistic variables make decisions and exert impact on each other in an individual-based model. Instead of visualizing individual interaction in a traditional 2-D coordinate, this research explores the interacting mechanisms and behaviors of individuals in 3-D or higher dimension context. Fuzzy set theory and associated techniques are employed to depict the linguistic variables. Insights are obtained for enhancing intervention design and implementation.

21 - In Pursuit of Estimating Crowdfunding Projects Success Chance Using Regularized Correlational Topic Modeling Algorithm

Ramin Khatami, The University of Tokyo, 7 Chome-3-1 Hongo, Bunkyo, Tokyo, 113-8654, Japan, ramin@khatami.me, Mohsen Jafari Songhori

Existing works in estimating crowdfunding campaigns success are mainly based on basic numerical features such as projects' goal, duration, etc. In this work we investigate impact of textual similarities between projects on their success chance. In doing that, we have proposed a novel "regularized correlational topic modeling" method that takes into account success effects. The results show that our proposed method with a predictive algorithm like "feed-forward neural network with a single hidden layer" can achieve as much as 10% improvement in term of F1-score. Our findings enable project owners to better assess the associated risks with their crowdfunding projects.

22 - From Value Chain to Supply Chain, and from Business Ecosystems to Service-Dominant Logic: Understanding the Value Creation Perspectives

Roberto Andrés Alcívar Espín, National Taiwan University, Taipei, Taiwan, roberto.alcivar@epn.edu.ec, Yon- Chun Chou

This research addresses the concept of value creation from different perspectives: value chain, supply chain management, business ecosystem, and service-dominant logic. For illustration, the banana supply chain in Taiwan convenience stores is used as a case study. This case shows the different interactions of value creation from the perspectives of the farmers, wholesales, convenience stores and government regulations. This research provides clear guidelines to understand different value creation perspectives. Keywords: Supply Chain Management, Supply Chain Integration, Supply Chain Relationship, Business Ecosystems, Service-Dominant Logic, Value Chain, Taiwan Banana Case.

23 - AI and Blockchain-Enabled Integrated Healthcare, Retail and Finance Models

Grace Lin, Asia University, Taipei, 110, Taiwan, gracelin.ny@gmail.com, Ya-Hui Chan, Han-Chao Lee, Yvette Lin, Shawn Liou, Ko-Yang Wang

Business model innovations enabled by advances in technology, such as AI and Blockchain have disrupted the healthcare, retail and financial industries. Holistic healthcare focusing on predictive, preventive, personalized and participatory care (the 4Ps of healthcare) is becoming the center of healthcare management in Taiwan. To achieve these 4Ps, products and services ranging from healthy food and supplements, exercise equipment and monitoring devices to medicines, medical devices and more importantly, medical personnel including doctors, nurses, caretakers, as well as nursing and home service are needed. A new omnichannel retail business model, called Consumer to Business (C2B) and Consumer to Manufacturing (C2M), together with coordinated product- and service-matching to provide right-time service, is very necessary. To realize the benefits of cross-industry innovations, the International AI & Blockchain Consortium (iABC) designed an AI and Blockchain-enabled Cyber-Physical System (CPS) platform to support human-centric healthcare connecting hospitals and care facilities with new commercial and financial services. A blockchain-based private data vault is being developed to handle data both inside and outside hospital walls, collected from environmental sensors, medical history, equipment readings, wearable devices, online buying histories, social networks, app data and other resources that can be integrated, stored and analyzed. This data vault will allow users to make personal data-sharing decisions. Consolidating medical records, insurance claims, nutrition / diet and food traceability records into a consistent and reliable immutable ledger makes it possible for AI techniques to more effectively identify and manage health risk factors, and detect insurance fraud. Keywords: AI, Blockchain, healthcare, retail, finance, Omnichannel, Cyber-Physical System

24 - Using Big Data and AI to Enhance Institutional Research

Brick Tsai, Asia University, Taipei, Taiwan, brick.tsai@gmail.com, YiJia Chung, Ct Lee, Yueh-Lin Tsai, Ting Ying Yang, Jia-nian Zheng, Mt Chen, Grace Lin, Jeffrey Tsai

The tendency of having fewer children in Taiwan has brought a drop in the number of students, resulting in an oversupply of colleges, pressuring them into urgent transformations. Concurrently, the recent maturation of Big Data technology has enabled it to assist in making decisions and to react to rapidly changing talent demands and increase teaching effectiveness. Hence higher education institutes have applied Big Data in institutional research, including prediction of learning effectiveness, course design, and institutional decision-making. Nevertheless, a well-established intelligent college administration system is highly dependent on vertical and horizontal data integration to ensure that students, teachers, schools and industries benefit from the decisions formulated via data analytics. Therefore, the overall goal of the research was to develop a self-learning IR decision-making system by incorporating AI and cognitive computing engines, as well as integrating time and space information in order to address talent demands and gaps. With the aim of an end-to-end framework for learning history, and learning outcomes, as well as job-matching, three subprojects were implemented in order to annually integrate results from the following tasks: 1) Building up a Big Data reservoir for institutional research; 2) Exploiting data mining from external industry talent demands; and 3) Predicting the results of internal learning. For colleges, research achievements are expected to increase the sensitivity of talent demands, effectively monitoring students' learning outcomes, and enhancing the efficiency of decision-making for effective teaching and institutional management. For industries, the results of this research could lead to developing robust talent cultivation and optimizing the effectiveness of educational resources, allowing industries to profit from the seamless matching of knowledge and skills. Keywords: Institutional Research, Talent Demand, Learning Outcomes, Big Data, Artificial Intelligence, Data Mining

25 - Supply Chain Finance

Ya-Hui Chan, Asia University, Taipei, Taiwan, yahui0219@gmail.com, Kh Chen, Lun-Wei Ku, Han-Chao Lee, Chia-Ya Shen, Ko-Yang Wang, De-Nian Yang, Grace Lin

For SMEs (small and medium-sized enterprises) situated in supply chains stretching across the globe with multinational buyers and suppliers, trapped capital is the primary obstacle to growth. Supply chain finance, also known as supplier finance or reverse factoring, is a set of solutions that optimizes cash flow by extending payment terms for buyers while providing the option to collect

payment early for suppliers. As buyers' working capital is optimized, and suppliers' additional operating cash flow is created, the overall risk of the supply chain is minimized, leading to a win-win. Though serving financial needs of SMEs becomes increasingly important, the accessibility of financial support for SMEs is limited due to deficit credit rating information and assessment mechanism. In this research, we propose leveraging Supply Chain Network information and using advanced NLP (Natural Language Processing), multi-source learning, and stochastic network modeling, and its analysis and optimization to better assess SMEs' credit rating and their risks, as well as providing financial services in way of loans, P2P (peer to peer lending) or crowd sourcing as needed. A robust model has been constructed by taking into account information both upstream and downstream of the supply chain including credit rating, supply and demand, and operation conditions, along with external factors and customer feedback from social networks. Thus risk and credit rating would be well-managed by the information about capabilities and the position in supply networks. Furthermore, a crowd-sourcing demo system invigorated by a blockchain and a smart contract will be established to study and to demonstrate the effectiveness of the proposed risk assessment, realize RegTech-embedded applications, and all above-mentioned methodologies and their applications. This system is expected to be commercialized by a FinTech and/or a financial company and an SME. Keywords: Financial Technology (FinTech), Natural Language Processing (NLP), Multi-Source Learning, Stochastic Network Modeling, Smart Contract, Supply Chain Financing

Monday, 1:30PM - 2:20PM

■ Monday – Keynote

102, 1st Floor

Keynote: Machine Learning, Artificial Intelligence and Optimization: Opportunities for Inter-Disciplinary Innovation

Keynote Session

1 - Machine Learning, Artificial Intelligence and Optimization: Opportunities for Inter-Disciplinary Innovation

Radhika Kulkarni, SAS Institute Inc., Cary, NC, United States,

Machine learning tools and AI platforms have become prolific in many industries. Applications range from health care to financial applications to manufacturing industries. In the world of big data and ML / AI tools, there are numerous opportunities for application of optimization techniques. Large scale implementation of machine learning tools in artificial intelligence platforms require automation at several levels - increasing productivity along the entire analytics lifecycle as well as automated model selection to improve predictive models. In many of these problems, optimization techniques play an important role in finding solutions as well as improving performance. This presentation will provide several examples that describe some of these innovations in various industries as well as discuss trends and upcoming challenges for future research.

■ Monday Keynote

101C/D, 1st Floor

Keynote: Smart Markets for a Smart Electricity Grid

Keynote Session

1 - Smart Markets for a Smart Electricity Grid

Shmuel S. Oren, University of California-Berkeley, Etcheverry Hall, Room 4119, Berkeley, CA, 94720-1777, United States, oren@ieor.berkeley.edu

Socio economic forces, development in generation technologies and environmental considerations have led to restructuring of the electric power systems in part of the USA and in many systems worldwide, transforming them from vertically integrated regulated monopolies to competitive market based systems. From a supply chain perspective competitive electricity markets represent, perhaps, the most challenging supply chain. The commodity is non-storable; demand is uncertain and highly correlated with weather, all the demand must be satisfied instantaneously with a high level of reliability (one day in ten years criteria for involuntary load curtailment). In addition service is provided over a network that is prone to congestion, flows over transmission lines cannot be directly controlled as in a transportation system (flows follow Kirchhoff's laws) and the market is encumbered by numerous externalities and market power. In spite of such obstacles there has been fascinating developments in the design and operations of competitive electricity markets over the last fifteen years through the use of state of the art optimization tools and economic principles. This talk will describe some of the key challenges in designing and operating competitive electricity markets. I will review the basic elements and alternative approaches adopted in different systems and discuss what we have learned so far in this area. I will also discuss new challenges and opportunities due to massive integration of renewable resources, proliferation of smart grid technologies and electrification of the transportation sector.

■ Monday Keynote

101A/B, 1st Floor

Keynote: Asymptotically Optimal Policies for Multi-Item Joint Inventory and Dynamic Pricing Control with Stockout-based Substitution

Keynote Session

1 - Asymptotically Optimal Policies for Multi-Item Joint Inventory and Dynamic Pricing Control with Stockout-based Substitution

Guillermo Gallego, HKUST, Kowloon, Hong Kong,
ggallego@ust.hk

We propose asymptotically optimal policies for a joint inventory and price control problem where the seller replenishes substitute products only once and dynamically controls the prices during the selling season to maximize the total expected profit. Considering complexity of the problem especially when the problem size is large and there exists dynamic stockout-based substitution by customers, we propose an efficient nonlinear program to determine the prices and a linear complementarity problem to decide on inventory levels reflecting consumer-driven substitution for given prices. We also show that a simple heuristic to dynamically update prices can further improve expected profits.

■ Monday Keynote

103, 1st Floor

Keynote: The Entrepreneurial University: Integrating Knowledge and Innovation for Impact

Keynote Session

1 - The Entrepreneurial University: Integrating Knowledge and Innovation for Impact

Lam Khin Yong, NTU-Nanyang Technological University,
Singapore, Singapore, lamky@ntu.edu.sg

Over the past decade, the intensifying societal demand for advanced knowledge and innovation has led to the unprecedented growth of new networks between industry, academics and public agencies. This trend continues unabated as the pursuit of economic competitiveness and the need to alleviate society's emerging challenges grows. As such, how can the university further mobilise key resources, networks and support to optimize the growth of impact pathways and corridors of innovation? What are the external determinants that actively shape the nature and structure of these collaborations and innovation eco-systems? This presentation seeks to undertake an assessment of the organisational patterns and the conditions that play an important role in galvanizing effective and rapid knowledge flows to stimulate economically and societally useful innovations. Drawing from examples at Nanyang Technological University, the presentation shall provide models of successful industry-academia-public agency interconnections that have served to create skills, knowledge and innovations of industrial and societal relevance.

Monday, 3:00PM - 4:30PM

■ MC01

101A, 1st Floor

Revenue Management and Pricing in OM&IS

Sponsored: Revenue Management & Pricing

Sponsored Session

Chair: Hao-Chun Chuang, National Chengchi University,
chuang@nccu.edu.tw

1 - Investigating Strategic Customer Behavior for Hotel Standby Upgrades

Guangzhi Shang, Florida State University, Department of
Marketing, College of Business, Tallahassee, FL, 32306,
United States, gshang@fsu.edu, Ovunc Yilmaz, Pelin Pekgun,
Mark Ferguson

Hotel chains are increasingly using standby upgrades to clear premium room inventory. While generating additional revenue through upgrades, this innovative practice might also incentivize cannibalization from strategic consumers. Using a large dataset sponsored by the implementer of standby upgrade, we empirically investigate the existence and extent of strategic consumer behavior.

2 - Exclusivity in the Software Industry

Yu-Chen Yang, National Sun Yat-sen University, 70 Lienhai Road,
Department of Information Management, Kaohsiung, 80424,
Taiwan, ycyang@mis.nsysu.edu.tw, Hao Ying, Yong J. Jin,
Hong Guo

Exclusive deals are very common in the software industry. For example, the video game "Rise of the Tomb Raider" was offered a full year of exclusivity on Microsoft's xBox One. It would not be released for the competitor, Sony PS4, until one year later. We develop an analytical model of game profits that examines the optimal exclusive duration for platforms and developers. Our result shows that platforms prefer making an exclusive deal while developer prefers staying across different platforms, where platforms and developers have the totally different preferences for the duration of the exclusivity. However, a game can only begin to make profit after platforms and developers making an agreement in the duration of exclusive deal. We further explore the strategies for platforms and game developers in the simultaneous game and sequential games.

3 - Certificate or Subscription? The Optimal Pricing Strategy of Massive Online Open Courses

Ling-Chieh Kung, National Taiwan University, Room 413,
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Taiwan, lckung@ntu.edu.tw, Pei-Jung Yang

Massive Online Open Courses (MOOCs) are raising worldwide concerns now. The educational characteristic of MOOCs makes it different from the traditional information goods, and its pricing strategy therefore deserves high attention. By observing that major MOOC platforms started to move from the certificate business model to the subscription one, we focus on the business model selection problem faced by MOOC platforms. In this paper, we construct a game theoretical model with a MOOC platform, an educational institution, and a group of learners. We study the profitability of three models: the certificate model, the subscription model, and the mixed model. We find that learners' bounded rationality is a key for MOOC platforms to introduce the subscription option to learners. Interestingly, while having some learners overestimating their ability benefits the institution and platform, it does not matter whether learners underestimate themselves or not.

4 - Multi-location Assortment Optimization under Capacity Constraints

Alper Sen, Bilkent University, Department of Industrial
Engineering, Bilkent, Ankara, 06800, Turkey,
alpersen@bilkent.edu.tr, Basak Bebitoglu, Philip Kaminsky

We study the assortment optimization problem for a retailer which uses multiple distribution centers (DC) to fulfill orders. Each DC can carry up to a fixed number of products and is primarily responsible for a geographical region whose customers' choice is governed by a separate multinomial logit model. A DC can satisfy the demand from a different region, but this incurs an additional shipping cost for the retailer. The problem is to determine which products to carry in each of its distribution centers and which products to offer for sale in each region so as to maximize its expected profit. We first show that the problem is NP-complete. We then develop a conic quadratic mixed integer programming formulation and suggest a family of valid inequalities. Numerical experiments show that our conic approach over-perform the MILP formulation and enables us to solve large instances optimally. Finally, we study the effect of various factors such as no-purchase preference, capacity constraint and shipping cost on profitability and assortment selection.

■ MC02

101B, 1st Floor

Inventory Management II

Invited: Supply Chain Inventory Management

Invited Session

Chair: Yixuan Xiao, City University of Hong Kong, Kowloon,
Hong Kong, yixuxiao@cityu.edu.hk

1 - Inventory Management under Corporate Income Tax

Yixuan Xiao, City University of Hong Kong, 83 Tat Chee Avenue,
Kowloon, Hong Kong, yixuxiao@cityu.edu.hk, Zhan Pang

Corporate income tax is one of the primary financial costs for businesses. We study a firm's inventory decision under taxation. Starting from the newsvendor setting, we characterize the structure of the optimal inventory policies under progressive tax. We show that how the tax structure impacts inventory decisions. We then generalize our analysis to dynamic settings with multiple accounting periods where each accounting period consists of multiple order periods. We also consider the case with loss carry forward and joint pricing and inventory decisions.

2 - Managing Multi-echelon Supply Chains with Guaranteed Service and Expediting

Yimin Yu, City University of Hong Kong, Department of Management Sciences, 83 Tat Chee Ave., Kowloon, Hong Kong, yiminyu@cityu.edu.hk, Xiaobei Shen, Jing-Sheng Jeannette Song

We consider the optimal coordination of inventory ordering and expediting in a multi-echelon supply chain with service guarantees on delivery time. Any new customer orders are guaranteed to be fulfilled within a fixed time period. We allow inventory expediting to ensure in-time service. We show that a calibrated echelon base stock policy is optimal for the ordering decisions, and the calibrated echelon base stock level is either a state-independent constant or a demand variable. For the inventory expediting and demand fulfillment problem, we find that a calibrated threshold policy is optimal. The calibrated threshold is either a state-independent constant or an echelon inventory variable. Though these policies are state-dependent, they can be efficiently applied in practice. We provide a polynomial-time algorithm to implement the optimal policies in this study. Essentially, all our results are obtained based on a new concept proposed in this study, named decomposition-degree-2, and its preservation under minimization operators.

3 - Preservation of Additive Convexity and its Applications in Stochastic Optimization Problems

Xiting Gong, The Chinese University of Hong Kong, Room 506, William M.W. Mong Engineering Building, Hong Kong, xtgong@cuhk.edu.hk, Tong Wang

In this paper, we establish two new preservation results of additive convexity for a class of optimal transformation problems and a class of optimal disposal problems. For both classes of problems, there are multiple resources and the optimal policies provide different priorities to transform/dispose these resources; and we prove that the additive-convexity property preserves under the optimal transformation/disposal decisions. We demonstrate the applications of our preservation results to three important stochastic optimization problems in operations management: stochastic inventory management with remanufacturing, dynamic inventory rationing with multiple demand classes, and dynamic capacity management with general upgrading.

■ MC03

101C, 1st Floor

Data-Driven Methods for Dynamical Systems

Invited: Machine Learning and Big Data Analytics

Invited Session

Chair: Chun-An Chou, Northeastern University, Boston, MA, 02115, United States, ch.chou@neu.edu

Co-Chair: Jr-Shin Li, Washington University in St. Louis, MO, United States, jsli@wustl.edu

1 - Subspace Learning and Representation of Dynamic Coordination Pattern across Multiple Joints for Chronic Ankle Instability

Chun-An Chou, Northeastern University, 360 Huntington Ave, 334 SN, Boston, MA, 02115, United States, ch.chou@neu.edu, Shaodi Qian, Sheng-Che Yen, Eric Folmar

Ankle sprains and instability are major public health concerns. Up to 70% of individuals do not fully recover from a single ankle sprain and eventually develop chronic ankle instability (CAI). The diagnosis for CAI has been mainly based on self report rather than objective biomechanical measures. The goal of this study is to examine differences in multi-joint running patterns between healthy individuals and those with CAI. The difference will be further developed as a diagnostic tool to differentiate these two populations. A novel subspace learning algorithm was proposed to estimate the coordination among bilateral hip, knee, and ankle joints to identify informative patterns. The computational results showed >95% classification accuracy with the identified patterns using a support vector machine within leave-one-subject-out cross validation. This developed method can potentially support the diagnosis and treatment of disability in motion and/or other functions.

2 - Koopman Reduction and Classification for Dynamic Data

Jr-Shin Li, Professor, Washington University in St. Louis, 1 Brookings Drive, Box 1042, Saint Louis, MO, 63130, United States, jsli@wustl.edu

For time-series data presenting active dynamic characteristics, many of the state-of-the-art techniques may fail to capture the inherited temporal structures in the dataset. Integrating the theory of Koopman operators, linear dynamical systems, and support vector machine, we develop a dynamic data mining approach to construct a low-dimensional linear model that approximates the nonlinear flow of high-dimensional time-series data generated by a nonlinear dynamical system. This induced linear model can then be used as a classifier to distinguish the dynamics represented by different time-series data. This framework lays a

foundation for effective dynamic data mining tasks such as classification and pattern recognition. We demonstrate the applicability and efficiency of this data-driven method through the study of time-series classification in the fields of bioinformatics and healthcare, including cognition classification and seizure detection using fMRI and EEG data, respectively.

3 - Koopman Operator Techniques in Data-driven Energy Systems Technology

Yoshihiko Susuki, Osaka Prefecture University, Sakai, Japan, susuki@eis.osakafu-u.ac.jp

The so-called data-driven approach is currently attracting a lot of interest in systems engineering for energy supply and distribution. I and my collaborators have studied Koopman operator theory in nonlinear dynamical systems and its applications to energy systems technology since 2009. The Koopman operator is a linear infinite-dimensional operator defined for a wide class of nonlinear dynamical systems, and its spectral analysis reveals statistical and geometric properties of the underlying nonlinear systems. In this talk, I will provide an overview of our research efforts with emphasis on data-driven analysis and control of energy systems. The target systems are taken from nationwide power networks and building energy systems. I will describe how spectral properties of the Koopman operator are exploited for control of cascading dynamics in a power network and for analysis of complicated temperature-field dynamics inside a practical building.

4 - Koopman Spectral Analysis with Reproducing Kernels for Nonlinear Dynamical Systems

Yoshinobu Kawahara, Osaka University / RIKEN, Osaka, Japan, ykawahara@sanken.osaka-u.ac.jp

In this talk, I describe a machine learning technique for spectral analysis of Koopman operators for nonlinear dynamical systems using reproducing kernels. Using reproducing kernels in the analysis could avoid the issue in selecting nonlinear observables to estimate accurately spectrums of Koopman operators from finite data. Also, it provides a more flexible scheme that is applicable to structured data sequences such as graph sequences. In this talk, I also show some applications of our method to several real-world data.

■ MC04

101D, 1st Floor

Competition and Contracting in Supply Chains

Invited: Operations and Marketing Interface

Invited Session

Chair: Ke Fu, Lingnan College, Guangzhou, 510275, China, fuke@mail.sysu.edu.cn

1 - Wholesale Pricing and Channel Coordination under Emission Cap and Fairness Concern

Zhaowei Miao, Xiamen University, Xiamen, China, miaozhaowei@xmu.edu.cn, Zhe Tan, Shuting Xu, Huiqiang Mao, Lili Shanguan

This paper incorporates the fairness concerns in a conventional competing dual channel to investigate whether fairness may have different impact on channel coordination between dyadic channel and dual channel. Contrary to previous studies, the results show that the constant wholesale price contract is not efficient to achieve the coordination of the fair dual channel supply chain due to the competition between two retailers. However, if the manufacturer takes into consideration the emission cap, the fair dual channel can be coordinated with a constant wholesale price, which means the introduction of a well-designed emission policy can not only improve the profits of the supply chain but also foster the equality relationships between the manufacturer and the retailers. What's more, it is also found that different to the result of the dyadic channel that the emission cost has always adversely effects on the profits of the chain and its members.

2 - Pricing and Tracking Strategies under Competition

Bin Dai, Wuhan University, Bayi Road, Wuhan, 430072, China, bin_dai@whu.edu.cn, xinyu Li

In a supply chain with product recall, this study considers optimal pricing and tracking strategies for two heterogeneous manufacturers who are competing on price and tracking capability. Our objective is to explore the impact of different competition modes, like the price-dominated competition, tracking capability-dominated competition, equally pooled competition, and general pooled competition, on the manufacturers' pricing and tracking strategies. We obtained the closed expressions of pricing and tracking strategies for each competition modes under various potential market sizes and product recall probability, and then explored the impact of competition by comparing optimal pricing and tracking strategies under various competitions with that of no competition. Furthermore, we explored the impact of both cartelization and coalition on the pricing and tracking strategies as well to characterize some management insights.

3 - Altruism or Shrewd Business? Implications of Technology Openness on Innovations and Competition

Hongyan Xu, Chongqing University, School of Economics & Business Admin, Chongqing, 400030, China, xuhongyan@cqu.edu.cn, He Huang, Geoffrey Parker, Yinliang Tan

In today's highly competitive business environment, a growing number of firms are opening their technologies. This leads us to wonder whether sharing one's proprietary technology is altruism or a shrewd business move. In this paper, we study the incentive of why firms share their proprietary technology with their competitors. In contrast to previous literature focusing on the network effect, our study reveals a novel explanation for why firms are willing to open their technologies.

4 - On Stackelberg Structures and the Introduction of Store Brand

Jing Liu, Sun Yat-sen University, Guangzhou, China, liuj243@mail2.sysu.edu.cn, Ke Fu

Store brand problem has become increasingly important as the competition between national brand manufacturers and retailers intensifies. This paper compares two alternative Stackelberg games between a national brand manufacturer and a retailer who may introduce a store brand. We assume that the retailer possesses better demand information due to its close proximity to consumers. We find that the two players' profits under the two Stackelberg games are different. In addition, both players prefer to be the leader when the demand information is perfect, while the first-mover advantage may disappear under incomplete information.

■ MC05

Practice V

Invited: Practice/Industrial Applications

Invited Session

Chair: Akira Sakakibara, Microsoft Japan, Microsoft Japan, Tokyo, Japan

1 - AI Research at Microsoft Research

Akira Sakakibara, Microsoft Japan, Tokyo, Japan

Microsoft Research (MSR), the research division of Microsoft, celebrated its 25th anniversary last year. MSR has been conducting AI research since its founding. In this talk, I will discuss the current direction of the AI-related research at MSR amidst the new AI boom we are experiencing, along with some research examples

2 - FinTech and the Financial Transformation

Ko-Yang Wang, Fusions360-Taiwan FinTech Corp., Taipei, Taiwan, kyw@fusions360.com

FinTech is disrupting the financial industry globally. McKinsey predicted that 40% of banking industry's revenue and 60% of the profits will be taken away by non-financial companies. But what's more important, is the much larger inclusive financial services of small and medium enterprises and individuals whom the financial institutes failed to serve. Since IT is disrupting every industry, enabling SMEs with inclusive financial services will power the growth of digital economy and accelerate the next wave of economy evolution. In this talk, Dr. Wang will discuss the current state of FinTech revolution and financial transformation, areas where analytics and AI can have significant impacts on the future of finance, and approaches for establishing an open, global sharing ecosystem to democratize accesses to data and analytics and to enable flexible, low cost, scalable inclusive financial services for smart digital economy.

■ MC06

103, 1st Floor

Tutorial: How to Leverage Big Data Analytics to Grow Business – I

Tutorial Session

1 - How to Leverage Big Data Analytics to Grow Business

Chi-Yi Kuan, LinkedIn, 640 Curtner Rd, Fremont, CA, 94539, United States, chiyi2@yahoo.com

In this tutorial, we will illustrate the big data analytics lifecycle and share our practices leveraging advanced big data analytics and machine learning techniques to grow business at LinkedIn. You'll learn how to empower business partners to access insights whenever needed, how to optimize business performance by leveraging unique data, and how to innovate for sustainable business growth.

■ MC08

201A, 2nd Floor

Information Extraction and Utilization

Invited: Fusions of Big Data, AI, Blockchain and FinTech Applications

Invited Session

Chair: Lun-Wei Ku, Institute of Information Science, Taipei, Taiwan, lwku@iis.sinica.edu.tw

1 - Identification of Adverse Drug Reactions and Medication Intakes from Social Networks Using Combinations of Language Features

Emily Su, Taipei Medical University, Taipei, Taiwan, emilysu@tmu.edu.tw

In this study, we proposed a systematic method to identify adverse drug reactions (ADR) and medication intakes. First, we collected tweets mentioning ADR and describing medication intakes. Secondly, we performed hashtags removal, tokenization, stemming, and identification of drug dosages. Finally, language features such as n-gram, part-of- speech, and lexicon-based features were extracted and incorporated into deep learning algorithms.

2 - AI Chatbots for Conversational Commerce in Finance

Min-Yuh Day, Tamkang University, New Taipei City, Taiwan, myday@mail.tku.edu.tw

In this talk, I will focus on the recent advances on AI chatbots for conversational commerce in finance. AI and Financial Technology (FinTech) has received a considerable attention in the fields of information technology and financial research in recent years. I will discuss the AI chatbots for innovative conversational commerce with intelligent human computer interaction model of robo-advisors in Finance.

3 - Chinese Textual Entailment Recognition Task

Chuan-Jie Lin, y, National Taiwan Ocean University, Keelung, Taiwan, cjlin@mail.ntou.edu.tw

In this talk, I will introduce the Chinese datasets for textual entailment recognition (RTE) in NTCIR RTE tasks. RTE is an important technique in NLP since it can achieve deeper understanding in many areas, such as information retrieval (to detect paraphrase passages or conflict news) and text summarization (to find redundant information). Achievements in the RTE tasks will also be discussed.

4 - Social Interaction Discovery and Publicity Mining

Yung-Chun Chang, Taipei Medical University, Taipei, Taiwan, changyc@tmu.edu.tw

Knowing the interactions of the persons involved in documents is helpful for readers to better comprehend the documents and their topics. To discover those interactions, we need a detection method that can identify text segments containing information about the interactions. We base on the recognition of reader's emotion of topic documents to further predict publicity of public figure in the social interaction network. In addition, we develop a flexible approach for topic classification that simulates such process in human perception.

■ MC09

201B, 2nd Floor

Operations Management I

Contributed Session

Chair: I-Ling Yen, University of Texas at Dallas (UTD), 800 W Campbell Drive, Plano, TX, 75080, United States, ilyen@utdallas.edu

1 - An Investigation of Orchestration in the Emergence of an Ecosystem: Evidence from a Smart City Ecosystem in Taiwan

Mei-Hsing Lin, PhD Student, National Cheng Kung University, 1, University Rd., Tainan, 701, Taiwan, R48011016@mail.ncku.edu.tw, Hsin-Hui Chou

This paper aimed at exploring the orchestration process in the emergence of an ecosystem. We integrated the concepts of service-dominant logic, business ecosystems, and orchestration, to lay the theoretical foundations. We conducted a case study on the emergence process of a smart city ecosystem (namely, Taoyuan Smart City) in Taiwan. The case, with a 3-year time-span, detailed how key stakeholders were orchestrated by the Ministry of Economic Affairs, and how the emergent systems were linked and coordinated, evolving towards a smart city ecosystem. The findings permitted us to enrich the understanding into ecosystems, and to develop implications for practitioners as well as policy makers.

2 - On Impact of Motivations on the Agent's Preferences in Representative Negotiations

Gregory E. Kersten, Concordia University, Montreal, QC, Canada, gregory.kersten@concordia.ca, Ewa Roszkowska, Tpmasz Wachowicz

Analysis of online bilateral negotiation experiments shows that the majority of agents, who negotiate on behalf of their principals, make both cardinal and ordinal errors in the reconstruction of the principals' preferences. We focus on the impact of epistemic, social, and identity motivations on the errors and on the impact of errors on the negotiation outcomes. The results show that the more rational the agents the more accurately they represent their principals' preferences. Substantive and learning goals are positively correlated with the ordinal and cardinal accuracy of the agents' preferences. The agents' errors are negatively correlated with the principals' substantive outcomes but the correlations are weak. The results also show that the agents who make no ordinal errors are less accommodating and avoiding but more competitive than the agents who make these errors. A majority of the ordinarily inaccurate agents achieve the best substantive outcomes in their own preference system, but these outcomes are the worst for the principals.

3 - Information Sharing in Supply Chains with Two Competing Retailers and Manufacturer Marketing Initiatives

Minghui Xu, Professor, Wuhan University, Wuchang District, Luojia Hill, Wuhan, 430072, China, mxu@whu.edu.cn

We study information sharing problem in a supply chain with one manufacturer and two competing retailers. We obtain equilibrium results and characterize conditions under which the retailer(s) share demand forecast information. The results indicate that the retailers' incentive to share information depends on marketing investment cost, competition intensity and the manufacturer's information contract. No (Only one, Both) retailer(s) would like to share information when marketing investment cost is small (moderate, large).

4- Cloud Workload Prediction using a Job-pool Based Approach and Clustering Based Learning

I-Ling Yen, University of Texas at Dallas (UTD), 800 W Campbell Drive, Plano, TX, 75080, United States, ilyen@utdallas.edu

Existing approaches for workload prediction are per-job based. The historical workload of a job is used to predict the future workload of the same job. However, these techniques may not be suitable for many cloud tasks because their workloads do not exhibit seasonality or predictable trend. Instead, we consider a job-pool based approach where the knowledge about the workloads of a pool of tasks is used to help predict the workloads of new tasks. In this paper, we develop a clustering-based learning approach to realize this concept and compare it with non-clustering based learning. Experimental results show that the clustering-based learning approach can predict the workload much more accurately.

5 - Could Omega Ratio Perform Better than Sharpe Ratio?

Sheung Chi Chow, Australian National University, Canberra, Australia, wong@asia.edu.tw, Haim Levy, Richard Lu, Wing-Keung Wong

In this paper, we will investigate whether there is any Sharpe ratio rule or Omega ratio rule that can be used to show that one asset outperforms another asset if it has a higher Sharpe ratio and/or Omega ratio. We find that Sharpe ratio rule could not detect preference of both risk averters and risk seekers in some strong dominance cases. We set up the Omega ratio rule and find that the Omega ratio rule is better than the mean variance rule because the former could the former can detect the first order stochastic dominated asset but the latter cannot. We also show the superiority of the Omega ratio rule over any Sharpe ratio rule by using hedging funds data and discuss the advantage of using the Omega ratio rule to stochastic dominance rule.

■ MC10

201C, 2nd Floor

Manufacturing Operation Analytics and Optimization

Invited: Operations Analytics and Optimization for Manufacturing, Logistics and Energy Systems

Invited Session

Chair: Lijie Su, Shenyang, 110819, China, sulijie@ise.neu.edu.cn

Co-Chair: Ying Meng, Northeastern University Logistics Institute, Shenyang, 110819, China, mengying@ise.neu.edu.cn

1 - Modeling and Analysis on Inventory Variability in a Multi-stage Steel Production Processes based on a Spatio-temporal Markov Approach

Junting Huang, Institute of Industrial and Systems Engineering, Northeastern University, China, Shenyang, 110819, China, huangjunting1987@163.com, Ying Meng, Lixin Tang

In this paper, a spatio-temporal Markov model is developed to describe the inventory variation propagation of multi-stage steel production processes. The inventory deviation transformations quantitatively described by the spatio-

temporal state transition probabilities, that is derived by the Markov model. Then, the bottleneck warehouses are further diagnosed based on the transition probabilities of inventory variation states. Finally, the experiments on real data in an iron and steel enterprise show the effectiveness of the proposed model.

2 - Performance Analysis and Reduction of a Class of Large-scale Supply Chain System by Semigroup Theory

Yuan Wang, Institute of Industrial and Systems Engineering, Northeastern University, China, Shenyang, 110819, China, 513495443@qq.com, Lixin Tang

A class of large-scale supply chain system with symmetries acting on structure is studied, which is also in accordance with the internal situation in industrial production supply chain. These symmetries are used to design algorithms with reduced complexity. The sufficient conditions of the performance analysis of this system are given based on the semigroup theory.

3 - A Simultaneous Method for Dynamic Optimization in Steel Reheating Furnace System

Lianjie Tang, Institute of Industrial & Systems Engineering, Northeastern University, Shenyang, China, tanglianjie@sina.com, Lixin Tang

According to the production process of steel reheating furnace, we develop a dynamic operation optimization problem with differential algebraic equation to get the optimal temperature profile. The control variables are limited by manufacturing process constraints in the problem. The traditional methods based on variational principle is unable to solve it. The simultaneous numerical method based on symplectic conservation is proposed for the nonlinear optimal control problem of steel reheating furnace.

4 - Modeling and Optimization for Batch Scheduling of Rare Earth Production Process with Uncertainty Demand

Lijie Su, Northeastern University, 135Box, Institute of Information, No. 3-11, Wenhua Road, Heping, Shenyang, 110819, China, sulijie@ise.neu.edu.cn, Lixin Tang, Ignacio E. Grossmann

This paper focuses on the batch scheduling for rare earth process with uncertainty demand of final products. We formulate a Mixed Integer Nonlinear Programming model for the batch scheduling problem based on unit-specific event driven continuous-time representation. The uncertainty demand is modeled using scenario tree. An improved Outer Approximation method is designed to solve the proposed model with real process data. Numerical experiments show that the optimization solution can improve the profit and working efficiency of rare earth process.

■ MC11

201D, 2nd Floor

Simulation and Finance

Invited: Financial Engineering in China

Invited Session

Chair: Yijie Peng, Peking University, 298 Chengfu Rd, Beijing, China, pengyijie@pku.edu.cn

1 - Efficient Simulation Design for Risk Management of Large Variable Annuity Portfolios

Ben Feng, University of Waterloo, 217 Holbeach Cres, Waterloo, ON, N2J 4Y3, Canada, ben.feng@uwaterloo.ca

Variable Annuities (VAs) have been popular yet complicated insurance products. For accurate valuation of individual VA contracts, Monte Carlo simulation is usually required due to the contracts' complexities. However, the computational resources required for valuing all contracts in a large VA portfolio could be prohibitively expensive. Recently there have been numerous research efforts on applying machine learning methods to the valuation of large VA portfolios. All of the proposed methods show superior computational efficiencies compared to the standard Monte Carlo experiment. However, it is unclear whether these proposals have leveraged the full power of the employed machine learning methods. The current research provides a comprehensive comparison among some of recent proposals for large VA portfolio valuation. In particular, we identify pitfalls in some methods and propose improvements. Moreover, we propose and test a new valuation method. We show that resulting procedure is faster and more accurate than the benchmark methods.

2 - Estimating Sensitivities of Copula using Monte Carlo

Lei Lei, PhD, Fudan University, Shanghai, 200433, China,
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Copula-based models provide a great tool in multivariate analysis to study dependencies between variables. To understand the influences of dependence, one needs to know how changes in dependence related parameters affect the output performance. When copulas are used to model the dependencies between variables, these effects can be called as copula sensitivities. In this paper, we provide a general infinitesimal-perturbation-analysis (IPA) estimator and an likelihood ratio (LR) estimator for copula sensitivity, both of which are unbiased and consistent. We also give an SPA (Smoothed Perturbation Analysis) estimator for two portfolio credit derivatives.

3 - A Misspecification Test for Simulation Metamodels

Kun Zhang, City University of Hong Kong, Kowloon, Hong Kong,
kkunzhang2013@gmail.com, Guangwu Liu, Shiyu Wang

We propose a novel misspecification test for simulation metamodels. It is a consistent test that helps to assess the adequacy of simulation metamodels. The test statistic we construct is shown to be asymptotically normally distributed under the null hypothesis that the metamodel is correct, while diverging to infinity at a rate of $\sqrt{n}$, where n is the test sample size if the given metamodel is inadequate. Furthermore, as a by-product, we construct confidence intervals for mean squared errors of the metamodels. Preliminary numerical studies show that the test works quite well and has good finite-sample properties.

4 - Maximum Likelihood Estimation by Monte Carlo Simulation: Towards Data-driven Stochastic Modeling

Yijie Peng, Peking University, 298 Chengfu Rd, Beijing, China,
pengyijie@pku.edu.cn, Michael Fu, Bernd Heidergott, Henry Lam

We propose a gradient-based simulated maximum likelihood estimation to estimate unknown parameters in a stochastic model without assuming that the likelihoods of the observations are available in closed form. The density and its derivatives are estimated using a generalized likelihood ratio method by Monte Carlo simulation. Gradient-based simulated maximum likelihood estimation is flexible in handling various types of model structures. Numerical results highlight the merits of the proposed method.

MC12

201E, 2nd Floor

Last Mile Logistics

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Tsung-Sheng Chang, National Chiao Tung University,
Hsinchu, Taiwan, tsc@nctu.edu.tw

1 - Multi-compartment Refrigerated Vehicle Routing Problems with Time Windows and Temperature Restrictions

Chi-Yu Chen, National Chiao Tung University, Hsinchu, Taiwan,
chenchiyu83@gmail.com, Tsung-Sheng Chang

To slow down decay, fresh produce is commonly carried by multi-compartment refrigerated vehicles. However, it is quite difficult to maintain the temperature in refrigerated vehicles that conduct multi-drop deliveries to customers with a little time between two stops because door openings cause heat ingress directly from outside air, and may damage foods. Therefore, this research intends to tackle the multi-compartment refrigerated vehicle routing problems with time windows by explicitly and strictly controlling the temperature in each compartment along delivery journeys.

2 - A Mathematical Programming Model for the Lastmile Delivery with Crowdsourcing Integration

Muhammad Nashir Ardiansyah, National Chiao Tung University,
Hsinchu City, Taiwan, nashir.ardiansyah@gmail.com,
m, Kuancheng Huang

Sharing economy has received considerable attention in various areas. Along with this trend, this study proposes a mathematical programming model, in which the crowdsourcing has been integrated with the traditional last-mile delivery by trucking. The numerical results show that the crowdsourcing can help increase the truck carrier utilization and reduce the number of trucks, especially for remote areas.

3 - Optimizing the Implementation of Dual Local Search

Mona Hamid, University of Edinburgh, Office 3.24, University of
Edinburgh Business, 29 Buccleuch Place, Edinburgh, EH8 9JS,
United Kingdom, Mhamid@ed.ac.uk, Jamal Ouenniche

In this research, we propose a refined generic and parametrised dual local search (GPDLS) algorithm with application in routing. The novelty of this dual search framework lies in exploring the space of infeasible solutions in search for the optimal or near optimal feasible solution. Furthermore, a hyperheuristic framework is proposed to optimise the choice of the parameters of GPDLS, referred to as HH-GPDLS. Empirical results suggest that the proposed HH-GPDLS delivers an outstanding performance.

MC13

201F, 2nd Floor

Operations and Economics Interface II

Invited: Operations and Economics Interface

Invited Session

Chair: Zhuoyu Long, The Chinese University of Hong Kong,
zylong@se.cuhk.edu.hk

1 - Joint Inventory and Pricing Control with Consumption Targets

Runhao Zhang, The Chinese University of Hong Kong,
No 1 Connaught Place, Jardine House, Hong Kong,
rhzhang@se.cuhk.edu.hk

In this paper, we study the joint inventory-pricing decision problem with financing control under the target-oriented decision criterion. We provide algorithm to solve the optimal control policies. In addition, we also identify the structure of the optimal policies under some special cases. With the target-oriented framework, we can also solve the approximate solutions efficiently using decision rules. With numerical studies, we report favorable computational results for using targets in regulating uncertain consumption over time.

2 - Analysis of Incentivized Ride Matching as Stackelberg Queue

Qi Wu, Chinese University of Hong Kong, William M.W. Mong
Engineering Building, Rm 507, Shatin, NT, Hong Kong,
qwu@se.cuhk.edu.hk

We study incentive strategies using a queueing game approach. Our key assumption is that the driver supply is finite and reusable while riders arrive stochastically. With this assumption, we first establish the endogenous forces driving the imbalances between supply and demand with zero monetary incentive. We then administer incentives between the platform and the driver population via Stackelberg games and study the system's intrinsic capacity bounds in steady state. We show that the optimal amount of myopic incentives is achieved when the circulation of the reusable pool of the driver supply is the fastest. Further spending beyond the optimal, however, is potentially disruptive.

3 - Worst-case CVAR and Distributionally Robust Assortment Optimization under the Multinomial Logit Model

Xiaolong Li, Shanghai Jiao Tong University, Shanghai, China,
ymingchen_123@163.com, Jiannan Ke

We consider distributionally robust assortment optimization problems under the multinomial logit choice model. The true parameters of the choice model are assumed to be unknown, and we only know their mean and covariance matrix. The objective is to find an assortment that maximizes the expected revenue within a chance constraint, which can be conservatively approximated by the worst-case conditional value-at-risk constraint. We show the equivalence between our problems and robust assortment optimization problems over the uncertainty set of parameters, so that revenue-ordered assortments are still optimal. We compare the performance of our approach to other methods in numerical studies.

4 - Risk Sharing, Inventory and Financial Decisions with Cooperative Financing

Bin Cao, South China University of Technology, Guangzhou, China, bincscut@foxmail.com, Yuanguang Zhong, Yong Wu Zhou, Xin Chen

Cooperative financing has been used commonly by small and medium-size enterprises (SMEs) for years. However, very few papers have investigated the efficacy of cooperative financing in operations literature. To fill this gap, this paper considers two financially-constrained firms finance their procurements under both non-cooperative and cooperative financing modes. Under the non-cooperative financing mode, we formulate a newsvendor-type model to derive the financing and ordering decisions. For the cooperative financing mode, the firms and the bank first make a prior cooperation arrangement that the firms should provide a completely joint liability each other at the end of the sales season, and thus the bank offers a loan to each firm when needed. With such prior arrangement, we develop a two-stage decentralized model in which the two firms separately make unilateral ordering decisions. We then establish the existence of equilibrium and thus characterize the (non-trivial) equilibrium solutions of the two firms for the cooperative financing mode. It is intriguingly to show that the firms become more aggressive in ordering as the shared risk goes up, and they overinvest in ordering under cooperative financing mode. Further, we compare the two financing modes from the perspective of the two firms, and show that the choice of a financing mode is completely determined by a simple two-threshold policy in regards to the two firms' initial cash levels and interest rates. Nevertheless, the cooperative financing mode can become a "win-win-win" arrangement for the two firms and the bank when its exogenously interest rate is within a reasonable range. In addition, we demonstrate the impacts of initial capital, retail price, product cost, and demand variability on the firms' and the bank's performances, and provide some plausibly managerial implications of how to look for the high-quality peers as possible for the firms.

■ MC14

202A, 2nd Floor

Harnessing Renewable Energy and Efficiency

Invited: Environment, Energy, and Natural Resources

Invited Session

Chair: Dong Gu Choi, Pohang University of Science and Technology, 77 Chengam-Ro, Nam-Gu, Pohang, Gyeongbuk, 37673, Korea, Republic of, dgchoi@postech.ac.kr

1 - Feasibility Evaluation and Development Strategies for Offshore Wind System in Taiwan

Thi anh tuyet Nguyen, PhD Student, National Taiwan University of Science and Technology, No. 43, Section 4, Keelung Road, Daan Dist, Taipei, 10607, Taiwan, anhtuyet213@gmail.com, Shuo-Yan Chou

This paper assesses the currently applied subsidies of Taiwan government through economic criteria, shows some deficiencies of the currently applied subsidies, and proposes more appropriate subsidies for solving the deficiencies of the currently applied subsidies. Particularly, we propose dividing the investigated regions into five groups, reducing Feed-in-tariff (FIT) in medium feasibility group, upper-medium feasibility group and high feasibility group, and allocating the reduced amount to low feasibility group. The results indicate that the proposed subsidies are more appropriate for Taiwan to promote the expansion of offshore wind system.

2 - Determining Optimum Control Strategies of Water Dispenser for Energy Conservation

Irene Karijadi, National Taiwan University of Science and Technology, Da'an District, No 43, Section 4, Keelung Road, Taipei, 8862, Taiwan, irenekarijadi92@gmail.com, Shuo-Yan Chou, Anindhita Dewabharata, Ferani Eva Zulvia, Yudhistira Chandra Bayu

This study develops a water dispenser management system which improves energy consumption efficiency while maintaining the service level. To save the energy consumption, the proposed system controls the heating and cooling process while it is not used. In the proposed system, some sensors are installed to the water dispenser to collect water consumption data. The data will be used to predict demand and design optimal control strategy. The proposed system is validated using a simulation. The result indicates that the proposed system can reduce energy consumption compared with the traditional water dispenser operation strategy.

3 - The Effects of New Energy Policy on the Power System Reliability and Flexibility in South Korea

Dong Gu Choi, Assistant Professor, Pohang University of Science and Technology (POSTECH), 77 Chengam-Ro, Nam-Gu, Pohang, Gyeongbuk, 37673, Korea, Republic of, dgchoi@postech.ac.kr, Daiki Min, Jong-hyun Ryu, Hansung Kim, Daeho Kim, Hyungjun Park

The Korean government has recently decided to expand renewable energy technologies (RETs) while reducing the portion of nuclear and coal power plants. The large deployment of RETs could possibly hurt the power system reliability and flexibility. This study proposes a model for analyzing the effects of unreliable RETs on the reliability and flexibility. Numerical analysis provides findings as follows: (1) the basic plan for long-term electricity supply could fail to meet the target level of power system reliability and flexibility; (2) the relationship between the reliability and flexibility is analyzed; (3) additionally required power plants and changes in generation mix are investigated.

■ MC15

202B, 2nd Floor

Service Design & Service Systems

Sponsored: Service Science

Sponsored Session

Chair: Jyun-Cheng Wang, PhD, National Tsing Hua University, Taiwan, jcwang@iss.nthu.edu.tw

1 - Exploring Perceived Value Creation and Underlying Contradictions of MOOCs Service Systems

Tonny Meng-Lun Kuo, National Tsing Hua University, Hsinchu, Taiwan, tonnykuo@iss.nthu.edu.tw, Jyun-Cheng Wang

This study depicts the perceived values of MOOCs service and 2) explains plausible underlying mechanism and contradictions behind the current service system using activity theory as analytical framework. Through the analysis of in-depth interviews of nine cases, five qualitative categories with structural

hierarchy were profiled. Seven contradictions derived from primary, secondary, and tertiary level were formulated. It is concluded that successful MOOCs premium service adoption is determined by complex resources integration, shared common goals, exclusive co-learning experiences, and institutional and technological support of service systems facilitated by instructors' teaching self-efficacy.

2 - Revisiting Contributions in Open Source Communities

Raden Agoeng Bhimasta, National Tsing Hua University, Hsinchu, Taiwan, agoeng.bhimasta@iss.nthu.edu.tw, Jyun Cheng Wang

The aim of this study is to deepen our understanding in online source communities. First, we will take a look on what past studies have been done in this area. Second, we proposed our research model for further researches.

3 - Chatbot Commerce

Pei-Fang Hsu, National Tsing Hua University, Hsinchu, Taiwan, pfhsu@iss.nthu.edu.tw, Pei-Ju Huang

The emergence of chatbot has brought substantial changes to businesses and consumers. However, not every firms is suitable for chatbot commerce due to characteristics difference in nature. There are limited studies providing strategies and guidance on which industry and what business scenarios are suitable for chatbot commerce. This study explores the important topic of usage scenarios in chatbot, and investigates two design components forming different usage scenarios: industry and task complexity. We conduct a lab experiment to compare user perception and user intentions between traditional App and Chatbot, with interaction effect of industry and task complexity. The objective of this research is to find key factors that results in better user perception and user intentions in chatbot commerce, and more importantly, explore reasons why users adopt chatbot, rather than App, in each specific scenario to guide chatbot user experience design.

■ MC16

203A, 2nd Floor

First-order and Stochastic Algorithms for Large-scale Optimization Problems

Invited: Optimization

Invited Session

Chair: Yangyang Xu, Ressenlaer Polytechnic Institute, 110 8th Street, Troy, NY, 12180, United States, xuy21@rpi.edu

1 - First-order Methods for Convex Programs based on Inexact Augmented Lagrangian

Yangyang Xu, Ressenlaer Polytechnic Institute, Department of Mathematical Sciences, 110 8th Street, Troy, NY, 12118, United States, xuy21@rpi.edu

Augmented Lagrangian method (ALM) has been popularly used for solving constrained optimization problems. Practically, subproblems for updating primal variables in ALM usually can only be solved inexactly. The convergence of ALM has been extensively studied. However, the global convergence rate of inexact ALM is still open for problems with nonlinear inequality constraints. In this talk, I will present an AL based first-order method for solving general convex programs with both equality and inequality constraints. The global convergence rate and iteration complexity results will be shown in terms of the number of gradient evaluations. For convex problems, $O(1/\epsilon)$ gradient evaluations are sufficient to guarantee an ϵ -optimal solution. For strongly convex problems, the result can be improved to $O(1/\sqrt{\epsilon})$.

2 - A Successive Difference-of-convex Approximation Method for a Class of Nonconvex Nonsmooth Optimization Problems

Ting Kei Pong, Hong Kong Polytechnic University, Hong Kong, tk.pong@polyu.edu.hk, Tianxiang Liu, Akiko Takeda

We consider a class of nonconvex nonsmooth optimization problems whose objective is the sum of a nonnegative smooth function and a bunch of nonnegative proper closed possibly nonsmooth functions (whose proximal mappings are easy to compute), some of which are further composed with linear maps. This kind of problems arises naturally in various applications when different regularizers are introduced for inducing simultaneous structures in the solutions, and is challenging due to the difficulty in proximal mapping evaluations. In this talk, we propose a successive difference-of-convex approximation method for solving this kind of problems. Our approach is based on the simple observation that Moreau envelopes of nonnegative proper closed functions are continuous difference-of-convex functions so that suitable majorization techniques can be applied to the subproblems that arise. Numerical illustrations will be presented. This is a joint work with Tianxiang Liu and Akiko Takeda.

3 - Analysis of Fully Preconditioned Alternating Direction Method of Multipliers with Relaxation in Hilbert Spaces

Hongpeng Sun, Renmin University of China, Beijing, China,
hpsun@amss.ac.cn

Alternating direction method of multipliers (ADMM) is a powerful first order methods for various applications in signal processing and imaging. However, there is no clear result on the weak convergence of ADMM with relaxation studied by Eckstein and Bertsekas in infinite dimensional Hilbert spaces. In this paper, by employing a kind of “partial” gap analysis, we prove the weak convergence of general preconditioned and relaxed ADMM in infinite dimensional Hilbert spaces, with preconditioning for solving all the involved implicit equations under mild conditions. We also give the corresponding ergodic convergence rates respecting to the “partial” gap function. Furthermore, the connections between certain preconditioned and relaxed ADMM and the corresponding Douglas-Rachford splitting methods are also discussed, following the idea of Gabay. Numerical tests also show the efficiency of the proposed overrelaxation variants of preconditioned ADMM.

4 - A Varying-coefficient Regularized Dual Averaging Algorithm

Conghui Tan, Chinese University of Hong Kong, Shatin,
Hong Kong, chtan@se.cuhk.edu.hk, Shiqian Ma, Tong Zhang

Regularized stochastic optimization arises in many application domains. Proximal stochastic (sub)gradient descent (PSGD) and regularized dual averaging (RDA) are two widely accepted approaches to solve regularized stochastic optimization problems. In practice, PSGD usually converges faster than RDA, while RDA can deal with sparse data more efficiently and it promotes the structure (e.g., sparsity) of the solution. There exist some efforts on combining the advantages of these two algorithms. One such attempt was the proximal follow-the-regularized-leader method (FTRL-Proximal), which has been successfully used in many industrial applications. In this paper, we propose an alternative named varying-coefficient regularized dual averaging (VC-RDA) algorithm that also combines the advantages of PSGD and RDA. Moreover, a novel adaptive scaling scheme is employed to further accelerate this algorithm. Numerical results indicate that our new method has superior practical performance over the existing algorithms mentioned above.

■ MC17

203B, 2nd Floor

Automated Traffic System in Container Terminals

Invited: Maritime Operations

Invited Session

Chair: V. Jorge Leon, Texas A&M University, College Station, TX,
77843-3367, United States, jleon@tamu.edu

1 - Real Time Path Planning for Multiple AGVs in the Automated Container Terminal

Zhipeng Qiu, National University of Singapore, Computing lab,
E1-07-26, NUS department of engineering, Singapore, 117578,
Singapore, zhipeng.qiu@u.nus.edu, Ek Peng Chew, Loo Hay Lee

The real time multi-AGV path planning is one of complicated problems in the practical operations of automated container terminal. Given the starting configurations (e.g. initial position and velocities of these moving AGVs), the feasible paths should be found real-time for these AGVs to guide them towards their targets. To obtain the feasible paths, various restrictions should be considered, such as conflict avoidance constraints and kinematics and dynamics of AGVs. In this study, we develop a time-discretized optimization model for the problem and the corresponding MIP formulation is established. We first solve the problem to global optimality by an exact solver. Since the problem may be difficult to solve when the number of AGVs becomes larger, a distributed rolling horizon strategy is proposed to solve problem in a real-time fashion. The experimental results show that the proposed approach is efficient and practical. The related implementation issues are also mentioned in this study.

2 - Resource-Constrained Scheduling Deadlock-Free AGV Routing Methodology

Loo Hay Lee, National University of Singapore, 10 Kent Ridge
Crescent, Industrial and Systems Engineering, Singapore, 119260,
Singapore, iseeelh@nus.edu.sg, Jorge Leon, Ek Peng Chew

We present a new methodology to specify deadlock-free routing schedules for large-scale AGV systems. The methodology is based on resource-constrained route-schedule generation and a novel decomposition of the transit network. The proposed resource capacity model enables the control of the traffic congestion through the use of dynamic traffic congestion factors for routing decisions, and a transformation of the resource-transit network into a bidirectional acyclic graph with switches for efficient deadlock detection and prevention. The methodology runs in polynomial time. Application example to automated container ports will be presented.

3 - A Fuzzy Logic Based Approach to the Control Problem of Yard Cranes within Multiple Container Blocks

Teng-Sheng Su, Chaoyang University of Technology, Taichung,
Taiwan, tssu@cyut.edu.tw

For smart logistics in modern yard crane handling system, three dispatching problems have become the critical issues in the seaport container terminal. These three problems are job-determination problem, the truck-pickup problem, and the quay zone-delivery problem. A decision-making in the job-determination problem is initiated by the truck-pickup job and quay zone-delivery job. Once containers loaded on trucks or on yard blocks, the yard crane is required to perform either a truck-pick job or a quay zone-delivery job. In this paper, an intelligent dispatching strategy and its rules based on fuzzy logic control (FLC) are developed to solve three control problems of yard cranes. Due to incomplete and vague information remained in decision-making within multiple yard blocks, we adopt fuzzy logic based approaches for expressing experts' linguistic terms to determine which job the yard crane should execute next. An empirical case is examined using computer simulation to compare the performance of the decision rules.

4 - Speed Optimization in a Cycle with Service Level Guarantee

Xiaofan Lai, Sun Yat-sen University, No 135 Road Xingang,
District HAIZHU, Guangzhou, 510275, China,
xiaofanlai@gmail.com, Jun Xia

This paper considers a speed optimization problem in a cycle, which has taken the uncertain port time into account and can ensure a certain level of schedule reliability. Stochastic programming models have been formulated and then are transformed into solvable deterministic models. Extensive experiments have shown the effectiveness and efficiency of the models and methods. The results can be applied to the practice so as to minimize the cost of carriers and also guarantee their service level.

■ MC18

North Lounge, 3rd Floor

Decision Analysis in Healthcare Systems

Invited: Healthcare Systems and Applications

Invited Session

Chair: Yong-Hong Kuo, The University of Hong Kong, Pokfulam Road,
Hong Kong, yhkuo@hku.hk

1 - Cost-effectiveness of Surgery after Chemoradiotherapy for Esophageal Cancer Patients

Sze-chuan Suen, University of Southern California, 3715
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United States, ssuen@usc.edu, Jonathan Salcedo, Shelly Bian

Long term survival rates for esophageal cancer remains low (below 15%) despite medical innovations. However, recent work has suggested that performing surgery after chemoradiotherapy may decrease cancer recurrence and increase long term survival, at the cost of increased postoperative mortality. In this study, we assess the desirability of this procedure by evaluating whether surgery after chemoradiotherapy would be cost-effective. We use a decision tree with a Markov model of health states to assess both long term and immediate surgical outcomes on survival, quality of life, and costs. We find that results may be sensitive to a few key parameters.

2 - Supervised Learning to Solve Decentralized Patient Admission Problem in Mass Casualty Incident

Hyun-Rok Lee, KAIST, 3101, E2-1, Guseong, Daejeon, 305-701,
Korea, Republic of, hyunrok@kaist.ac.kr, Taesik Lee

In the event of mass casualty incident, it is important to distribute the patients to multiple hospitals to efficiently utilize limited resources, and controlling patient admission at each hospital is a possible solution. For this problem, we formulate a Decentralized-Partially Observable Markov Decision Process (Dec-POMDP) model where hospitals make their admission decisions individually based on the partial observations available to them. We propose a heuristic method to obtain a solution from the Dec-POMDP model. This method adopts supervised learning with a Recurrent Neural Network (RNN) model by using sample histories of action-observations generated from a centralized policy. Our computational experiment results demonstrate the performance of the proposed algorithm.

3 - Analysis of Pick-up Service on an Elderly Day Care Facility in Japan

Masato Takanokura, Kanagawa University, 3-27-1 Rokkakubashi, Kanagawa-ku, Yokohama, 221-8686, Japan, takanokura@kanagawa-u.ac.jp, Jun Asai, Daisuke Kitayama, Mitsuharu Ogiya

Elderly day care facilities are available for enhancing or maintaining daily activities of elderly persons in Japan. Elderly users receive healthcare services (rehabilitation, massage, etc.) for half a day in a facility. Healthcare workers pick them up from their houses to the facility and, after services, drop off by a micro-bus. Such works are expressed as a travelling salesman problem with time windows. Vehicle routes and time windows vary by the day for the facility; therefore, we formulate them from actual pick-up services. We propose optimal routes to minimize a service time for several days under constraints of time windows.

4 - Incorporating Biological Effect into Optimization of Proton Therapy for Cancer Patients

Wenhua Cao, MD Anderson Cancer Center, Houston, TX, United States, wcao1@mdanderson.org

Proton therapy is capable of producing highly conformal dose distributions to tumor targets. However, the relative biological effectiveness of protons is a complex function of dose, linear energy transfer, tissue biological parameters, etc. The present study investigates two approaches including one complex and one simplified model to considering biological effect of protons in optimizing intensity modulated proton therapy. Tests on patient cases show that both approaches could achieve improved biologically effective tumor and normal tissue dose compared to conventional optimization used in current practice.

■ MC19

South Lounge, 3rd Floor

Scheduling Optimization and Management in Healthcare

Invited: Healthcare Management

Invited Session

Chair: Gang Du, China, nusdugang@foxmail.com

1 - Analyzing Disparity in the US Heart Allocation System

Naoru Koizumi, George Mason University, School of Public Policy, 3351 North Fairfax Drive, Arlington, VA, 22201, United States, nkoizumi@gmu.edu, Fatemeh Karami, Mehdi Nayeypour, Monica Gentili, Andrew Rivard

The US transplant community has voiced a number of concerns regarding geographic disparity in access to a heart transplant. We used simulation to measure the disparity in access to a heart transplant. Several metrics are considered, including transplant rate, waiting time and pre-transplant mortality rate. We defined a new measure of access which accounts for the distance between donor hospitals and transplant centers, and the supply/demand ratio at each transplant center. The results indicated the need for a change in the current allocation system to overcome the disparity.

2 - Effect of Emergency Room Redesign on Performance

Dmitry Krass, Professor, University of Toronto, 105 St George St, Toronto, ON, M5S3E6, Canada, Krass@Rotman.Utoronto.Ca, Opher Baron, Tianshu Lu

We analyse the operations of the emergency department (ED) at Southlake Regional Health Centre in Newmarket, ON. The head of ED, Dr. Marko Duic, has led a radical re-design affecting almost every aspect of how ED functions. We study the impact of this re-design on key performance measures including TPIA (Time to Physician Initial Assessment), LWBS (left without being seen), LOS (length of stay) and operational efficiency (patients per physician). In particular, we show that the efficiency gains were not a result of either exogenous factors or increased resource usage, but were indeed due to the new design of the ED.

3 - Characterizing the Dynamics Underlying Global Spread of Epidemics

Joseph Wu, The University of Hong Kong, Hong Kong, joewu@hku.hk

Over the past few decades, global metapopulation epidemic simulations built with worldwide air-transportation data have been the main tool for studying how epidemics spread from the origin to other parts of the world (e.g., for pandemic influenza, SARS, and Ebola). However, it remains unclear how disease epidemiology and the air-transportation network structure determine epidemic arrivals for different populations around the globe. Here, we fill this knowledge gap by developing and validating an analytical framework that requires only basic analytics from stochastic processes. We apply this framework retrospectively to the 2009 influenza pandemic and 2014 Ebola epidemic to show that key epidemic parameters could be robustly estimated in real-time from public data on local and global spread at very low computational cost. Our framework not only elucidates the dynamics underlying global spread of epidemics but also advances our capability in nowcasting and forecasting epidemics.

■ MC20

401, 4th Floor

Computation and Control in Stochastic Systems

Sponsored: Applied Probability

Sponsored Session

Chair: Cathy Honghui Xia, Ohio State University, Columbus, OH, 43210, United States, xia.52@osu.edu

1 - Moderate Deviations in Weighted Poisson Sum

Yingdong Lu, IBM, 1101 Kitchawan Rd, Mathematical Science, TJ Watson Research Center, Yorktown Heights, NY, 10598, United States, yingdong@us.ibm.com, Cathy Honghui Xia, Yue Tan

We study the accuracy of a scaled Poisson approximation to the weighted sum of independent Poisson random variables, focusing on in particular the calculation of the tail distribution. We establish a moderate deviation bound on the approximation error using a modified Stein-Chen method. Applications in cloud computing, along with numerical experiments, are also presented.

2 - Asymptotic Performance of Large-scale Parallel and Distributed Processing Systems with Advancing Resource Capabilities

Cathy Honghui Xia, Ohio State University, 210 Baker Systems Engineering, 1971 Neil Ave, Columbus, OH, 43210, United States, xia.52@osu.edu, Yun Zeng

As the development of cloud computing and big data analytics, parallel and distributed processing systems have expanded into unprecedented scales. Meanwhile, as revealed by Moore's Law, storage space and processing speed are also scaling. A critical issue concerns throughput scalability: whether or not throughput decreases to zero as the systems scale in size and capabilities. We model parallel and distributed processing systems as fork and join queueing networks with blocking. Such networks can have arbitrary topology, arbitrary initial state, arbitrary and possibly scaling buffer sizes and service rates, and generally distributed service times. We construct throughput bounds and scalability conditions that depend on the asymptotic behaviors of network topology, buffer sizes, and service rates. Results show proper scaling in processing and storage capabilities could mitigate throughput degradation. These results provide useful guidelines in designing next generation parallel and distributed processing systems at scale.

■ MC22

Elegance, 4th Floor

Negotiation Analysis and Support

Sponsored: Group Decision Making and Negotiation

Sponsored Session

Chair: Gregory E. Kersten, Concordia University, Montreal, QC, H3G 1M8, Canada, gregory.kersten@concordia.ca

Co-Chair: Adiel Teixeira De Almeida, Universidade Federal de Pernambuco, Recife PE, 50630-970, Brazil, adielta@gmail.com

1 - Three Definitions of Coalitional Stability in the Graph Model

Marc Kilgour, Wilfrid Laurier University, Waterloo, ON, Canada, mkilgour@wlu.ca, Ziming Zhu, Keith William Hipel

Three forms of coalitional stability have been defined for the Graph Model for Conflict Resolution. Using a more easily applied version of the classical definition, it is compared to the non-cooperative and Pareto definitions. All three forms admit Nash, general metarational, symmetric metarational, sequential, and symmetric sequential stability. These definitions are then illustrated using a graph model of an offshore oil exploration conflict that helps to clarify their differences, and to demonstrate the insights that can be gained from their application.

2 - Maximin Stability in the Graph Model for Conflict Resolution

Leandro Chaves Rêgo, Universidade Federal do Ceará, Fortaleza, Brazil, leandro@dema.ufc.br, Giannini I. Vieira

In this article our objective is to use the maximin decision rule in the graph model for conflict resolution (GMCR), considering a variable horizon. More specifically, we consider a GMCR with two decision makers (DMs) and introduce the concept of maximin stability with horizon h for a given DM similarly to the notion of limited-move stability with horizon h present in the GMCR literature. The maximin paradigm is adequate for cautious DMs who have no knowledge about the other DMs preferences.

3 - On Impact of Motivations on the Agent's Preferences in Representative Negotiations

Gregory E Kersten, Concordia University, 1455 De Maisonneuve Blvd. W., Montreal, QC, H3G 1M8, Canada,
gregory.kersten@concordia.ca, Ewa Roszkowska,
Tomasz Wachowicz

Analysis of online bilateral negotiation experiments shows that the majority of agents, who negotiate on behalf of their principals, make both cardinal and ordinal errors in the reconstruction of the principals' preferences. We focus on the impact of epistemic, social, and identity motivations on the errors and on the impact of errors on the negotiation outcomes. The results show that the more rational the agents the more accurately they represent their principals' preferences. Substantive and learning goals are positively correlated with the ordinal and cardinal accuracy of the agents' preferences. The agents' errors are negatively correlated with the principals' substantive outcomes but the correlations are weak. The results also show that the agents who make no ordinal errors are less accommodating and avoiding but more competitive than the agents who make these errors. A majority of the ordinarily inaccurate agents achieve the best substantive outcomes in their own preference system, but these outcomes are the worst for the principals.

Monday, 4:35PM - 6:05PM

■ MD01

101A, 1st Floor

Smart Pricing and Inventory Control

Sponsored: Revenue Management & Pricing

Sponsored Session

Chair: Yu-Chung Tsao, National Taiwan University and Science and Technol, Taipei, 106, Taiwan, yctsao@mail.ntust.edu.tw

1 - Robust Multi-objective Optimization for Smart Grid Design Considering Sustainability and Dynamic Pricing Strategy

Vo-Van Thanh, National Taiwan University Science and Technology, Taipei, Taiwan, vvthanhs@hcmut.edu.vn,
Yu-Chung Tsao

This paper considers the smart grid design problem where three dimensions of sustainability and dynamic pricing strategy are considered concurrently. A multi-objective robust fuzzy stochastic programming model is presented to minimize the total costs of the network including economic, environmental, and social costs under uncertain environment. The objective is to determine the optimal number, location, capacity of renewable distributed generation units, dynamic pricing, and energy resources scheduling. The proposed method is applied to Vietnam's smart grid. The results indicate that demand response with dynamic pricing increases 3.5% revenue and reduces social and environmental cost.

2 - A Differential Pricing Strategy for Smart Grid Considering a Buy-back Contract

Thuy Linh Vu, National Taiwan University of Science and Technology, Da'an District, Taiwan, iamlinh.242@gmail.com,
Yu-Chung Tsao

Consider a smart grid that integrates Distributed Generations (DGs) in which company and users act as two players in the supply chain. Both players can choose to cooperate or non-cooperate with each other to obtain the benefit or share the risk. A continuous approximation is adopted to model the problems. The objective of this paper is to determine the electricity price, the preventive maintenance budget, and the DGs' capacity and service area to maximize the profit in two cases: centralized and decentralized case. A numerical example is conducted to illustrate the solution procedure and show the comparison between two cases. Results show that the centralized model is more beneficial than the other one.

3 - Effects of Pricing and Carbon Emission for a Dual-channel Supply Chain

Tsung-Hui Chen, National Pingtung University, Pingtung, Taiwan, thchen918@gmail.com

In order to reduce the impacts of global warm problem incurred by the carbon emission, many countries, governments, and enterprises engaged many activities to reduce the damage for the environment. Under the two-echelon and dual-channel supply chain, this study investigate the combined effects of pricing and carbon emission policies under the carbon emission restriction for the deterioration items.

4 - Gift Card's Effect on Product Price Considering the Card's Separation Between Purchasing and Redemption

Qinhong Zhang, Shanghai Jiao Tong University, Shanghai, China, zhangqh@sjtu.edu.cn

We investigate gift card's influences on the retailer's product price under different situations, including retailers' competition, secondary market of gift cards and the retailer's buyback policy. We show that: (1) gift card increases the retailer's product price; (2) when there are two competing retailers, gift card increases both retailers' prices if any of them issues gift cards and three possible equilibria exist; (3) the secondary market of gift cards weakens the gift card's effect in increasing the retailer's product price and profits; (4) the buyer's buyback of the second hand gift cards can slightly compensate the negative effect of secondary market in some situations.

■ MD02

101B, 1st Floor

New Topics in Operations with Pricing and Inventory Considerations

Invited: Supply Chain Inventory Management

Invited Session

Chair: Guang Xiao, Hong Kong Polytechnic University, Hung Hom, Hong Kong, guang.xiao@polyu.edu.hk

1 - Alleviating Spectrum Scarcity by Sharing – A Queueing Perspective

Shining Wu, The Hong Kong Polytechnic University, LMS Dept, Hong Kong, 999077, Hong Kong, sn.wu@polyu.edu.hk

Dynamic spectrum sharing is considered as a promising approach to alleviating the artificial spectrum scarcity caused by current static allocation practice in radio spectrum management. In this study, we model a shared spectrum network with both licensed and unlicensed users as a many-server two-class queueing system. We approximate the key performance indicators under the asymptotic regime and then study the optimal sharing decisions of the system to maximize the system throughput rate while maintaining the delay probability of the licensed users below a certain level. We find that it is possible to improve spectrum utilization while guaranteeing a very high service level expected by licensed users. Spectrum sharing can potentially be a socially optimal solution to alleviating spectrum scarcity. Our analysis also reveals a number of distinctive properties of the system.

2 - Approximation Approaches for Inventory Systems with General Production/ordering Cost Structures

Miao Song, The Hong Kong Polytechnic University, Department of Logistics and Maritime Studies, Hong Kong, miao.song@polyu.edu.hk, Ye Lu, Yi Yang

The production/ordering cost structure is fundamental to determining an optimal inventory control policy. However, many of the cost structures that have arisen from the practice are quite complex and make the optimal policies too complicated for managers to implement. In this paper, we propose several easy-to-implement and efficient heuristic policies for inventory systems with general production costs which, include multiple linear pieces and fixed costs, suggesting a wide application to many practical problems that were previously difficult to solve. We establish the worst-case performance bounds on the proposed heuristic policies by using the concept of K-approximate convexity. Our extensive numerical studies, which are designed to reflect practical inventory control applications, evaluate the performance of the heuristic policies and show that the best heuristic policy we propose performs extremely well. We also try to provide explanations for the performance of different heuristic policies.

3 - The Effect of Overconfidence on Supply Chains' Members

Juan Li, Nanjing University, 5 Ping Cang Xiang, Nanjing, China, 23895115@qq.com, Jinling Cai

In order to illustrate how the overconfidence influences supply chain members' decision and profit, this paper considers a supply chain consist of a manufacturer and two retailers. Given price contracts the retailers decides order quantity, then the manufacturer produces to at least satisfy the retailers' order quantity before demand uncertainty is realized. Each retailer has a chance to replenish products from the manufacturer after demand uncertainty is realized. The manufacturer distributes the remaining stock to two retailers based on the declared allocation rules. The paper illustrates the members' overconfidence may induce lower rational members' profits, and higher its own profits.

4 - Crowdfunding under Word-of-mouth Communication

Guang Xiao, Hong Kong Polytechnic University, M634, 6/F, Li Ka Shing Tower, Hung Hom, Hong Kong, guang.xiao@polyu.edu.hk, Fasheng Xu, Xiaomeng Guo, Fuqiang Zhang

In substantially growing markets of rewards-based crowdfunding, startups pre-sell new products not only to raise funding directly from the crowd to cover early stage investment, but also to expand product awareness via word-of-mouth (WoM) communication. In this talk, we study a startup firm's optimal funding choice between reward-based crowdfunding and bank financing in the presence of WoM communication. We investigate the impacts of market uncertainty and WoM intensity on the performance of both funding strategies as well as their corresponding social welfare implications.

■ MD04

101D, 1st Floor

Operations & Marketing Interface

Contributed Session

Chair: Axel G. Stock, University of Central Florida, Dept of Marketing CBA, P.O. Box 161400, Orlando, FL, 32816-1400, United States, Axel.Stock@ucf.edu

1 - Exploring Dependencies across Multiple Online Social Network Platforms

Hwang Kim, Chinese University of Hong Kong, 11F Cheng Yu Tung Building, # 12, Room 1134, Shatin, Hong Kong, kimhwang@baf.cuhk.edu.hk, Vithala R Rao

Users' interplay among these various social networking platforms implies that several sources may induce interrelationships among the platforms. To understand this, the authors propose an integrated visit model that accommodates networking activities across social network platforms and test the model using data from two social network gaming platforms. The model discovers a new source of dependencies that stems from communications with common network members overlapping in different network platforms. The simulation study provides managerial implications for organizations attempting to target valuable customers and allocate resources across multiple network platforms.

2 - Performance of the Razor-and-blade Business Model Amid Cost-conscious Consumers and Third-party Compatible Products

Hisashi Kurata, Associate professor, University of Tsukuba, 1-1-1 Tenno-dai, 3F1227, Tsukuba Ibaraki, 305-8573, Japan, kurata@sk.tsukuba.ac.jp

The razor-and-blade business model earns profits by selling consumable items required for the use of durable products. However, the price of brand-name consumable items is often considered to be unfairly high, so third-party firms produce low-priced compatible consumable items. We analyze how budget-conscious customers influence the performance of the razor-and-blade model and whether selling both low-price compatible items and brand products can coordinate a supply chain composed of a brand-name manufacturer and a retailer.

3 - Joint Pricing and Inventory Decision under Probabilistic Selling Strategy

Yifan Wu, East China University of Science and Technology, 130 Meilong Rd 114, Shanghai, China, yifanwu@ecust.edu.cn

This study examines whether probabilistic selling could enhance inventory management considering market size uncertainty in a rather general setting. We propose to study the impact of probabilistic selling on the profit, price and order quantity within a newsvendor framework. By comparing probabilistic selling against traditional selling, we find that probabilistic selling could generally increase firm's expected profit. Moreover, the firm will enhance the price and the order quantity for the component product.

4 - Dominant Retailer, Lower Product Quality and Uninformed Customers

Axel Stock, University of Central Florida, Dept of Marketing CBA, PO Box 161400, Orlando, FL, 32816-1400, United States, Axel.Stock@ucf.edu, Somnath Banerjee

A number of consumer and business reports suggest that slightly lower quality (or feature) variants of products are being sold through dominant and mass retailers, while higher quality variants continue to be sold through specialty and weaker retailers and, customers are uninformed about such differences. Using a game theoretic model, we find that (1.) in a bilateral monopoly of manufacturer and retailer an increase in bargaining power of the retailer leads to a lower product quality in the channel, if quality is non-contractible. (2.) The weaker retailer does not have an incentive to communicate its higher quality even if the advertising is costless, if the quality differences are not too high.

■ MD05

102, 1st Floor

Innovation/Entrepreneurship

Contributed Session

Chair: Qingyu Zhang, Arkansas State University College of Business, Dept of Computer & Information Technology, PO Box 130, Jonesboro, AR, 72467, United States, q.yu.zhang@gmail.com

1 - Research on the Evolutionary Path of Bricolage in the Growth Process of Small and Medium Sized Enterprises

Gang Zheng, Associate Professor, Zhejiang University, 1310-5, School Of Management, Zhejiang University (Zijingang Campus), No. 866, Yuhangtang Road, Hangzhou, 310058, China, zhg1213@zju.edu.cn, Qingqing Zheng

This paper analyzes the case of Soton Straw, a traditional straw company in Zhejiang Province of China, and explores the evolutionary path and mechanism of traditional manufacturing SMEs' bricolage behavior. This study reveals the dynamic evolutionary process of bricolage behavior, as well as the internal mechanism that affects the evolution of SME's bricolage behavior, which hope to be a good reference for the development of other traditional manufacturing SMEs.

2 - Entrepreneurial Financing, Serial Venturing, and Experiential Learning

Hong-Jen Charles Chiu, Associate Professor of Strategy, National Taiwan University, RM 914, No. 85 Roosevelt Road, Sec. 4, Taipei, 10617, Taiwan, hongjen@ntu.edu.tw

We examine the impact of founders' experiential learning from serial venturing on entrepreneurial success. Our analysis focuses first on Weibull regressions on duration of new ventures, second on parameter estimation of a Bayesian model on diffusion of entrepreneurial finance, and third on the alternative entrepreneurial finance. Our findings show the relative roles of basic information transmission, and distinguish capital acquisition information passing by serial entrepreneurs and first-time startup founders. The probability of exits falls with past experience at starting new ventures. Finally, angel funding by these three angel groups is associated with improved venture performance.

3 - Technology, Research and Development, and Innovation Capability in Technology Services

Sidhartha R. Das, Professor, George Mason University, 4400 University Drive, Fairfax, VA, 22030, United States, sdas@gmu.edu, Maheshkumar Joshi

Our research examines the antecedent relationships between an organization's technology intensity and R&D levels with respect to innovation capability in technology service organizations; and their effect on firm performance.

4 - Strategic Entrepreneurship Model of Sharing Economic Platform: A Case of We Work

Hong-Wei Yan, Asia University, 500, Lioufeng Rd., Wufeng, Taichung, 41354, Taiwan, kk0938566209@gmail.com, Wen-Hong Chiu, Hui-Ru Chi

Abstract not available.

5 - Impact of Interorganizational System Appropriation and Supply Chain Collaboration on Innovation

Qingyu Zhang, Professor, Shenzhen University, Naihai Road 3688, Shenzhen, 518060, China, q.yu.zhang@gmail.com, Mei Cao

The objective of the study is to explore the impact of IOS appropriation (i.e., IOS use for integration, IOS use for communication, and IOS use for intelligence) and supply chain collaboration on innovation. Data were collected through a Web survey of U.S. manufacturing firms in various industries. The statistical methods used include confirmatory factor analysis and structural equation modeling (i.e., LISREL). The results indicate that IOS appropriation generally supports supply chain collaboration, which in turn improves innovation. The moderation effects of firm size are also reported in the paper.

■ MD06

103, 1st Floor

Tutorial: How to Leverage Big Data Analytics to Grow Business – II

Tutorial Session

1 - How to Leverage Big Data Analytics to Grow Business

Chi-Yi Kuan, LinkedIn, 640 Curtner Rd, Fremont, CA, 94539, United States, chiyi2@yahoo.com

In this tutorial, we will illustrate the big data analytics lifecycle and share our practices leveraging advanced big data analytics and machine learning techniques to grow business at LinkedIn. You'll learn how to empower business partners to access insights whenever needed, how to optimize business performance by leveraging unique data, and how to innovate for sustainable business growth.

■ MD07

105, 1st Floor

Modeling and Algorithmic Approaches for Critical Intelligent Systems

Invited: Operations and Decisions in Smart Manufacturing and Logistics

Invited Session

Chair: Giulia Pedrielli, Arizona State University, Tempe, AZ, 85281, United States, giulia.pedrielli.85@gmail.com

1 - Queuing Bandits

Stephane Bressan, PhD, National University of Singapore, Singapore, 117417, Singapore, steph@nus.edu.sg

We formulate the allocation problem in a single-server multiple-queue system with known arrival rate and unknown service rates as a multi-armed bandit problem. The server and the queues are analogous to the gambler and the arms, respectively. This formulation of queueing is relevant for modelling a vast range of service systems, such as supply and demand in online platforms, order flow in financial markets, packet flow in communication networks, and supply chains. The proposed multi-armed bandit formulation provides a model-free framework to explore the queue parameters and to exploit them on-the-go. In order to resolve the exploration-exploitation trade-off in the bandit formulation, we adapt our information geometric algorithm, BelMan, for multi-armed bandits. This approach does not only solve the proposed formulation but also caters for an information geometric analysis of allocation in a queueing system. We comparatively evaluate our approach with the state-of-the-art bandit algorithms, such as Thompson sampling, Q-ThS, and Q-UCB1.

2 - Reinforcement Learning under Model Mismatch

Sebastian Pokutta, Georgia Institute of Technology, H. Milton Stewart School Of Isye, 765 Ferst Drive, Atlanta, GA, 30332-0205, United States, sebastian.pokutta@isye.gatech.edu, A. Roy, H. Xu

We study reinforcement learning under model misspecification, where we do not have access to the true environment but only to a reasonably close approximation to it. We address this problem by extending the framework of robust MDPs to the model-free Reinforcement Learning setting, where we do not have access to the model parameters, but can only sample states from it. We define robust versions of Q-learning, SARSA, and TD-learning and prove convergence to an approximately optimal robust policy and approximate value function respectively. We scale up the robust algorithms to large MDPs via function approximation and prove convergence under two different settings. We prove convergence of robust approximate policy iteration and robust approximate value iteration for linear architectures (under mild assumptions). We also define a robust loss function, the mean squared robust projected Bellman error and give stochastic gradient descent algorithms that are guaranteed to converge to a local minimum.

3 - Fundamental and Complete Resolution of Practical Mixed-integer Linear Programming Problems

Peter B. Luh, University of Connecticut, Dept of Electrical/Computer Engineering, 371 Fairfield Way, Storrs, CT, 06269-4157, United States, peter.luh@uconn.edu

MILP problems are of great importance. However, existing approaches are limited in the sizes of problems or quality of solutions. A fundamental and complete resolution of such problems for near-optimal solutions and fast is presented. The novelties lie in (1) a decomposition and coordination framework; (2) an innovative way to tighten subproblem formulations offline; and (3) a novel method for effective coordination of subproblem solutions. Numerical testing demonstrates superior performance, and points a brand new way to formulate and solve practical MILP problems.

■ MD08

201A, 2nd Floor

SCM Finance & Big Data Institutional Research

Invited: Fusions of Big Data, AI, Blockchain and FinTech Applications

Invited Session

Chair: Grace Lin, Asia University, Taipei, 110, Taiwan, gracelin.ny@gmail.com

Co-Chair: Jia-Nian Zheng, Asia University, Taichung, 41354, Taiwan, jianian.zheng@gmail.com

1 - Assessing Mental Status with Online Social Network Data

Chi-Ya Shen, National Tsing Hua University, Hsinchu, Taiwan, chihya@cs.nthu.edu.tw

Currently, the identification of potential mental disorder patients usually relies on supervisors and parent, which is passive and may result in late clinical intervention. Therefore, we study the automatic identification of mental disorder patients to help those patients receive timely treatment by analyzing the online social network data. We model this problem as a classification problem. We extract profile-based and behavioral features along with network topological features to identify the patients effectively. We evaluate the proposed approach with real datasets.

2 - Adopting Machine Learning Methods for Delisting Risk Predicting in Taiwan Stock Market

Grace Lin, Asia University, Taipei, Taiwan, gracelin.ny@gmail.com

Delisting risk is a key reference for risk management in financial services, such as lending, crowdfunding, etc. Previous studies proposed numerous mathematical model for predicting company's delisting probability but lacked common definition of the rules for financial actions. This research aimed to develop a new methodology by adopting Bayesian network and SVN with machine learning to estimate the delisting risk by discrete index. This study employed three data categories: account item, finance ratio and supply chain information for Taiwan stock market. The result shows that the accuracy of Bayesian network and SVN with machine learning reached more than 70% and 80% accuracy separately.

3 - Blockchain-based Crowdfunding for SMEs & ICO Case Studies

Ko-Yang Wang, Fusion\$360-Taiwan FinTech Corp., Taipei, Taiwan, kyw@fusions360.com

Integrating blockchain into crowdfunding platforms or ICO enable startups and growing SMEs to obtain financing quickly and cheaply from individuals and professional investors. We study the fraud issues and through implementing credit scoring & smart contract as a safeguard in supply chain finance environments.

4 - Development of Big Data Lake and System Architecture for AI-Based Institutional Research

Grace Lin, Asia University, No.15, Lane 172, Section 1, Keelung Road, Taipei, 110, Taiwan, gracelin.ny@gmail.com, Jeffrey Tsai, Ya-Hui Chan, Jia-Nian Zheng, Ming-Der Chen, Brick Tsai

This research aims at developing an IR decision-making system by incorporating AI and cognitive computing engines to adapt to rapidly changing demand of human resources and to improve the effectiveness of teaching. The project has three major topics: 1) build up Big Data Lake of internal and external data, 2) perform data mining on external industry talent demand, and 3) analyze learning effectiveness. The integration of the results are expected to enhance the effectiveness of decision-making on teaching and institutional management.

5 - Talent and Skill Mining with Temporal Dynamics in Taiwan's Job Market

Ya-Hui Chan, Institute for Information Industry, No 133, Sec 4, Taipei, 105, Taiwan, yahui0219@gmail.com, Grace Lin, Yueh-Lin Tsai, Kun-Huang Chen

To drive a better supply-demand match between education and industry, the present study adopted the data mining technique to extract the talents and skills demands with temporal dynamics in Taiwan. Online job opening data are retrieved through web API and crawler on daily basis. A Talent-Skill Map was built and updated continuously, in which the demand trends of talents were probed and related/required skills can be expanded. By mapping the Talent-Skill Map into Syllabus, we help the colleges build the observation-judgement-action mechanism which could increase the linkage with education supplies and industry needs.

■ MD09

201B, 2nd Floor

Data Mining and Computation with Emerging Applications

Invited: Data Mining

Invited Session

Chair: Xuying Zhao, University of Notre Dame, 361 Mendoza College Of Business, Notre Dame, IN, 46556, United States, xzhao1@nd.edu

Co-Chair: Gerhard Wilhelm Weber, Poznan University of Technology, Chair of Marketing and Economic Engineering, Ul Strzelecka 11, Poznan, 60-965, Poland, gerhard.weber@put.poznan.pl

Co-Chair: Kathryn Steckle, University of Texas at Dallas, 4, Richardson, TX, 4, United States, ksteckle@utdallas.edu

1 - Continuously Updating Nonnegative Matrix Factorization

Yaw O. Chang, Professor, University of North Carolina, 601 South College Road, Wilmington, NC, 28403-5970, United States, Changy@uncw.edu, Nikolai D. Lipscomb, Austin Z. Gratton, Cuixian Chang, Yishi Wang

Nonnegative matrix factorization (NMF) is a problem that decomposes a real matrix with nonnegative elements into a product of two real, nonnegative matrices. This decomposition is often used as a dimension reduction tool by choosing a small value for the inner dimension of the product. NMF has been widely applied in information retrieval, computer vision and pattern recognition. While various methods have been proposed to improve the quality of the factorization, no research to address how to update the factorization when new data stream coming in. We proposed a novel approach called Continuously updating nonnegative matrix factorization (CUNMF) to address the updating issue.

2 - Interior Point Method for Knowledge-based Analytics

Xin W. Chen, Associate Professor, Southern Illinois University-Edwardsville, P.O. Box 1805, Edwardsville, IL, 62026-1805, United States, xchen@siue.edu

This study develops and implements an improving search algorithm that effectively and efficiently identifies pathways of interest using knowledge-based analytics. Many methods have been developed in the past to identify structures in large graphs. They are computationally inefficient for large graphs and their outcome depends on the graph metrics and statistical measures. The algorithm developed in this study converges to the optimal solution by traversing the interior of a feasible region.

3 - One Data Mining Technique for Light Detection and Ranging Data Classification in Detection of Windshear

Jingyan Huang, Hong Kong Baptist University, Hong Kong, 14251000@life.hkbu.edu.hk, Michael Kwok-po Ng, Pak Wai Chan

In this paper, we analyze runway-specific Light Detection and Ranging Data (LIDAR) from Hong Kong Observatory (HKO) to enhance the windshear detection performance. Considering the ways that windshear over runway threaten the airplanes for take-off and the uncertain range of windshear location, we develop one data mining technique which gets 100% prediction accuracy for windshear and null windshear examples. Supervised Principal Component Analysis (Supervised PCA) is compared with the data mining technique in terms of prediction accuracy. The results indicate that our data mining technique performs better since supervised PCA might not account for the windshear in irregular locations.

■ MD10

201C, 2nd Floor

Optimal Design and Operations in Supply Chains

Invited: Operations Analytics and Optimization for Manufacturing, Logistics and Energy Systems

Invited Session

Chair: Weiwei Chen, Rutgers Business School, Piscataway, NJ, 08854, United States, wchen@business.rutgers.edu

1 - Multiple Parallel Resources Scheduling for Surgeries:**A Two-Stage Data Driver Robust Optimization Approach**

Hainan Guo, City University of Hong Kong, 3 Station Lane, Rammon Mansion, Flat A, 8/F, KLN, Hong Kong, hainaguo-c@my.cityu.edu.hk
Hainan Guo, Shenzhen University, 3688 Nanhai Avenue, Shenzhen, 518060, China, hainaguo-c@my.cityu.edu.hk, Jin Wang, Kwok-Leung Tsui

We propose a two-stage stochastic dynamic programming model with recourse to solve the problem of minimizing daily surgical resources usage and overtime costs. The first stage allocates multiple parallel resources to the surgeries with duration uncertainty and assigns the surgery sequencing to them. The second stage determines the actual start times based on realized durations and prescribes overtime to resources to ensure all the surgeries can be completed with the scheduling rule determined in the first stage. Since the conventional methods are not suitable for the complexity of our problem, we develop a data-driven robust optimization approach to the optimality of such large-scale problem.

2 - A Branch and Price Algorithm for the Integrated Berth Allocation and Quay Crane Assignment Problem

Canrong Zhang, Tsinghua University, Tsinghua Campus, Building E, Shenzhen, China, crzhang@sz.tsinghua.edu.cn

This paper integrates, from a tactical perspective, berth allocation and quay crane assignment, two important closely-related decisions in the container terminal operations, in a single model. To obtain optimal solutions, a branch-and-price algorithm is sought in this paper under the framework of Dantzig-Wolfe decomposition. The algorithm decomposes the original problem to a master problem which links all vessels competing for the shared resources of berths and quay cranes, and multiple per-vessel pricing subproblems that can be solved efficiently in polynomial time. The numerical experiments show that our method outperforms the commercial solver and state-of-the-art solution methods reported in the literature in terms of both solution quality and computational time.

3 - Would a Licensing Fee Scheme Promote the OEM to Increase the Product Design Level for Recycling?

Shui Hua Han, Xia men University, School of Management, Xia men, 361005, China, hansh@xmu.edu.cn, Yufang Fu, Rongrong Cai

Product design strategies for recycling are gaining increased attention within the manufacturing industry, even though some products are still designed to be disposable and are of poor remanufacturability. This research examines the following questions: would different licensing fee schemes promote the OEM to increase the product design level for recycling? If so, how would the OEM set the design level and charge the licensing fees? We develop a two-stage model to capture the key elements driving the OEM's choices of design for recycling. The OEM decides the product design level and produces new products in the first stage. In the second stage, the IR enters the remanufacturing market, competes with the OEM, and pays the OEM licensing fees according to pre-set schemes. A numerical example demonstrates the performance of the proposed model with respect to industrial characteristics.

4 - Coordinating Supplier Selection and Project Scheduling in Construction Supply Chains

Weiwei Chen, Rutgers Business School, 100 Rockafeller Road, Supply Chain Management, Piscataway, NJ, 08854, United States, wchen@business.rutgers.edu, Lei Lei, Zhengwei Wang, Mingfei Teng, Junming Liu

In this work, we study the problem of coordinating supplier selection and project scheduling, motivated by a real-life construction project. In particular, we consider a project network consisting of multiple concurrent projects, with the objective of minimizing the total tardiness of all projects. These projects are independent in operation but are subject to shared suppliers and the final quality inspection by the same committee, which then leads to the need for project review sequencing. We formulate this problem as a mixed integer linear programming (MILP) model, and propose a mathematical programming-based heuristic to solve the model. The heuristic decomposes the model into subproblems, and solves the subproblems through an iterative process. Each subproblem has a much smaller size and can be solved quickly and independently. Numerical examples show the computational effectiveness of the proposed heuristic, and the benefits of coordination.

■ MD11

201D, 2nd Floor

Simulation and Optimization

Invited: Financial Engineering in China

Invited Session

Chair: Zhaolin Hu, HKUST, Hong Kong, Hong Kong,
russell@tongji.edu.cn**1 - Balancing Exploitation and Exploration in Continuous Simulation Optimization**

Zhaolin Hu, Tongji University, Shanghai, China, russell@tongji.edu

Many real-world problems can be formulated as optimization via simulation (OvS) problems. In this paper we consider an important class of OvS problems where the decision variables are continuous. The problems are usually classified as continuous OvS (COvS) problems in the literature. We tailor the so called Gaussian process-based search (GPS) algorithm to solve the COvS problems. We develop certain estimation schemes and build the global convergence for this search algorithm. We also study how to use statistical learning methods to handle the sampling issues in the GPS algorithm.

2 - Hybrid Acceleration Method for Pricing European Options Under Levy ProcessYongchao Sun, Tongji University, Shanghai, China,
103644@tongji.edu.cn

This paper introduces an efficient hybrid Monte Carlo variance reduction method for pricing options driven by Levy process. The hybrid variance reduction method combines conditional Monte Carlo (CMC) and importance sampling (IS) techniques. We formulate the conditional expectation form of the European option price under Levy process and then IS method is used to reduce simulation variance. Furthermore, we proposed a very efficient prediction-correction algorithm to determine the optimal parameters in importance sampling measure transformation based on moments match idea. Some theoretical results are also given.

■ MD12

201E, 2nd Floor

Logistics

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Houcai Shen, Nanjing University, Nanjing, 210093, China,
hcshen@nju.edu.cn**1 - Intelligent Automotive Outbound Logistics: Models, Algorithms and Applications**Feng Chen, Shanghai Jiao Tong University, Room A618
Mechanical Building, 800 Dongchuan Road Minhang District,
Shanghai, 200240, China, fchen@sjtu.edu.cn

This paper addresses a recent successful application of operations research on automobile outbound logistics, where an intelligent dispatching system has been developed successfully for the biggest automobile logistics company in China. Practical requirements and characteristics are discussed and a corresponding key combinatorial optimization problem is further proposed. The methods of integer linear programming, branch and bound, decomposition and rolling methods are employed for designing efficient algorithms. Computational tests and case studies are given to show the efficiencies of proposed problems, models, and algorithms.

2 - Logistics Network Optimizing and Reengineering: A Case Study of Electric Power System in TaiwanYu-Jyun Lin, Research Assistant, National Dong Hwa University,
Hualien, Taiwan, 610637002@gms.ndhu.edu.tw,
Cheng-Chieh Chen

Increasing integration of transport resources and warehouses location management is a valuable approach toward achieving efficient, reliable, flexible, and sustainable logistics. This paper specifies a mixed integer programming problem for assisting electric power system operators in Taiwan with warehouses location decisions in minimizing freight transportation delivery costs. A two-stage electricity parts supply chain network system is considered and solved by a branch-and-bound method.

3 - Inventory Routing of Industrial Gases with Stochastic DemandMohamed Wahab Mohamed Ismail, Professor, Ryerson University,
350 Victoria Street, Toronto, ON, M5B 2K3, Canada,
wahab@ryerson.ca, James H Bookbinder, Xianfeng Cao

This paper proposes a model to solve the inventory routing problem for industrial gases with stochastic demand. A tanker distributes gases from a depot on a route to several dispersed customers. The demand of each customer is

described by a Brownian motion. The model determines the optimal quantity required to refill each customer by trading off the cost associated with earliness, which increases the number of visits per year, with that of lateness, which increases the probability of stockout. Overall, the model minimizes the total system cost and helps to find the optimal tanker capacity for a given route. Numerical examples and sensitivity analyses are given to illustrate the proposed model.

4 - Reliable Optimization of Biomass Supply Chain under Feedstock Seasonality and Collection Facility HardeningZhixue Liu, Huazhong University of Science and Technology,
1037 Luoyu Road, Wuhan, China, lsy868@mail.hust.edu.cn,
Shukun Wang

We design a reliable biomass supply chain network considering feedstock seasonality and random disruptions of collection facilities. We consider unreliable but cheap facilities as well reliable (not subject to disruptions) but expensive facilities. We optimize facility location, inventory, biomass quantity and shipment decisions in a multi-period planning horizon setting. Properties of this reliable facility problem are derived and a real-world case in Hubei, China is studied for managerial insights.

5 - Daily Berth Planning in a Tidal Port with Channel Flow ControlLu Zhen, Shanghai University, School of Management,
99 Shang Da Road, Shanghai, 200444, China, lzhen@shu.edu.cn

This talk focuses on an operational-level berth allocation and quay crane assignment problem (daily berth planning) with the consideration of the tides and channel flow control constraints. An integer programming model is proposed for this problem. Then a column generation solution approach is developed on a set partitioning based reformulation of the original model.

■ MD13

201F, 2nd Floor

Operations and Economics Interface IV

Invited: Operations and Economics Interface

Invited Session

Chair: Daniel Lin, linyt@SanDiego.edu

1 - The Impact of Animal Welfare Regulation on Firms' Product Offerings: Humane Product or Organic ProductYinping Mu, University of Electronic Science and Technology of
China, Chengdu, China, ypmu@uestc.edu.cn, Wenli Xiao,
Yen-Ting (Daniel) Lin

We consider two competing supply chains with a supplier and a retailer. We examine the retailers' choice between offering an organic product, which improves both animals' living condition and the product's nutritional benefit, and a humane product, which improves only animals' living condition, when an animal welfare regulation is introduced.

2 - Operational Role of Retail Bundling and Its Implications in a Supply ChainQingning Cao, University of Science and Technology of China,
96 Jinzhai Rd, Hefei, 230026, China, caoq@ustc.edu.cn,
Xianjun Geng, Kathryn E. Steckle, Jun Zhang

We study the impacts of retail bundling on a supply chain with a manufacturer and a retailer. The retailer orders a primary product from the manufacturer before demand uncertainty materializes, and can retail it in a bundle with a secondary product afterwards. Our findings reveal three effects of bundling, which can benefit the manufacturer but might hurt the retailer.

3 - Optimal Policies to Match Supply with Demand for Online Seasonal SalesFang Liu, Nanyang Technological University, S3-B2a-13,
50 Nanyang Avenue, Singapore, 639798, Singapore,
liu_fang@ntu.edu.sg, Yun Fong Lim

An online retailer (she) sells multiple products for a seasonal sale. She orders the products from a supplier and stores them at multiple warehouses. Before the season starts, she decides the order quantities and determines the storage quantities to each warehouse subject to its capacity constraint. After the demands are realized, she decides the retrieval quantities from each warehouse. The objective is to maximize the retailer's expected profit over the selling season. We characterize the optimal retrieval, storage, and ordering policy when the retailer sells to a single demand zone. Specifically, the optimal retrieval policy is a greedy policy. The optimal storage policy is to store the products according to each warehouse's target stock-out probability. It can be found by a non-greedy algorithm. The optimal ordering policy is a newsvendor-type policy. We propose two heuristics when the retailer sales to multiple demand zones. They show promising performance in a case study with a major fashion online retailer in Asia.

4 - The Adoption of Smart Home Appliance for Energy Shifting

Wenbin Wang, Shanghai University of Finance and Economics, Shanghai, China, wang.wenbin@shufe.edu.cn, Yannan Jin

Smart home appliances can shift energy consumption in response to energy price and thus hold great potential for reducing the energy cost. This paper uses a game theoretical approach to analyze the consumers' decision on adopting smart home appliances.

■ MD14

202A, 2nd Floor

Sustainable Energy and Environmental Policy

Sponsored: Environment, Energy, and Natural Resources

Sponsored Session

Chair: Makoto Tanaka, National Graduate Institute for Policy Studies (GRIPS), Tokyo, 106-8677, Japan, mtanaka@grips.ac.jp

Chair: Ryuta Takashima, Tokyo University of Science, Chiba, 278-8510, Japan, takashima@rs.tus.ac.jp

1 - Some Expansions of the Integrated Assessment Model Formulation - Lessons and Proposals from ICA-RUS Project

Shunsuke Mori, Tokyo University of Science, Tokyo, Japan, sh_mori@rs.tus.ac.jp

Four topics on the expansions of IAM in the ICA-RUS project by EPA Japan. (1) The decision under uncertainties on climate sensitivity is shown. Based on the evaluation on how the climate sensitivity uncertainty would be eliminated by the accumulation of observation, I expanded ATL procedure and applied it to the MARIA model. (2) I expanded the formulation on the adaptation. (3) I proposed a formulation to reconsider the "Business-as-Usual" scenario after the Paris agreement and show how the climate target should be modified when the presumptions change. (4) A statistical meta-analysis is applied to the model results. The existence of the consistent structure among models is suggested.

2 - Interactions of Emissions Trading and Renewable Energy Policy

Mari Ito, Tokyo University of Science, 2641 Yamazaki, Noda-shi, Chiba, 278-8510, Japan, mariito@rs.tus.ac.jp, Ryuta Takashima

Recently, policies for reducing greenhouse gas emissions, e.g., emissions trading as the cap and trade (C&T), and renewable energy policy as renewable portfolio standards (RPS), have been introduced in various countries. In this work, we examine market equilibria under C&T, RPS and the mixed policy by bi-level problem. For lower level, generation outputs of renewable and non-renewable generators and electricity price are decided by maximizing their profits. For upper level, the policy maker chooses the rate of emission cap and the RPS requirement by maximizing the social welfare. We have found that the mixed policy has the biggest social welfare whereas the C&T obtains the lowest greenhouse gas emissions.

3 - Evaluating Renewable Energy Policies from Social Welfare Aspect using Reinforcement Learning Agents

Masaaki Suzuki, Tokyo University of Science, 2641 Yamazaki, Noda-shi, Chiba, Japan, m-suzuki@rs.tus.ac.jp, Mari Ito, Ryuta Takashima

Governments have introduced various policies for promoting renewable energy technologies. In order to clarify how the relationships among renewable energy policy, market structure, and number of producers impact social welfare, we modeled the deregulated electricity market as the blind and single-price call auction and constructed multi-agent system with reinforcement learning. We validated our proposed simulation model by comparing the simulation result with the theoretical analysis result under simple market condition. Reinforcement learning agents enables us to evaluate more realistic market and to observe emergent processes of equilibrium states.

4 - Investments in Power Generation and Transmission: The Effect of Capacity Procurement

Kazuuya Ito, 2641 Yamazaki, Noda-shi, Chiba-ken, 278-8510, Japan, 7416605@ed.tus.ac.jp, Ryuta Takashima, Makoto Tanaka

The penetration of renewable energy has induced a decrease in capacity factors and a decommissioning for existing generations, and a reduction in new investments. This problem implies a fear for the shortage of capacity in the electricity market. Thus, in order to meet the capacity in the market, policymakers implement various policies for capacity procurements. In this work, we analyze investments in power generation and transmission by means of real options theory. The ISO decides the investment timing by maximizing social welfare whereas a power generator invests by maximizing the own profit. Especially, we examine the effect of capacity procurement for the ISO on the investment decisions.

■ MD15

202B, 2nd Floor

Service Science I

Sponsored: Service Science

Sponsored Session

Chair: Wei-Lun Chang, Tamkang University, Tamkang University, Taiwan, wlc.allen@gmail.com

1 - A Design Thinking of Service Innovation in the Sharing Economy

Wei-Feng Tung, PhD, Fujen University, New Taipei City, Taiwan, weifeng.tung@gmail.com, Nicholas Johnson

With sharing economies driving the future global economy, it is important to understand how the business landscape will change. This is because all goods and services have the ability to be shared within a community of people. Companies like Uber and Airbnb are leading the market because they understand human centric design the best. Human centric design, pioneered by IDEO, is now being used to create services. Service experience engineering (S.E.E.) puts the end user at the center of focus and designs a service around their needs and wants. This research outlines design thinking and how current sharing economies have either succeeded or failed in designing their innovative business models.

2 - Analysis of Introducing Cloudbursting for an Application Service Firm Who has Internal Computing Capacity

Li-Ming Chen, PhD, National Chengchi University, Taipei, Taiwan, lmchen.liming@gmail.com

Cloudbursting, a hybrid cloud computing model, helps firms supplement their internal computing capacity by using external resources from a public cloud to meet increased demand. This paper examines whether cloudbursting benefits an application service firm by using only its in-house capacity. We develop newsvendor-typed models. Overall, a profit-maximizing firm will benefit from migrating to cloudbursting if risk is considerably low and will maintain a private cloud if risk is considerably high. However, a firm under competition might counterintuitively remain in a private cloud even though risk is considerably low.

3 - Does Consumer Value Co-creation Behavior Matter to Frontline Service Employee Innovative Behavior?

Chin Hsiu Huang, Yuan Ze University, 135 Yuan Tung Road, Zhongli, 32003, Taiwan, ritahuang@liontravel.com, Yun-Hsin Chou

This study aims to examine the effect of consumer value co-creation on frontline employee innovative behavior along the dimensions of organizational intellectual capital. A preliminary study was conducted to establish the proposed research model and the hypotheses. A total of 282 valid frontline employee responses were collected from a travel agent. The results show that the interactions between consumer value co-creation and human capital, and between consumer value co-creation and organizational capital have a significant moderating effect on frontline service employee innovative behavior.

■ MD16

203A, 2nd Floor

Reinforcement Learning and Optimal Sequential Decision Making

Invited: Optimization

Invited Session

Chair: Yangyang Xu, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY, 12180, United States, xuy21@rpi.edu

1 - Asynchronous Parallel Empirical Variance Guided Algorithms for the Thresholding Bandit Problem

Ji Zhong, California State University, Los Angeles, CA, United States, jie.zhongmath@gmail.com, Ji Liu

This paper considers the multi-armed thresholding bandit problem — identifying all arms whose expected rewards are above a predefined threshold via as few pulls (or rounds) as possible. This work proposes an asynchronous parallel thresholding algorithm and its parameter-free version to improve the efficiency and the applicability. On one hand, the proposed two algorithms use the empirical variance to guide the pull decision at each round, and significantly improve the round complexity of the "optimal" algorithm when all arms have bounded high order moments. The proposed algorithms can be proven to be optimal. On the other hand, most bandit algorithms assume that the reward can be observed immediately after the pull or the next decision would not be made before all rewards are observed. Our proposed asynchronous parallel algorithms allow making the choice of the next pull with unobserved rewards from earlier pulls, which avoids such an unrealistic assumption and significantly improves the practical efficiency of bandit algorithms.

2 - SBEED Learning: Convergent Control with Nonlinear Function Approximation

Lihong Li, Research Scientist, Google Inc., 747 6th St S, Kirkland, WA, 98033, United States, lihongli.cs@gmail.com

When function approximation is used, solving the Bellman optimality equation with stability guarantees has remained a major open problem in reinforcement learning for decades. The fundamental difficulty is that the Bellman operator may become an expansion in general, resulting in oscillating and even divergent behavior of popular algorithms like Q-learning. In this paper, we revisit the Bellman equation, and reformulate it into a novel primal-dual optimization problem using Nesterov's smoothing technique and the Legendre-Fenchel transformation. We then develop a new algorithm, called Smoothed Bellman Error Embedding, to solve this optimization problem where any differentiable function class may be used. We provide what we believe to be the first convergence guarantee for general nonlinear function approximation, and analyze the algorithm's sample complexity. Empirically, our algorithm compares favorably to state-of-the-art baselines in several benchmark control problems.

3 - Attacking Black-box Machine Learning Models by Zeroth Order Optimization

Cho-Jui Hsieh, UC Davis, Davis, CA, chohsieh@ucdavis.edu

It has been observed recently that machine learning algorithms, especially deep neural networks, are vulnerable to adversarial examples. However, almost all the attack algorithms are developed for the white-box setting, which assumes that the model is fully exposed to the attackers. In this talk, we discuss how to attack machine learning models under more restricted black-box settings, where only input-output pairs of the model is observed. We will show how to formulate this problem as zeroth order optimization problem, and how to address the challenges including high dimensionality and limited query budgets.

■ MD17

203B, 2nd Floor

Future of Yard Operation in Maritime Logistics I

Invited: Maritime Operations

Invited Session

Chair: Chenhao Zhou, National University of Singapore, Singapore, 117576, Singapore, a0096340@u.nus.edu

1 - Flexible Allocation Strategy for Reshuffling Considered Storage Allocation Problem in Transshipment Terminals

Chenhao Zhou, National University of Singapore, 1 Engineering Drive 2, E1A-05-21, Singapore, 117576, Singapore, a0096340@u.nus.edu, Wencheng Wang, Haobin Li

The storage allocation decision is usually made on sub-block level which is not ideal way in terms of the space utilization, and the effect of the container reshuffling is omitted by assuming the yard crane handling capacity a constant. According to the terminal operators, due to the high uncertainty of vessels and vehicles, the reshuffling still has strong impact on the yard throughput no matter what grouping rules are applied. So we proposed a simulation-based optimization approach for the flexible allocation strategy for reshuffling considered storage allocation problem.

2 - Research of Joint Quay Crane Scheduling and Block Allocation in Container Terminals

Hongtao Hu, Room101, No 96, 555 Guzong Road, Shanghai, China, hu.hongtao@foxmail.com, Shanghai Maritime University, Shanghai, China, hu.hongtao@foxmail.com

Container terminal is a complex system in which the makespan of a ship service depends not only on the operations of quay cranes (QCs) but also on the operations of yard cranes (YCs) and the horizontal transportation by trucks. This paper addresses the joint quay crane scheduling and block allocation problem at container terminals. We obtain the quay crane scheduling by considering the traveling time of trucks, the handling capacity and storage capacity of yard blocks. A mixed-integer linear programming model is formulated to minimize the makespan of a ship service and the traveling time of trucks. A hybrid Particle Swarm Optimization (PSO) algorithm in which a neighborhood search with a taboo list and a heuristic preprocessing are incorporated to improve the solution quality and CPU runtime. Numerical experiments are performed to validate the effectiveness of the proposed models and the efficiency of the proposed algorithm.

3 - A Branch-and-bound Approach for the Container Relocation Problem

Ching-Jung Ting, Yuan Ze University, Dept of Industrial Engineering & Mgt, 135 Yuan-Tung Road, Chung-Li, 32003, Taiwan, ietingcj@saturn.yzu.edu.tw, Kun-Chih Wu

Container relocation problem is one of the important problems for container yard operations. This paper presents a depth-first branch-and-bound (B&B) method, which take into account the lower bound for selecting a branch, for the restricted container relocation problem (RCRP). The results from benchmark instances show that our B&B method can provide very competitive performance with those comparing exact solution approaches.

4 - Approximate Dynamic Programming for Container Reshuffling Problem

Ren Zhao, Institute of Industrial & Systems Engineering, Northeastern University, zhaoren@ise.neu.edu.cn, Jianyuan Hu, Lixin Tang

Container reshuffling problem is to assign relocated items to suitable storage space for retrieving a given sequence of the export containers so as to minimize the total number of relocations. In this paper, an approximate dynamic programming (ADP) algorithm is proposed with the value function approximations in view of slabs and stacks formulated. The experimental results indicate that the proposed approximate dynamic programming algorithm can obtain better solutions in effective time compared with the existing methods.

■ MD18

North Lounge, 3rd Floor

Healthcare Policy and Applications

Invited: Healthcare Systems and Applications

Invited Session

Chair: Naoru Koizumi, George Mason University, George Mason University, Arlington, VA, 22201, United States, nkoizumi@gmu.edu

1 - Blood Incompatible Deceased Donor Kidney Transplantation – Time to Remove the Barrier

Mehdi Nayeypour, George Mason University, Founders Hall, 3351, Fairfax Dr, Arlington, VA, 22201, United States, mnayeypo@gmu.edu, Naoru Koizumi

ABO incompatible kidney transplantation has been practiced with satisfactory outcomes. But most of them have been accomplished by using live donors and after preparing recipients in advance. In partnership with the GWU Hospital we report the first case of successful directed deceased donor ABO incompatible kidney transplantation. We advocate that if our current system allows for ABO incompatible transplantation we could decrease kidney discards. We used the Kidney-Pancreas Simulated Allocation Model to simulate this policy. Results show an increase in the number of transplants, less disparity between African American and other recipients and higher proportion of HLA zero miss-matches.

2 - Challenges in Residency Scheduling

Amy Cohn, University of Michigan, 1205 Beal Avenue, Department of IOE, Ann Arbor, MI, 48109, United States, amycohn@umich.edu

When scheduling medical residents, we face all of the typical challenges found in personnel scheduling. We also face additional challenges due to the dual role of residency — both in providing patient care and also as a continuation of medical training. Thus, this complex combinatorial optimization problem also has multiple objective criteria as well as ill-defined constraints. We discuss our experiences in shift, call, and block scheduling for medical residents at the University of Michigan Medical School.

3 - Online Surgical-Case Scheduling

Diwakar Gupta, Professor, University of Texas, 2110 Speedway Stop B6000, Austin, TX, 78712, United States, diwakar.gupta@mcombs.utexas.edu, Shashank Goyal

In an open scheduling environment, surgery-booking requests arrive one at a time. Surgeries must be placed in one of the ORs scheduled to be open at a future date, or turned away. We develop easy-to-use algorithms, derive their competitive ratio bounds, and report results from numerical experiments.

4 - Inducing Compliance with Post-market Studies for Drugs under FDA's Accelerated Approval Pathway

Hui Zhao, The Pennsylvania State University, 419 Business Building, Smeal College of Business, University Park, PA, 16802, United States, huz10@psu.edu, Liang Xu, Nicholas C Petruzzzi

In 1992, FDA instituted the accelerated approval pathway (AP) to allow promising drugs into the market based on limited evidence of efficacy, with verification of true clinical benefits conducted through post-market studies. However, most post-market studies have not been completed as promised. We synthesize and distill the salient tradeoffs and complicating factors facing FDA's non-compliance problem and provide a potentially implementable solution considering FDA's information asymmetry, moral hazard, and enforceability challenges.

■ MD19

South Lounge, 3rd Floor

Dynamic Decision Making for Health Care Policy

Invited: Healthcare Management

Invited Session

Chair: TingYu Ho, University of Washington, Seattle, WA, 98125, United States, tyhotw@uw.edu

1 - Branch-and-bound Approach for Dynamic Resource Allocation in Population Disease Management

TingYu Ho, University of Washington, 12012 38th Ave NE, Seattle, WA, 98125, United States, tyhotw@uw.edu, Shan Liu, Zelda B Zabinsky

Dynamic resource allocation for disease prevention, screening, and treatment interventions in population disease management has received much attention in recent years due to excessive healthcare costs. We present a branch-and-bound algorithm to solve this type of problems by embedding an approximation that quickly finds a good incumbent solution. The budget constraint is manipulated to allow bound on the solution. A numerical study on screening and treatment policy implementation for chronic hepatitis C virus (HCV) infection provides useful insights regarding HCV elimination for baby boomers.

2 - Modeling and Analyzing Seasonal Influenza Spread and Policy Design for Taiwan with Agent Based Simulation

Hao Huang, Yuan Ze University, IEM Department, Yuan Ze University, 135 Yuan-Tung Road, Chung-Li, Taoyuan, 32003, Taiwan, haohuang@saturn.yzu.edu.tw

An agent-based simulation model is proposed in order to simulate the spread of seasonal influenza at Taiwan and support potential policy designing. Taiwanese public insurance provides free vaccination for certain demography, where the non-qualified cohort can only be vaccinated on their own expenses or private premium insurance plan. The agent-based simulation model includes the spread of influenza, vaccination activities, and treatment activities if infected. Numerical experiments are implemented in multiple scenarios in order to provide insights for policy design.

3 - Benefits of Combining Early Aspecific Vaccination with Later Specific Vaccination

Rommert Dekker, Professor of Quantitative Logistics, Erasmus University-Rotterdam, Burg. Oudlaan 50, P.O Box 1738, Rotterdam, 3000 DR, Netherlands, rdekker@ese.eur.nl, Lotty Evertje Duijzer

Timing vaccination in case of an outbreak or the yearly flu is critical. Yet in early stages little information is available, so a vaccine may not be that effective as a later available vaccine. We study this choice problem through the standard SIR model. We show analytically that in many cases it is profitable to combine two types of vaccine. Using three types of vaccine, however does not improve the results. Finally we extend the results to more general disease progression models.

■ MD20

401, 4th Floor

Performance Analysis of Computer Systems and Networks

Invited: Applied Probability

Invited Session

Chair: Cheng-Shang Chang, National Tsing Hua University, Hsinchu, 30043, Taiwan, cschang@ee.nthu.edu.tw

1 - The Capacity of QoE for Wireless Networks

I-Hong Hou, PhD, Texas A&M University, College Station, TX, 77845, United States, ihou@tamu.edu

Video streaming is anticipated to dominate wireless traffic in the near future. We study wireless systems where an access point delivers video streams to multiple clients over wireless channels. The performance of each client is measured by the amount of time that its video playback halts due to buffer underflow, which has been shown to have the most impact on clients' perceived quality of experience (QoE). This performance measure is significantly different from traditional quality of service metrics. We develop an analytic framework that jointly captures the video playback process and the unreliable and heterogeneous wireless channels. We then derive both the capacity region of QoE as well as a scheduling policy that is QoE-optimal.

2 - Network Inference for Cyber Security in Online Social Networks

Chee Wei Tan, PhD, City University-Hong Kong, Hong Kong, cheewtan@cityu.edu.hk

Online social networks represent a fundamental medium for the spreading and diffusion of various information where the actions of certain users increase the susceptibility of other users to the same; this results in the successive spread of

information from a small set of initial users to a much larger set. Examples include the spread of malicious rumors and Internet hoax. To enhance the network cyber security, we focus on the mathematical theories and algorithms of network inference for cyber-security in online social networks by leveraging ideas in graph theory and statistical inference. We conclude with insights on putting the theory into practice in graph analytics software.

3 - On Binary Maximum Distance Separable Array Codes with Asymptotically Weak-optimal Repair

Yunghsiang S Han, PhD, Dongguan University of Technology, Dongguan, 523808, China, yunghsiangh@gmail.com, Hanxu Hou

Binary maximum distance separable (MDS) array codes have been widely employed in storage systems. A binary MDS array code contains k information columns and r parity columns such that any k out of $k+r$ columns are sufficient to reconstruct all k information columns, in which each entry in the array is a bit. The repair bandwidth is the total bits downloaded in repairing a failure column. It has been known that the minimum repair bandwidth of a failure column in MDS array codes is $(k+1)L/2$ when $k+1$ surviving columns are connected, where L is the number of bits in each column. If the minimum repair bandwidth is achieved by $k+1$ specific columns, it is called weak-optimal repair. In this talk, we present a construction of binary array codes over a quotient ring and exploit the property of encoding matrix that can asymptotically achieve weak-optimal repair. A sufficient MDS condition of the proposed binary array codes is also presented. We show that there exist many encoding matrices that can asymptotically achieve weak-optimal repair.

■ MD21

Joy, 4th Floor

Measurement & Evaluation

Invited: Circular Economy

Invited Session

Chair: Hsin-Wei Hsu, Tunghai University, No.1727, Sec.4, Taiwan Boulevard, Xitun District, Taichung, 40704, Taiwan, hwhsu@thu.edu.tw

Co-Chair: I-Hsuan Hong, National Taiwan University, Taipei, 106, Taiwan, ihong@ntu.edu.tw

1 - Boosting Uptake Level of Environmentally Friendly Products: Subsidy for Consumer or Firm?

I-Hsuan Hong, PhD, Institute of Industrial Engineering, National Taiwan University, Taipei, Taiwan, ihong@ntu.edu.tw, Lukas Gandajaya

The subsidy policy has been a driving force to stimulate the consumption of environmental friendly products. This study examines two various subsidy policies: subsidy for consumer and subsidy for firm, where the regulator allocates the subsidy to consumers who purchase environmental friendly products under the policy of subsidy for consumer and the government puts the subsidy to the firm who produces environmentally friendly products under the policy of subsidy for firm. We investigate the impact on the uptake level of environmentally friendly products. This study incorporates the reference-dependent preferences theory to derive consumers' decisions on buying environmentally friendly or less environmentally friendly products under the influence of each subsidy policy. Given our specific framework, the counter-intuitive theoretical result shows that subsidy for firm policy is capable to induce at least as good as the uptake level of environmentally friendly products under the policy of subsidy for consumer.

2 - A Perishable Food Logistic Model with Environmental Considerations and Service Level

Hsin-Wei Hsu, Assistant Professor, Tunghai University, No.1727, Sec.4, Taiwan Boulevard, Xitun District, Taichung, 40704, Taiwan, hwhsu@thu.edu.tw

The main challenges of food logistics are distributing high quality perishable food and reducing the environmental impacts such as carbon footprints and fuel consumption. Therefore, in this study, the multi-periods and multi-stages mathematical model for perishable food logistics to combine the concepts of sustainable and service supply chain will be formulated. The properties of perishable food was investigated, and besides the traditional cost minimization objective, the energy-related emission for environment and maximum shelf life for service level will also be considered into the generalized food logistic model. A food logistics network problem will be presented and formulate into a multi-objective integer linear programming model. Moreover, the decisions for selecting the places of food processors, distribution centers, and retailers with the respective operation units were supported with maximum service level, minimum cost and emission. An illustrative problem, case study, will be used to demonstrate the results.

3 - On Computable Multi-player Equilibrium for Capacitated and Connected Resources Competition with Alliances and Transshipment

Yu-Ching Lee, PhD, Department of Industrial Engineering & Engineering Management, National Tsing Hua University, Hsinchu, 300, Taiwan, ycllee@ie.nthu.edu.tw, Yuan Feng, Yue Dai, Chun-Han Wang

An equilibrium programming framework which formulates the leader-follower game in the capacitated resource competition is constructed. The followers are firms competing for common and limited resources. The leader is the entire industry. An order quantity of each firm for the common resource should be computed. Alliances and transshipment between firms are considered in the framework, and then mechanisms to improve industry profitability and individual firm's profitability are designed.

4 - Pricing Incentives for Car Returning in a Car-sharing Network

Yuyi Feng, Professor, School of Business, Sichuan University, Suite 109, School of Business, Sichuan University, Chengdu, China, yufeng@live.com, Li Luo

We study an incentive control on customers returning their rented cars in consideration with the numbers of cars (car capacities) in different locations for a car-sharing system. The big challenge the firm faces is moving cars around locations for customer satisfaction is so expensive. By using the incentives, the firm running an electricity car-sharing network can dynamically allocate its car capacities at various locations properly for customers' pick-up, and meanwhile, reduce cost of moving cars around the locations.

■ MD22

Elegance, 4th Floor

Preference Elicitation, Communication, and Use

Sponsored: Group Decision Making and Negotiation

Sponsored Session

Chair: Adiel Teixeira de Almeida, Universidade Federal de Pernambuco, Universidade Federal de Pernambuco, Recife, Brazil, adielta@gmail.com

1 - Electricity Generation Technologies in Jordan as a Contested Discussion: Applying Multi-criteria Decision-making Analysis to Understand Stakeholders' Preferences

Nadejda Komendantova, PhD, International Institute for Applied Systems Analysis, Laxenburg, Austria, komendan@iiasa.ac.at, Love Ekenberg, Mats Danielson

The goal of this paper is to evaluate the stakeholders preferences on different electricity generation technologies in Jordan against a set of criteria which are relevant for national and local governance of energy policy. The methodology is based on participatory multi-criteria decision analysis for developing compromise-oriented solutions of contested problems. Stakeholders elicitation were evaluated through criteria ranking and surrogate weights with application of the DecideIT software.

2 - Preference Modeling for Multi-criteria Group Decision Making/aiding with FITradeoff Method

Adiel Teixeira De Almeida, Universidade Federal de Pernambuco, Cx Postal 7462, Recife PE, 50630-970, Brazil, adielta@gmail.com, Eduarda Asfora

The paper presents the FITradeoff method for Preference Elicitation for modelling a multi-criteria group decision making/aiding in a situation of using partial information. The organizational context plays a relevant role and has to be considered, such as the role of each DM and the power relation of those DMs.

3 - Improving Graphical Visualization in the FITradeoff DSS by Using Neuroscience Experiment

Lucia Reis Peixoto Roselli, PhD Candidate, Universidade Federal de Pernambuco, Universidade Federal de Pernambuco, Recife, 50000-000, Brazil, luciapr@hotmail.com, Adiel Teixeira de Almeida

The aim of this study is to improve the use of graphical visualization in the FITradeoff Decision Support System (DSS) by undertaking neuroscience experiments. Therefore, applying an eye-tracking experiment some suggestions have been made to the analysis of the decision process and for improvements in the design of the DSS so that solutions could accurately express a DM's preferences.

4 - Multiple Floors Healthcare Facility Layout Problem

Ling Gai, Shanghai University, Office 432, Management Science, School, No. 599 Shangda Road, Shanghai, 201444, China, lgai@shu.edu.cn

We consider a multi-attribute group decision making problem for the multi-floor healthcare facility layout problem (MHFLP). Several feasible alternatives are produced first with the objective of minimizing flow costs. These alternatives are

then evaluated according to their qualitative criteria by a group of experts. Given the facts that each alternative has several qualitative attributes, and the experts have different specialties on these attributes, we propose an method to determine the proper attributes weight and the experts weight (on different attributes), if they are partially known in advance. The interval-valued intuitionistic fuzzy sets are applied to evaluate the attributes.

Tuesday, 8:00AM - 9:30AM

■ TA01

101A, 1st Floor

Pricing and Behavioral Issues

Sponsored: Revenue Management & Pricing

Sponsored Session

Chair: Ningyuan Chen, Hong Kong University of Science and Technology, Kowloon, Hong Kong, nychen@ust.hk

1 - Product Quality Decisions with Online Product Reviews

Dongwook Shin, Professor, Hong Kong University of Science and Technology, HKUST, Lee Shau Kee Business Building, Room 4039, Clear Water Bay, Kowloon, Hong Kong, dwshin@ust.hk

This research investigates the supply chain where a manufacturer sells their product through an online retailer. The online retailer has private demand information, which may or may not be share with the manufacturer. Based on the retailer's information sharing decision, the manufacturer can determine the quality of the product endogenously. Compared to traditional brick-and-mortar retailers, we establish that the online retailer has more incentive to share demand information.

2 - Does Loss Aversion Preclude Price Variation?

Ningyuan Chen, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, nychen@ust.hk, Javad Nasiry

In modern retailing, frequent discounts are seemingly at odds with the idea that price variation antagonizes loss-averse consumers and hence diminishes their demand for products and services. We model a monopolist selling a product over time to loss-averse consumers who differ in their sensitivity to losses. Although the market is thus segmented, the firm cannot price-discriminate among consumers based on that sensitivity. We show that charging a long-run constant price may be suboptimal and then derive conditions under which the optimal policy is cyclic (e.g., a periodic markdown policy). These findings establish that loss aversion does not preclude price variation and thereby underscore the importance of incorporating consumer heterogeneity into pricing policies.

3 - Dynamic Nonlinear Pricing of Inventories Over Finite Sales Horizons

Yan Liu, University of Science and Technology of China, 96 Jinzhai Road Baohe District, School of Management, Hefei, 230026, China, bizliuy@ustc.edu.cn, Guillermo Gallego, Michael Zhi-Feng Li

We present three dynamic pricing models in a setting where consumers can be incentivized to purchase multiple units. We assume a finite sales horizon with a sunk investment in limited inventories. The dynamic linear pricing (DLP) model charges a uniform price that depends on the time-to-go and remaining capacity. The dynamic nonlinear pricing (DNP) model allows complete freedom in pricing different bundle sizes. We also study dynamic block pricing (DBP) as an intermediate scheme in which prices are linear within each block, where the block can be either fixed or flexible.

4 - Dynamic Pricing with Service Unbundling

Boqian Song, Southwestern University of Finance and Economics, Chengdu, China, song0089@e.ntu.edu.sg, Michael Zhi-Feng Li

In this paper, we investigate unbundling when a firm dynamically prices a basic service, while separating the sale of a fixed-price add-on. We characterize the optimal dynamic unbundling pricing policy and investigate its structural properties. We find that the value function with unbundling increases in the degree of dependence between consumers' reservation prices for basic service and add-on. However, there are no similar monotonicity properties for the optimal price of the basic service. For several families of commonly-used joint distributions, we show that the influence of the dependence parameter on the optimal price of the basic service depends on a threshold, which is a function of the dependence parameter. Moreover, the price of the bundled service is higher under unbundling when the add-on price is high, and vice versa. Finally, our model is compared with the bundling model through a numerical experiment.

■ TA02

101B, 1st Floor

Supply Chain Inventory

Invited: Supply Chain Inventory Management

Invited Session

Chair: Sean Zhou, Chinese University of Hong Kong, Shatin N T, Hong Kong, zhoux@baf.cuhk.edu.hk

Co-Chair: Li Xiao, e, Tsinghua-Berkeley Shenzhen Institute, Hong Kong, cloaxiao@gmail.com

1 - Managing a Hybrid RDC-DC Inventory System

Chaolin Yang, Associate Professor, Shanghai University of Finance and Economics, No. 100, Wudong Road, Yangpu District, Shanghai, 200433, Shanghai, 200433, China, yang.chaolin@sufe.edu.cn, Xiaoyue Yan, Tong Wang

In this paper, we study a hybrid RDC-DC serial inventory system where RDC replenishes its stock from an outside supplier, while DC faces random demand and replenishes its stock from RDC. However, unlike in the traditional serial system, DC itself can replenish its inventory from the outside supplier as well. We propose two simple and easy-to-implement heuristic policies for the system. The first heuristic policy, which we call three-index policy, combines the characteristics of the echelon-base-stock policy for the serial system (Clark and Scarf 1960) and the dual-index policy for the dual-sourcing system (Veeraraghavan and Scheller 2008). We then develop another heuristic policy (the ALP policy) based on the three-index policy and the multimodularity of the problem. Our numerical results show that the ALP policy and the three-index policy are comparable, and that the former performs slightly better. Moreover, we demonstrate that the outside supplier option of DC can draw considerable cost savings under both policies.

2 - Managing Perishable Inventory Systems with Multiple Demand Classes

David Chen, the Chinese University of Hong Kong, Shenzhen, Shenzhen, China, davidchen@cuhk.edu.cn, Hossein Abouee-Mehrizi, Opher Baron, Oded Berman

Preferences for different ages of perishable products exist in many examples, including grocery items and blood products. We study a multi-period stochastic perishable inventory system with multiple demand classes with different requirements on the age of acceptable products. We show that the optimal order quantity is decreasing in the inventory levels, the optimal allocation policy is a sequential rationing policy, the optimal disposal policy is characterized by $n-1$ thresholds, and they are robust to different assumptions. Moreover, we show that ignoring the difference between demand classes and using simple policies (e.g., FIFO) can significantly increase the total cost. We examine how the firm can improve the control of perishable items and show that the beneficial numerical examples.

3 - Influenza Supply Chain Management with Overconfident Agents

Lijun Ma, Shenzhen University, No. 3688 Nanhai Road, Nanshan District, Shenzhen, Guangdong, China, ljma@szu.edu.cn, Meiyan Lin, Weili Xue

In this paper, we study the influenza supply chain management problem with overconfident agents. We focus on how consumer over-confidence, and manager overconfidence affect the influenza supply chain. First, we characterize the threshold value for an overconfident consumer to search for the vaccine. Then, we characterize the optimal production policy.

4 - A Multi-Source Inventory System with Order Tracking and Expediting

Li Xiao, xiaoli@sz.tsinghua.edu.cn, Jing-Sheng Jeannette Song, Hanqin Zhang, Paul H Zipkin

We consider an inventory system with multiple supply sources and expediting options. The replenishment leadtimes from each supply source are stochastic, representing congestion and disruption. We develop performance evaluation tools for a family of reasonable ordering and expediting policies. These policies take into account real-time supply information, which can be obtained through tracking technologies such as GPS and RFID. Performance evaluation of such state-dependent policies is generally hard. The main thrust of the paper is to show that, under these policies, the supply system becomes a network of queues with a special routing mechanism called an overflow bypass. The analysis therefore reduces to the analysis of these networks. We show that under several alterations of the general policy, the solution has a simple product form and thus we obtain closed-form performance measures.

■ TA03

101C, 1st Floor

Data Privacy, Path Models and Predictive Analytics

Invited: Machine Learning and Big Data Analytics

Invited Session

Chair: Galit Shmueli, National Tsing Hua University, Institute of Service Science, Hsinchu, 30013, Taiwan, galit.shmueli@gmail.com

Co-Chair: Soumya Ray, National Tsing Hua University, Hsinchu, Taiwan, soumya.ray@iss.nthu.edu.tw

1 - Industry-academia Big Data Collaborations in the New Era of Data Regulation

Travis Greene, National Tsing Hua University, Hsinchu, Taiwan, greenet09@gmail.com, Galit Shmueli

2018 will see the introduction of both the European Union's General Data Protection Regulation (GDPR) and the revision of the Common Rule (Final Rule) in the USA. We explore how these sweeping new changes will likely affect behavioral big data (BBD) research, particularly collaborative research between industry and academia.

2 - A New Tree-Based Method for Clustering Many Time

Mahsa Ashouri, National Tsing Hua University, Hsinchu, Taiwan, mahsa.ashouri@iss.nthu.edu.tw

We propose a new method for clustering time series that captures temporal information and cross-sectional features. The method is based on model-based partitioning trees, and can be used as an automated yet transparent tool for clustering many time series. The two-step method first clusters by trend and seasonality and cross-sectional features, and then further clusters by autocorrelation and cross-sectional features.

3 - A Critical Review of PLS Path Modeling in Management Research and Ways Forward

Nicholas Danks, National Tsing Hua University, Hsinchu, Taiwan, nicholasdanks@iss.nthu.edu.tw, Soumya Ray

A clearer understanding of Partial Least Squares (PLS) path modeling is emerging that stresses the difference between composite and common-factor measurement. We highlight the differences between these modeling approaches and demonstrate the dangers of mixing the logic of these two types of constructs. We offer a new open-source R package that guides practitioners to produce rigorous PLS path models.

4 - Evaluating the Predictive Performance of Constructs in PLS Path Modeling

Nicholas Danks, National Tsing Hua University, Hsinchu, Taiwan, nicholasdanks@iss.nthu.edu.tw, Soumya Ray, Galit Shmueli

Recent and exciting advances in evaluating predictive performance in Partial Least Squares (PLS) path models have been largely limited to predicting measurement items. We argue that the predictive validity of constructs should be of greater importance to empirical researchers. We propose a novel technique for overcoming the challenges of measuring predictive power of constructs, and provide suitable predictive metrics.

■ TA04

101D, 1st Floor

Special Session: Condition Based Maintenance and Hazards Modeling

Invited: Military, Defense, and International Security

Invited Session

Chair: Greg H Parlier, North Carolina State University, 255 Avian Lane, Madison, NC, 35758, United States, gparlier@knology.net

1 - Condition Based Maintenance and Hazards Modeling

Scott Koshman, CFC Toronto, Ottawa, ON, Canada, scottkoshman@hotmail.com

The ability to assess materiel condition enables the optimization of asset management based on actual and developing material need. This session will explore the use of survival analysis, notably proportional hazard modeling, in condition based maintenance for equipment.

■ TA05

102, 1st Floor

Practice VI

Invited: Practice/Industrial Applications

Invited Session

Chair: Tim Lin, Experian, Orange County, CA, United States

1 - Revolution in Fraud Risk Management Driven by Advancing Analytics and Technology

T.J. Jiao, Uber, San Francisco, CA, United States, tyjiao@gmail.com

What you'll learn: Functions and capabilities of fraud risk management systems from leading technology companies. Examples of best practices and use cases in large scale Risk decisions by leveraging rules engine/ data science and analytics. Description: Companies in many industries such as Financial/ Banking/ ecommerce & payment are facing unprecedented challenges from fraud risk and under constant pressure to innovate and keep up with a continuously moving target of threats to the bottom line of the business. Uber Risk team is at the forefront of one of the world's biggest challenges working on delivering innovative risk management capability to maximize legitimate revenue and sustainable growth. Everyday we process millions of mobile transactions in over 75 different counties in real time through highly scaled decision platform with sophisticated machine learning models/ risk strategies. This talk will cover: 1. common functions and structure of risk management in technology companies; 2. evolution of concept, tools and techniques in fraud risk management; 3. importance of measurement/ test iterations and 4. Some emerging techniques and their applications at Uber Risk

2 - Marketing with Data During the Digital Revolution

Tim Lin, Experian, Orange County, CA, United States

Empowered by the digital revolution, marketing has emerged as one of the key functions in leading companies. As this paradigm shift ensues, the success of the marketing will be determined by the ability to combine physical, digital, sensorial and emotional experiences to personalize and individualize target audience interactions. As businesses make the transition away from siloed experiences, they will be able to deploy data-driven solutions that understand user behavior in order to connect with customers deeper than ever before. As a B2C department in one of the biggest credit bureau in the world that manages the data of over 200 million people, Experian Consumer Service is always brainstorming new methodologies on customer service and seek to evolve the experience as we collect data and learn more and more about customer needs. This talk will frame the proper marketing mindset needed to take advantage of the modern digital world. Tim will reveal real use case examples Experian has had in leveraging the full potential of data for customers on their e-commerce site as well as in email marketing and online advertising to accomplish the conversion and retention goals. He invites you today in learning how to build a frictionless customer journey that drives authentic and measurable engagement

■ TA06

103, 1st Floor

Tutorial: Analytics for the Supply Chain 4.0

Tutorial Session

1 - Analytics for the Supply Chain 4.0

Kai Hoberg, Kuehne Logistics University, Großer Grasbrook 17, Hamburg, 20457, Germany, Kai.Hoberg@the-klu.org

Supply chain management has always been technology oriented and data intensive. New technologies like robots in warehousing, self-driving trucks or IoT solutions offer many interesting possibilities for supply chain research. However, the on-going explosion of data available along the supply chain has also attracted a lot of attention from practice and academia. Until recently, the supply chain management community has focused primarily on complex mathematical models and operations research methods. However, now there is a strong push by many scholars to leverage new data sources and the breadth of data for creating new insights and to improve decision making. In this tutorial, we have a look at the analytics opportunities along the different stages of the supply chain and discuss some detailed applications.

■ TA08

201A, 2nd Floor

Transportation Operations

Contributed Session

Chair: Zolboo Gansukh, Yanshan University, Qinhuangdao, 066000, China, gansukh.zolboo@stumail.ysu.edu.cn

1 - Aircraft Acquisition under Demand and Cost Uncertainties: An Integer Programming Approach

Wei-Ting Chen, The University of New South Wales, Sydney, Australia, weitingchen1983@gmail.com, Cheng-Lung Wu, David Tan

For aircraft acquisition problem, a consideration of both operating and financial leases becomes more and more critical under the new accounting standard which will be applied in 2019. This paper formulates an integer programming model to optimize an airline's combination of aircraft from operating leases, financial leases, and purchases, under demand and cost uncertainties of aircraft acquisition. Numerical experiments contain airlines with different business models. The results confirm that the developed model is applicable to the real-world problems and lead to a better decision for aircraft leasing.

2 - Leadership and Human Resource Strategies to Implement Emerging Technologies in the US Maritime Industry

Robert Bauleke, SUNY Maritime College, 6 Pennyfield Ave, G116D, Bronx, NY, 10465, United States, robert.bauleke@gmail.com

Limited information sharing, transactions via phone and email, and a lack of technology has been the norm for US maritime firms. Carriers, insurers, brokers, and operators vulnerable to disruption receive pressure from customers to provide technological services. As a result, emerging technologies like blockchain, autonomous vehicles, and IT ecosystems are disrupting portions of the industry. Presented in this thesis are leadership and human resource strategies for US maritime firms to posture a smarter and more adaptable workforce to work alongside or operate new technologies.

3 - Schedule Design for Liner Services under Vessel Speed Reduction Incentive Programs

Dan ZHUGE, The Hong Kong Polytechnic University, Hong Kong, dan.zhuge@connect.polyu.hk, Shuaian Wang, Lu ZHEN

This paper studies a schedule design problem of a liner shipping company under Vessel Speed Reduction Incentive Programs (VSRIPs). A mixed-integer non-linear mathematical model on minimizing total costs (i.e., fuel cost and operating and capital cost minus dockage refunds) is proposed considering three determinants, i.e., the compliance of VSRIPs, the speed limit and the limited number of ships. An exact algorithm and a piecewise-linear approximation algorithm are put forward to solve the model.

4 - Empirical Investigation on the Range Anxiety for Electric Vehicles

Sang Won Kim, CUHK Business School, Hong Kong, skim@cuhk.edu.hk, Ho-Yin Mak, Marcelo Olivares, Ying Rong

Electric vehicles are an important technology for curbing the carbon footprint of road transportation. Despite substantial government incentives, mass adoption has yet to happen in major auto markets. One of the most well-cited reasons of slow adoption is the range anxiety, coming from the fact that electric vehicles have limited driving range. Although the range anxiety is quite well recognized, it has not been adequately quantified, quite possibly due to the lack of quality data. In this work, we propose a novel way to do so by use of a dataset from car sharing.

5 - The Efficiency Forecast of Trilateral Transit Transportation of Economic Corridor

Zolboo Gansukh, PhD Student in Yanshan University, International Student Block #6A, Qinhuangdao, 066000, China, gansukh.zolboo@stumail.ysu.edu.cn

The efficient transit transport is the vital issue for landlocked states. Due to the lack territorial access to seaports unique way is to transit transportation with neighboring countries. Mongolian geographical location, mining, and rapid development of energy sector are crucially important for connecting "New Silk Road", "Steppe Road" and "Eurasian Transportation Corridor". Mongolia-China-Russia economic corridor is a new intensification of trilateral cooperation among Mongolia, China, and Russia, which provides a favorable condition not only trilateral cooperation but also regional economic cooperation.

■ TA09

201B, 2nd Floor

Data Mining, Graphs, and Networks

Contributed Session

Chair: Yinxing Li, Tohoku University, Aobaku, Sendai, 9800871, Japan, dgod1028@gmail.com

1 - Social Media and the Diffusion of an Information Technology Product

Yinxing Li, Tohoku University, Aobaku, Hatsiman 1-3-2-202, Sendai, 9800871, Japan, dgod1028@gmail.com, Nobuhiko Terui

The expansion of the Internet has led to a huge amount of information posted by consumers online through social media platforms such as forums, blogs, and product reviews. This study proposes a diffusion model that accommodates pre-launch social media information and combines it with post-launch sales information in the Bass model to improve the accuracy of sales forecasts. Specifically, we construct variables from social media by using sentiment analysis and topic analysis. These variables are fed as key parameters in the diffusion model's evolution process for the purpose of plugging the gap between the time-invariant key parameter model and that of observed sales.

2 - To More Precisely Detect Attitudes Toward Luxury Brands by Comparing Cognition-based with Emotion-based Online Sentiments

Tiffany Ting-Yu Wang, KNU, No 70-7, Ln 16, Xianyan Road, Taipei, 11688, Taiwan, tiffanyt.wang122@gmail.com

Despite the paradox of communicating to non-target audiences who cannot afford to buy branded luxury offerings, their online sentiments matter to maintain and strengthen prestigious brand awareness. In addition to the frequently-used tailoring of linguistic resources such as dictionaries to fit the subject domain, our study attempts to extend the customization method of text analytics through examining sentiments toward luxury brands on social media and in an online experiment in terms of cognition- vs. emotion-inducing message factors. The original contribution lies in measuring audiences' induced cognition and emotion as bases for evaluating precision of sentiment detection.

3 - Opinion Mining for Effective Design Based on Customer Reviews Annotation: Mapping Design Elements and Users' Satisfaction

Zhi Li, Associate Professor, Guangdong University of Technology, 100 Waihuan Xi Road, Guangzhou, 510006, China, topstream@gmail.com, Zonggui Tian, Waiming Wang, Jiawen Wang

In this study, we follow two main aims firstly is to explore the feasibility of obtaining users' affective demands from customer reviews, secondly is to develop a method based on review annotation by extracting customer opinions and demands from reviews, and then explore the relationship between design elements and users' satisfaction to facilitate the process of product design.

4 - The Application of LoRa Technology in Internet of Things Transmission and Service Innovation

Shu Sen Sun, Asia University-Taiwan, 500 Lioufeng Road, Wufeng, Taichung, 41354, Taiwan, benson@mail.macrotech.com.tw, James K.C. Chen

LoRa's wireless transmission technology helped the Internet of Things to complete the last piece of the puzzle. Because LoRa has eight frequency channels, it can accommodate approximately 4,800 devices per minute ($2.5 \times 4 \times 8 \times 60 = 4800$). This research focuses on how LoRa can assist service providers in technical aspects, be able to connect endpoints to existing infrastructure, have reliable systems and communications protocols, and be able to confirm link strength and practical technical limitations. The future provides a wide range of applications and services in industrial control, building automation, consumer, asset tracking and localization. In the future, when LoRa's mobile devices are widely deployed, a large amount of terminal equipment data will be collected in real time in public clouds or deployment clouds that break into multiple prediction models to perform big data analysis and calculations. Keywords: LoRa, ETC, LTE, GSM, WiFi, FPGA, Flexible Frequency Table, AMI, M2M, IoT, luetooth, RFID, Zigbee

5 - Visual Analytics in Competitive Systems

Frenanda Capela, Stevens Institute of Technology, Castle Point on Hudson, School of Systems & Enterprises, Hoboken, NJ, 07030, United States, fcapela@stevens.edu, Denisse Martinez, Jose Emmanuel Ramirez-Marquez

This presentation will describe a novel view, analysis and understanding of the paradigm of competitive networks. We posit that competitive networks can only exist and are dependent on the performance of each network along with how it is affected by the performance of its opposing networks. We present a formal definition of competitive networks and formalize the concept via visual analytics. An in depth case study of soccer games illustrates how our visual analytics can help in identifying behavior that cannot be addressed via point statistics or traditional network metrics.

■ TA10

201C, 2nd Floor

Supply Chain and Logistics Management

Invited: Operations and Economics Interface

Invited Session

Chair: Shining Wu, sn.wu@polyu.edu.hk

Co-Chair: Jie Zhang, Guangdong University of Finance and Economics, Guangzhou, 510320, China, jiezhang@gdufe.edu.cn

1 - Strategic Analysis of Dual Sourcing and Dual Channel with an Unreliable Alternative Supplier

Jie Zhang, Guangdong University of Finance and Economics, China, jiezhang@gdufe.edu.cn, Baozhuang Niu, Hsing K. Cheng, Yinliang Tan

In today's increasingly interconnected world, co-opetition due to the introduction of dual sourcing and dual channel has emerged as a new business practice among the high-tech firms. This study develops an analytical model to investigate the dual sourcing decision of the OEM in the presence of a competitive supplier as well as a non-competitive supplier who nevertheless suffers from unreliable production yield. We study the competitive supplier's dual channel decision if it prefers operating both component-selling business and self-branded business, and find that the OEM always prefers supplier diversification even though the additional non-competitive supplier is unreliable. Interestingly, we show that the non-competitive supplier may not have incentive to improve its production technology once it reaches a threshold. Furthermore, we show that this termination of component-selling business by competitive supplier is a non-credible threat to prevent OEM seeking the alternative supplier.

2 - Warranty Pricing with Consumer Learning

Yong Lei, Southwestern University of Finance and Economics, Rm. C320, Zhizhi Building, No. 555, Liutai Avenue, Chengdu, Sichuan, 611130, China, leiyong@swufe.edu.cn, Qian Liu, Stephen Shum

We consider a problem in which a firm dynamically prices a product and its warranty service over time. Consumers can learn about the reliability of products based on warranty prices. A firm's optimal product and warranty pricing policies are characterized. We find that a warranty should be priced lower than the marginal warranty service cost, which implies that warranty sales will not generate profits directly. However, offering a modest warranty still benefits the firm's overall profits. Besides, we note that a firm benefits from consumer learning by hiding the information about the true product reliability only when the true product failure rate is relatively high.

3 - Post-Disaster Humanitarian Logistics Planning: A Time-to-Survive Framework

Yini Gao, Singapore Management University, 50 Stamford Road, #04-10, Lee Kong Chain School of Business #4031, Singapore, 178899, Singapore, yngao@smu.edu.sg, Guodong Lyu

Post-disaster humanitarian logistics problem is one of the greatest challenges faced in humanitarian operations. We study the production and transportation planning of disaster relief items in the presence of logistic uncertainties. We propose to use a novel measure, Time-to-Survive (TTS), to evaluate the performance of humanitarian logistics system. A two-stage distributionally robust approach is introduced to address the capacity configuration and transportation issues so that the TTS of the humanitarian logistics system is maximized. We demonstrate that the robust problem is equivalent to a conic programming problem which can be solved via a positive semi-definite programming problem (SDP). Our analytical framework is then applied to a real humanitarian logistics planning problem.

4 - Service Design under Acclimation and Non-homogeneous Memory Decay

Yifu Li, Hong Kong University of Science and Technology, Room 3208, Lift 21, Clear Water Bay, Kowloon, 999077, Hong Kong, ylick@connect.ust.hk, Tinglong Dai, Xiangtong Qi

In today's "experience economy," service providers increasingly emphasize creating delightful service experiences, a crucial aspect of which is the schedule of activities a service package comprises. Empirical literature shows an ideal schedule often entails an interior peak. Theoretic literature, on the other hand, points to a U-shaped schedule. To bridge this gap between empirical and theoretical literature, we propose a model which incorporates the heterogeneity in the memory-decay rates across different activities. We find this heterogeneity alone is sufficient to explain the phenomenon of interior peaks. We find an interior peak is optimal when the memory-decay rate of the peak activity is neither too high nor too low. Our results also show the optimal start time of peak activity may change in a non-monotonic fashion. Lastly, we develop a dynamic programming algorithm in pseudo-polynomial time for the optimal service design problem.

■ TA12

201E, 2nd Floor

Intelligent Transportation Systems II

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Sundaravalli Narayanaswami, IIM Ahmedabad, Ahmedabad, India, sundaravallin@iima.ac.in

1 - Challenges & Learnings for Intelligent Transport Systems Projects in India

Vijay Kovvali, PhD, Institution Builders, Bangalore, India, vkovvali@gmail.com, Maqsood Ahmed

A review of the public sector ITS projects in the past decade in India shows that very few projects were successfully implemented. With Government of India's new initiative for making 100 cities smart, it is imperative for consultants, system integrator and decision makers to understand the challenges and learnings from these earlier ITS projects to create successful smart cities. This paper draws upon IBI Group's extensive experience on ITS and Smart City projects to provide recommendations on technical, operational and human factors associated with Indian ITS projects to make future technology projects successful.

2 - Traffic Accident Analysis By Random Forest

Hsuan-Yu Lu, Graduate Institute of Logistics Management, National Dong Hwa University, Hualien County, 974, Taiwan, 610537010@gms.ndhu.edu.tw, Chih-Peng CHU, Tseng-Chang Huang

Traffic accident has been one of major causes of death in Taiwan. Thus, it is important to effectively analysis the traffic accident patterns in order to reduce traffic accidents. This study collects the 2015-2016 de-identified traffic accident data from Traffic Police Brigade, Hualien County Police Bureau. The whole study is divided into two parts. The first part focuses on public-facility relative factors for inattentive accidents which will result in more severe damage. The second part is to realize human factors which have great influence on causing severe accident or the property damage.

■ TA13

201F, 2nd Floor

Operations and Economics Interface V

Invited: Operations and Economics Interface

Invited Session

Chair: Ling-Chieh Kung, National Taiwan University, Taipei, Taiwan, lckung@ntu.edu.tw

1 - Risk Minimization in Robust Inventory Routing Problem

Zheng Cui, Chinese University of Hong Kong, William M.W. Mong Engineering Building, Room 609, Hong Kong, zcui@se.cuhk.edu.hk, Daniel Zhuoyu Long, Jin Qi, Lianmin Zhang

We study a finite horizon stochastic inventory routing problem. In this problem, the supplier acts as a central planner who determines the replenishment quantities as well as the times and routes to all customers. We allow ambiguity in the probability distribution of uncertain demand at each customer. To quantify the risk in fulfilling the demand, we propose a decision criterion called Requirement Window Violation (RWV) Index, which takes into account both the frequency and magnitudes of violation. The whole problem can be formulated as a mixed integer programming problem and the exact optimal solution can be found effectively. We compare the performance of our solutions with several benchmarks.

2 - Revenue Sharing for Radiation Treatments between Equipment Vendors and Hospitals

Yu-Hung Chen, Assistant Professor, National Taiwan University, Taipei, 10617, Taiwan, yhchen@ntu.edu.tw, Ling-Chieh Kung, Jiun-Yu Yu, Hsin-Jung Tsai, Yu Jen Wang, Yu Jen Wang

We study the contracting problem between an equipment manufacturer and a hospital for radiation treatment. The manufacturer has private equipment reliability information that prevents the hospital to pay a high price for a reliable machine. In this environment, we show that the popular revenue sharing contract can serve as a signaling device and enhance the system efficiency. It is shown that signaling through revenue sharing is more effective for not-for-profit hospitals than for for-profit ones.

3 - Impact of Waiting on Customer Respond Speed in Live-chat Service Centers

Guangzhi Shang, Florida State University, Department of Marketing, College of Business, Tallahassee, FL, 32306, United States, gshang@fsu.edu, Noyan Ilk

It is well-known that the waiting time customers experience in a service system is determined by the service processing time, among other factors. We propose that a directionally opposite effect, which diffuses from waiting time to service time, also exists in the online service context where a significant fraction of the service time is contributed by the customer. We test this hypothesis using a unique operational dataset that combines server log information with instant-messaging transcripts collected from the live-chat contact center of an S&P 500 service firm. Our results show that waiting before service (i.e., queue wait) accelerates customer engagement - one dimension of customer instigated service time. However, this effect is "short-lived": it disappears after the first chat message posted to the conversation. On the contrary, we find that waiting during service slows down customer responses - another dimension of customer instigated service time.

4 - When do Autonomous Vehicles More Effective than Self-scheduled Drivers in Providing Transportation Services? A Game-theoretic Investigation

Ling-Chieh Kung, National Taiwan University, Room 413, Management Building 2, No. 85, Roosevelt Road, Taipei, 10617, Taiwan, lckung@ntu.edu.tw, Ching-Chieh Lin

Transportation service is rapidly changing in past few decades. On one hand, ride-sharing services in the sharing economy impacts the transportation industry. On the other hand, autonomous vehicles may also revolutionize transportation services. We consider a transportation service provider choosing between offering ride-sharing services or autonomous vehicle services. For each service mode, we derive its optimal prices, subsidies, revenue sharing proportions, and quantity of vehicle deployment. A comparison between these two modes is then conducted. We find that the autonomous vehicle service is more profitable than the ride-sharing one under economy of scale. Interestingly, the optimal service price decreases in the cost of deploying autonomous vehicles. Our study thus sheds lights in the choice of quality incentive and price incentive.

■ TA14

202A, 2nd Floor

Location Model

Sponsored: Location Analysis

Sponsored Session

Chair: Atsuo Suzuki, Nanzan University, Nagoya, 466-8673, Japan, atsuo@nanzan-u.ac.jp

1 - Approximation Algorithms for Capacitated Vehicle Routing Problem with Fixed Depots

Liang Xu, Southwestern University of Finance & Economics, 555 Liutai Avenue, Tongbo Tower A 202, Chengdu, China, arecxuliang1112@gmail.com

We study the problem of routing capacitated vehicles in a fixed k depots to serve customers, with an objective to minimize the total travel distance. This article provides the first constant ratio approximation algorithm for CVRP with limited vehicle. Meanwhile, although a $3/2$ -approximation algorithm for the multiple TSP with a fixed number of depots, which is an un-capacitated special case of CVRP, has been provided in the literature. In this article, the proposed approximation algorithms have a polynomial running time only when the depot number is a fixed constant and the vehicle number can be part of the problem instance.

2 - Rough Estimation of K Tsp for On-Site Scheduling by Users

Shuto Tsuchiya, Graduate Student, The University of Tokyo, Ce-408, 4-6-1, Komaba, Meguro, Tokyo, 153-8505, Japan, shuto555@iis.u-tokyo.ac.jp, Yudai Honma

In this research, we propose a new estimation method to solve the k -TSP regarding the on-site scheduling by users. The mathematical structure of k -TSP is frequently observed in a plenty of urban problems. For example, on-demand transportation service, which is considered for declining cities, could be categorized as a typical k -TSP. However, their route scheduling generally should be handled by themselves, it results in inefficient routing behavior. In this study, we consider two easy-solvable methods for k -TSP; one is an analytical equation for the optimal number of vehicles, and the other is a greedy algorithm for k -TSP. Both of them will be useful tools for a variety of urban situations which k -TSP need to solve. As a numerical example, we specifically focus on the repair work by city office and assume that work with the uncertain workloads occurs frequently. We show the effectiveness of the proposed method through simulation using actual work data.

3 - New Algorithms for Capacitated k-Facility Location and Network Connection Problems

Zhou Xu, M505e, Department Lms, The Hong Kong Polytechnic University, Hong Kong, lgtzx@polyu.edu.hk

In this work, we present several new approximation algorithms for the the Capacitated k-Facility Location and Network Connection Problems.

4 - BTST Method of the Weber Problem with Attraction and Repulsion with a Polygonal Obstacle

Atsuo Suzuki, Nanzan University, Dept of Systems and Mathematical Sciences, 18 Yamazato-cho, Nagoya, 466-8673, Japan, atsuo@nanzan-u.ac.jp

We apply the Big Triangle Small Triangle (BTST) Method to the Weber problem with attraction and repulsion with a polygonal obstacle (WARPO). We consider a problem of a variation of the Weber problem where the weight of the objective function is either positive or negative and a convex polygonal obstacle exists in the feasible region. The customers are not able to pass through the obstacle to access to the facility and the facility should not be located in the obstacle. We formulate the problem and show an algorithm to obtain the exact solution of the problem using BTST method.

■ TA15

202B, 2nd Floor

Machine Learning and Big Data Analytics

Contributed Session

Chair: Matthew Norton, Naval Postgraduate School, 1 University Circle, Monterey, CA, 93943, United States, mdnorto@gmail.com

1 - Measuring User Similarity on Twitter

Huiming Deanna Wang, Professor, San Francisco State University, Dept of Marketing, College of Business, 1600 Holloway Avenue, San Francisco, CA, 94132, United States, wangh@sfsu.edu, Swati Pradeep Patel, Hui Yang

This paper distinguishes and measures two important dimensions of user similarity using Twitter data-topical interests and social interactions. In measuring the interest similarity, variations of topic modeling approaches based on LDA (Latent Dirichlet Allocation) and DDM (Dirichlet Mixture Model) are employed and compared. The interaction-based similarity measure utilizes dynamic retweet networks. Our analysis indicates that the two similarity measures are different and have validity in distinguishing different social groups.

2 - A Data-driven Approach for Assortment Selection

Huiqiang Mao, PhD Candidate, City University of Hong Kong, Tat Chee Avenue, Hong Kong, huiqiangm@gmail.com, Yanzhi Li

We consider a dynamic assortment selection problem in the framework of multi-arm bandit (MAB) model. A naive MAB formulation leads to an exponential regret bound in the assortment size. Based on a non-parametric approach, we propose an algorithm to sequentially learn customer preferences and optimize assortments having effective regret bounds. We test this algorithm on real transaction data to demonstrate the performance of our approach.

3 - Predicting 72-hour Reattendance in Emergency Departments using Discriminant Analysis Via Mixed Integer Programming with Electronic Medical Records

Fanwen Meng, National Healthcare Group, 3 Fusionopolis Link, #03-08 Nexus@one-north, Singapore, 138543, Singapore, fanwen_meng@nhg.com.sg, Kiok Liang Teow, Kelvin Wee Sheng Teo, Chee Kheong Ooi, Seow Yian Tay

Proportion of patients who reattended emergency department (ED) in 72 hours is an important indicator of quality of care. This study develops a practical framework to predict patients who will reattend ED in 72 hours. Using univariate analysis on the EMR data of 328,733 ED patients with over 100 factors, a pool of risk variables is derived for factor selection using filter method. We apply a mixed integer programming model based on discriminant analysis to determine the classification rule. In numerical experiments, various small subsets of risk factors are used for classification and prediction. The results show that favorable predicting performances can be achieved in both training and test sets.

4 - Error Type Control in Binary Classification

Matthew Norton, Assistant Professor, Naval Postgraduate School, 1 University Circle, Monterey, CA, 93943, United States, mnorton@nps.edu, Stan Uryasev

Finding a classifier that minimizes the Type I (false alarm) error rate subject to a constraint on the allowable Type II error rate is a computationally demanding task yielding a discontinuous and non-convex optimization problem. Utilizing a new concept called Buffered Probability of Exceedance, we propose a surrogate problem that is its optimal convex approximation, solvable via convex or linear programming. While effectively controlling the Type I and Type II error, this formulation also shares characteristics with SVM's, being amenable to the kernel trick, yielding a dual that is a QP with linear constraints, and yielding a classifier with a support vector expansion.

■ TA16

203A, 2nd Floor

Optimization I

Contributed Session

Chair: Kuan Lu, Tokyo Institute of Technology, 2 Chome-12-1 Ookayama, Meguro, Tokyo, 1450062, Japan, lu.k.aa@m.titech.ac.jp

1 - A Nonconvex Hessian Free Method for Deep Learning Problems

Wenwen Zhou, Principle Operations Research Specialist, SAS Institute Inc., 100 SAS Campus Drive, Cary, NC, 27513, United States, wenwen.zhou@sas.com, Joshua Griffin, Alireza Yektamaram

Success of Hessian-Free for deep learning has re-surfaced interest in Krylov-based nonconvex optimization. Current deep learning approaches are unable to solve the underlying Newton equations to user-defined levels of accuracy; In this talk, we have modified and applied a line search approach, and it uses the exact Hessian-vector information, and it is therefore hoped that it inherits all the nice convergence properties from the Newton method. Numerical results on some deep learning problems have been given.

2 - An Optimal Pair of Two Levels for Adding Edges with Short Lengths in the Same Levels of a Complete K-ary Tree

Kiyoshi Sawada, University of Marketing and Distribution Sciences, 3-1 Gakuen-Nishi-Machi, Nishi-ku, Kobe, 651-2188, Japan, Kiyoshi_Sawada@red.umds.ac.jp

This study proposes a model of adding close relations, that is, edges with short lengths in two levels to an organization structure which is a complete K-ary tree. When edges with lengths L which is less than 1 between every pair of nodes with the same depth M and those between every pair of nodes with the same depth N which is greater than M are added to a complete K-ary tree of height H, an optimal pair of depth (M,N)* is obtained by maximizing the total shortening distance which is the sum of shortened lengths of shortest paths between every pair of all nodes by adding edges.

3 - On Sensitivity Analysis of Linear Integer Program: The Cases Of Stochastic Programming and Non-linearity in Parameters

CY (Chor-yiu) Sin, Dr., National Tsing Hua University, Kuang-Fu Road, Hsinchu, 30013, Taiwan, cysin@mx.nthu.edu.tw

A stochastic programming with P states can well be formulated as a deterministic programming with P-1 probabilities. In this and the case with non-linearity in parameters, when one parameter changes the others may also change. Consequently the existing sensitivity analysis in the linear integer program may not be applicable, as it confines the attention to one-parameter change. This paper considers a special type of Lagrangian dual function which renders strong duality. Using this Lagrangian dual function, we first generalize the result in Shapiro (1977) to multi-parameter cases. Further, we show with synthetic data that our analyses save a lot of computer time in large-scale optimization.

4 - Solving the Minimum Maximal Flow as a Mixed Integer Problem

Kuan Lu, Tokyo Institute of Technology, Tokyo, Japan, lu.k.aa@m.titech.ac.jp, Shinji Mizuno, Jianming Shi

This research concerns a minimum maximal flow (MMF) problem, which finds a minimum maximal flow in a given network. The problem is known to be NP-hard. We show that the MMF problem can be formulated as a mixed integer programming (MIP) problem and we propose to find the minimum maximal flow by solving the MIP problem. By performing computational experiments, we observe that the proposed approach is efficient to the MMF problem even for relatively large instances, where the number of edges is up to 5000, and that the growth rate of running time of our approach is slower than the rates of previous works when the sizes of the instances grow.

■ TA17

203B, 2nd Floor

Future of Yard Operation in Maritime Logistics II

Invited: Maritime Operations

Invited Session

Chair: Xin Jia Jiang, Nanjing, 210016, China, cemjxj@hotmail.com

1 - A Hybrid Heuristic for the Flexible Ship Loading Problem

Dario Pacino, Associate Professor, Technical University of Denmark, Kgs. Lyngby, Denmark, darpa@dtu.dk, Jonas Christensen

Improving container terminal productivity is a shared goal between carriers and terminal operators. The Flexible Ship Loading Problem investigates a collaboration between the carrier, which provides a class-based stowage plan, and the terminal. The latter now has the flexibility of determining the position of specific containers, while planning the handling operations. In this work, we present how such a problem can be modelled, and how a hybrid heuristic approach can be used to find high-quality solutions in short computational time.

2 - A Target-driven Heuristic Optimization for the Pre-marshaling Problem on Container Terminal

Yanwei Zhang, Associate Professor, Wuhan University of Technology, Wuhan, China, zywgtg@whut.edu.cn, Wan Zhou, Loo Hay Lee

This paper addresses the outbound container intra-bay pre-marshaling problem in container terminal. A target-driven heuristic algorithm is proposed. It has three key components: first, the target state of a yard bay is determined according to the heuristic information. Second, the relevant containers are relocated to their desired slot by rules mined from heuristic information; and third, the influence of the previous stage decision on the subsequent decisions is evaluated and the pre-marshaling solution is optimized. In addition, An intelligent decision system of pre-marshaling is achieved. Massive computational experiments are conducted and the effectiveness is proved by results. Keywords: Container terminal; Outbound container; Pre-marshaling; Optimization

3 - An Intelligent Yard Crane Scheduling Problem in Container Ports

Xin Jia Jiang, Nanjing University of Aeronautics and Astronautics, 29 Yudao Street, Nanjing, 210016, China, cemjxj@hotmail.com

The storage allocation is planned considering the practical requirements from traffic control, space capacity and yard crane workload, etc. However, most of the studies on space allocation assumed that yard cranes are always ready whenever needed, while the yard crane deployment problem was neglected. This may lead to not only unnecessary operational cost, but also the infeasibility of some storage allocation plan. In this work, the intelligent cross-sectional deployment of yard cranes is studied to improve the situation.

4 - Shipping to Heterogeneous Customers with Competing Carriers

Tao Lu, Rotterdam School of Management, Erasmus University, Mandeville Building T09-03, P.O Box1738, Rotterdam, 3062 PA, Netherlands, lu@rsm.nl, Ying-Ju Chen, Jan C. Fransoo, Chung-Yee Lee

We consider a shipper selling a perishable product to heterogeneous customers in a destination market. The product can be shipped via two competing carriers with distinct speeds. Our analysis reveals a trade-off between the benefits from differentiation and competition. Dual-mode shipping can therefore be inferior to restricting to a single mode.

■ TA18

North Lounge, 3rd Floor

Innovative Applications in Health Care and Health Policy Research

Invited: Healthcare Systems and Applications

Invited Session

Chair: Shinyi Wu, University of Southern California, University of Southern California, Los Angeles, CA, 90089, United States, shinyiwu@usc.edu

1 - Analysis of Effective Engagement with Health Technology for Promoting Self-management Behaviors Among Older Adults with Diabetes

Shinyi Wu, University of Southern California, 3715 McClintock Avenue, GER 240 C, Los Angeles, CA, 90089, United States, shinyiwu@usc.edu, Haomiao Jin, Pey-jiuan Lee

This study analyzed what levels of engagement with mobile technology applications (app) are sufficient to improve diabetes self-management (DSM). Using a dataset from the Intergenerational Mobile Technology Opportunities Program with 334 diabetes patients aged 55+, we characterized patterns by trajectory of IMTOP app use over time and found meaningful 3-group patterns (high, 26.8%; high-low, 27%; low, 46.2%). A difference-in-difference analysis revealed that both the “high” and the “high-low” engagement groups were associated with significantly better improvements in DSM than the “low” group.

2 - An Agent-based Model of Insurer-provider Bargaining in Private Healthcare Markets

Shinyi Wu, University of Southern California, 3715 McClintock Avenue, GER 240 C, Los Angeles, CA, 90089, United States, shinyiwu@usc.edu, Abdullah Alibrahim

Understanding the provider-insurer relationship is imperative in light of payment and competitive reforms in healthcare markets (HM). As part of a simulation model to capture competitive dynamics of private HM, insurer-provider bargaining is operationalized using a stylized game-theoretic bargaining model influenced by agents’ market leverage. The Nash product solution reflects equilibrium prices at which agents maximize the product of their disagreement tradeoffs. To create the virtual HM where agents bargain, choosing patient agents are generated to be served by providers and insurers.

3 - Evaluating Key Factors for Success in a Critical Care Fellowship Program using Data Envelopment Analysis

Vikram Tiwari, Vanderbilt University Medical Center, 2957 Polo Club Rd, Nashville, TN, 37221, United States, vikram.tiwari@vanderbilt.edu, Avinash Kumar

The current system of summative multi-rater evaluations and standardized tests to determine readiness to graduate from critical care fellowships has limitations. We sought to pilot the use of data envelopment analysis (DEA) to assess what aspects of the fellowship program contribute the most to an individual fellow's success. Fifteen fellows were evaluated on two inputs and two outputs. Five fellows were rated as DEA efficient, and 10 fellows were characterized in the DEA inefficient group. The model was able to forecast the level of effort needed for each inefficient fellow, to achieve similar outputs as their best performing peers.

4 - Social Learning in Health Insurance Choices: Evidence from Employer-sponsored Health Plans

Chaoran Guo, University of California-Berkeley, Berkeley, CA, 94709, United States, cguo@berkeley.edu

Research has documented that consumers have imperfect information about the health insurance plans from which they are asked to choose; but we know less about the sources of that information. This paper investigates the role of social learning in health insurance selection, using longitudinal data from the University of California. I employ a discrete choice estimator to formally model plan choice behavior, finding that a 10 percentage point increase in the share of peers who select a particular insurance plan will lead to a 14 percentage point increase in the probability that an individual will choose the same plan, equivalent to lowering the monthly premium by 18 percent.

■ TA19

South Lounge, 3rd Floor

Healthcare System Resource Allocation: Insight, Analysis, and Optimization

Invited: Healthcare Management

Invited Session

Chair: Mabel Chou Cheng-Feng, Singapore, mabelchou@nus.edu.sg

1 - Distance, Quality or Relationship? Interhospital Transfer of Heart Attack Patients

Susan F. Lu, Purdue University, Krannert 441, West Lafayette, IN, 47907, United States, lu428@purdue.edu, Lauren Xiaoyuan Lu

We empirically investigate the pattern of where heart attack patients are transferred between hospitals. Using 2011 Florida State Emergency Department and Inpatient Databases, we demonstrate the relative importance of three key factors in determining transfer destinations: hospital relationship, distance, and quality. Our conditional logit analysis shows that the relationship of being affiliated with the same multihospital system plays a dominant role in the choice of transfer destinations, compared to distance and quality. When using 30-day readmission rate to evaluate the health outcome of transferred patients, we find that relationship-based transfers are associated with a much higher readmission rate than distance-based and quality-based transfers. We also find that nonprofit hospitals are more likely to conduct quality-based transfers than their for-profit counterparts.

2 - Bed Allocation to Reduce Overflow

Jingui Xie, University of Science and Technology of China, School of Management, 96 Jinzhai Road, Hefei, 230026, China, xiejingui@gmail.com, Marcus Teck Meng Ang, Mabel Chou, David D Yao

To address the overflow issue, we build an analytical model and propose two easy-to-compute bed allocation policies. We use the real data from the only university hospital in Singapore and a simulation model to evaluate the effectiveness of our proposed policies against the base case provided by the empirical study of the hospital. Through the simulation study, we show that the proposed policies can reduce the overflow rate from 18.91% to about 4-5% without sacrificing other performance measures. More surprisingly, our simulation studies suggest that the existing capacity actually can accommodate 50% more elective patients while keeping the overflow rate at a level of less than 10%.

3 - Appointment Systems under Service Level Constraints

Zhenzhen Yan, National University of Singapore, 1 Business Link, Biz 2 Building, B1-01, PhD Program Deans Office Biz2, Singapore, 117592, Singapore, a0109727@u.nus.edu; yanzhenzhen8@gmail.com

In this paper, we tackle the classical appointment scheduling problem from a completely new angle. We study an appointment system where a finite number of customers are scheduled to arrive in such a way that (1) the expected waiting time of each individual customer cannot exceed a given threshold, and (2) the appointment times are set as early as possible (without breaking the waiting time constraint). Using a transient queueing analysis approach, we analytically characterize the structure of the optimal appointment schedule and prove the limiting behavior of our system. Compared with the literature, our paper brings unique features in both modeling perspectives and analysis methods. We further explore the optimal appointment schedule under the probability constraint.

4 - Simulation and Robotic Process Automation for Hospitals in Singapore

Mark Goh, Professor, NUS, 15 Kent Ridge Drive, Singapore, 119245, Singapore, mark_goh@nus.edu.sg, D.S. Dao, B. Dutta, W. Liu, S. Tiwari, Z. Wu, L. Zhang, W. Zhang, M. Zhao, R. de Souza

This study seeks to apply robotics process automation to complement the workforce of a hospital's support services, enhance labour productivity, and reduce bottlenecks in the processes related to the different in-house supply chains of several hospitals in Singapore. This study is part of the National Robotics Program designed to develop robotic technologies to address national challenges such as an ageing workforce and lagging productivity, and to build capabilities to support firms in their business model transformations by leveraging on smart technologies.

■ TA22

401, 4th Floor

Stochastic Models in Quantitative Finance

Sponsored: Applied Probability

Sponsored Session

Chair: Xuefeng Gao, Chinese University of Hong Kong, Shatin, Hong Kong, xfgao@se.cuhk.edu.hk

1 - Market or Limit: An Asymptotic Analysis on Optimal Spread Crossing Strategies

Nan Chen, Chinese University of Hong Kong, William M W Mong Engineering Bldg, Rm 609, Shatin N T, Hong Kong, nchen@se.cuhk.edu.hk, Xuefeng Gao, Xiang Ma

We study when a pre-committed trader converts a limit order to a market order in algorithmic executions of orders. We formulate the problem as an optimal stopping problem. We present structural properties of the optimal strategy and show how it depends on market conditions. We derive and rigorously prove high order asymptotic expansions for the optimal exercise boundary near expiry. Numerical experiments illustrate the accuracy of the approximation.

2 - Dynamic Mean-risk Asset Allocation and Myopic Strategies: A Universal Portfolio Rule

Zhaoli Jiang, The Chinese University of Hong Kong, Shatin, Hong Kong, zljjiang@se.cuhk.edu.hk, Xuedong He

In a market that consists of multiple stocks and one risk-free asset whose expected return rates and volatility are deterministic, we study a continuous-time mean-risk portfolio selection problem in which an agent is subject to a constraint that the expectation of her terminal wealth must exceed a target and minimizes the risk of her investment, which can be the variance or tail risk of her terminal wealth. Setting the target to be proportional to the agent's current wealth, we derive the equilibrium policy in closed form, and this policy is myopic and does not depend on the risk measure used by the agent nor on the agent's evaluation period. For another two targets, one that is the risk-free payoff of the agent's current wealth plus a premium and the other that is a weighted average of the risk-free payoff of the agent's current wealth and a pre-determined target, we also derive the equilibrium policy in closed form when the agent measures risk by the variance of her terminal wealth.

3 - A Multidimensional Hilbert Transform Approach for Barrier Option Pricing and Survival Probability Calculation

Lingfei Li, Chinese University of Hong Kong, 608 William M.W. Mong Engineering Building, Shatin, N T, Hong Kong, llli@se.cuhk.edu.hk, Jie Chen, Liaoyuan Fan

We propose a new method for pricing discretely monitored multi-asset barrier options and computing joint survival probability in multivariate exponential Levy asset price models. We calculate the Fourier transform of appropriately dampened value functions recursively using multidimensional Hilbert transform, which can be approximated using multidimensional Sinc expansion. We prove that, for Levy processes whose joint characteristic functions have an exponentially decaying tail, the error of our method decays exponentially in

some power of the number of terms used in the expansion for each dimension. Various numerical examples confirm the computational efficiency of our method in the two-dimensional case for popular Levy models and it outperforms the two-dimensional Fourier-cosine algorithm. Our method can also handle the survival probability calculation efficiently for the three-dimensional Black-Scholes model.

4 - Affine Point Processes: Refined Large Time Asymptotics

Xuefeng Gao, Chinese University of Hong Kong, William M.W. Mong Engineering Building, Room 606, Shatin, Hong Kong, xfgao@se.cuhk.edu.hk

Affine point processes are versatile Markov models used to capture the "clustering" feature of event arrivals. The components of affine point processes are self- and mutually-exciting, hence they have become popular models in financial applications such as credit risk managements to model default clustering. In this paper, we prove refined asymptotics for affine point processes in the large-time regime. Numerical experiments illustrate the accuracy and efficiency of the resulting analytical approximations for tail probabilities. This is a joint work with Lingjiong Zhu from Florida State University.

■ TA22

Elegance, 4th Floor

Multidisciplinary Applications of MCDM II

Sponsored: Multicriteria Decision Making

Sponsored Session

Chair: Gwo-Hshiung Tzeng, National Taipei University, Taipei, Taiwan, ghtzeng@gm.ntpu.edu.tw

1 - Technology Evaluations and Selection of Financial Technologies using a Fuzzy MCDM in the Emerging Market

Yucheng Kao, National Taiwan University of Science and Technology, No.43, Keelung Rd., Sec.4, Da'an Dist., Taipei, 10607, Taiwan, d10216005@mail.ntust.edu.tw, Kao-Yi Shen, Gwo-Hshiung Tzeng, Jim-Yuh Huang, Jonchi Shyu

In recent years, Fintech can be said to be the hottest topic, reflecting that people are encountering a huge transformation of many economic, social phenomena and life patterns. This study aimed to explore a financial technology selection process in the emerging market based on fundamental analysis. The proposed model may potentially help industry practitioners and government policy-makers in guiding research and development investments and reallocating resources more strategically.

2 - Exploring Continuous Improvement Strategies for Urban Green Development by Using Hybrid Dynamic MCDM Model

Wen-Yi Huang, Sanming University, Sanming City, China, hwy11161986@126.com

The most prominent problems in the existing urban green development is that the governmental policies on urban green development is often difficult to put forward the continuous improvement strategies, which brings the short-term behavior of policies in the process of promoting green development. As a result, urban green development become unsustainable, it is unsuspected that the governments of countries of the world would not like to see that. Therefore, in order to exploring continuous improvement strategies for urban green development at common sense.

3 - The Service Improvement Strategies of Public Bicycle Sharing Service Systems Based on IAA-NRM Approach

Chia Li Lin, Dr., National Taipei University, 151 University Road, San Shia 237, Taiwan, New Taipei City, 151, Taiwan, lincialio704@yahoo.com.tw

Public bicycle sharing service system (PBSSS) is used to connect the short distance. However, how to let the citizens give up drive their cars and use the PBSSS. Through the favorable price, well facility planning and good service quality to be much accounted of the users. This study will evaluate the merits and demerits, and help service providers to understand users' needs and increase the user's willingness. Therefore the study also propose the improvement strategies of PBSSS performances through the IAA-NRM analysis and aid decision maker to strengthen PBSSS performances by integrating the PBSSS service systems to satisfy the transportation and recreation needs.

4 - Comparison of Travel-visiting Images: Case of European Countries VS. Taiwan

Mei-Chen Lo, Dr., National United University, Miaoli, Taiwan, amy.mjlo@gmail.com, Gwo-Hshiung Tzeng

People may have decided to move to another country in order to experience a new culture, or to change their current way of life. Perhaps work, study, or family commitments have influenced the decisions. We focus on the behavioral decision making study on sustainable culture attractiveness through subjected images of visiting some European countries and Taiwan. We have built the behavioral decision framework to advice and help to sketch the importance of country's images.

5 - Competition and Innovation in Haiti's Banking Industry: A Meta-frontier Approach

Jean-Raymond Fontin, PhD Student, National Taiwan University of Science and Technology, No.43, Sec. 4, Keelung Rd., Da'an Dist., Taipei City, 10607, Taiwan, jeanraymondfontin@yahoo.fr

This paper aims to evaluate the nexus between innovation and competition within the banking industry of Haiti using the Lerner Index and the Meta-frontier approach.

Tuesday, 10:00AM - 10:50AM

■ Tuesday Keynote

101B, 1st Floor

Keynote: Operations Research and Public Health

Keynote Session

1 - Operations Research and Public Health

Edward H. Kaplan, Yale University, Yale School of Management, Box 208200, New Haven, CT, 06520-8200, United States, edward.kaplan@yale.edu

According to the US National Academy of Medicine, the mission of public health is to "fulfill society's interest in assuring conditions in which people can be healthy." Major public health activities include disease surveillance and environmental risk assessment to identify population health problems and priorities; the design and delivery of health promotion and disease prevention services; and the evaluation of public health programs. Both the epidemiological science underlying public health interventions and the day-to-day operations of public health services present exciting opportunities for the application of operations research and management. This talk will illustrate applications of operations research to public health problems, with results to the benefit of us all.

■ Tuesday Keynote

101C, 1st Floor

Keynote: Transforming Industries and Professions through AI, IoT and Blockchain

Keynote Session

1 - Transforming Industries and Professions through AI, IoT and Blockchain

Sriram Raghavan, IBM Research, New Delhi, India, raghavan

The emergence of a triumvirate of disruptive technologies - AI, IoT, and Blockchain — is poised to transform every industry and profession. As the fundamental innovations underpinning these technologies progress at a rapid pace and we see early exemplars of their use, it is clear that we are headed to a world of deeper insights, re-imagined engagement, extreme personalization, and new cross-industry business ecosystems. Blockchain applied to supply chain networks redefines engagement between business partners enabling a more transparent and open business environment with reduced friction, reduced fraud, and entirely new business models. AI applied to a combination of terabytes of remote sensed data coupled with intelligent smart on-field IoT sensors is transforming the world of agribusiness, enabling very fine grained crop monitoring, targeted intervention, reduced farming costs, and highly actionable insights at a resolution and cost point that was unimaginable less than a decade ago. Using these and numerous real examples drawn from IBM's work with clients in financial services, healthcare, logistics, and retail, this talk will illustrate the transformative power of these three technologies and showcase how this is driving new business models and disrupting entire cross-industry value chains.

■ Tuesday Keynote

102, 1st Floor

Keynote: From Open Data to Digital Economy – The Taiwan Perspective

Keynote Session

1 - From Open Data to Digital Economy – The Taiwan Perspective

San-Cheng (Simon) Chang, Chairman, Taiwan Mobile Foundation, Taiwan, Taiwan, -

In late 2012, Taiwan initiated its open data program. In 2015, Taiwan was ranked No.1 globally in the open data initiative by the UK Open Knowledge Foundation (okfn) and carries this world-class honor till today. In the meantime, the Taiwan government started to employ big data technology to study and plan important policies. This effort leads most of the big data projects in the private sector and

was recognized as a major milestone in government IT applications. AI, after dormant for some years, was revived due to the big data technology and processing capabilities of enhanced IT hardware. As the stronghold of world IT hardware supplier for decades, the Taiwan industry, on the other, hand lacks the foundation of good IT application development and is facing tremendous challenge in the upcoming AI era. But building on its successful foundation of government open data and big data applications, Taiwan has a chance to embrace and prepare itself for innovative AI applications in the coming years. Taiwan needs to understand the strategies of major global enterprises in AI development and plan accordingly its policies and actions. The government also needs to work out the plan to interact with and leverage the strength of these enterprises and prepare necessary infrastructures. With intelligent policies and solid implementation, Taiwan would be able to play an important role in the digital economy age.

Tuesday, 11:00AM - 12:30PM

■ TB01

101A, 1st Floor

Pricing and Revenue Optimization

Sponsored: Revenue Management & Pricing

Sponsored Session

Chair: Yulan Wang, Hong Kong Polytechnic University, Kowloon, Hong Kong, yulan.wang@polyu.edu.hk

Chair: Miao Song, miao.song@polyu.edu.hk

1 - The Implications of Farm Subsidy Schemes on Farmer Welfare, Production Efficiency and Income Inequality in Developing Economics: Input- vs. Output-based Subsidy

Yulan Wang, Associate Professor, Hong Kong Polytechnic University, Faculty of Business, Kowloon, Hong Kong, yulan.wang@polyu.edu.hk, Christopher S. Tang, Ming Zhao

We examine the implications of two commonly observed farm subsidy schemes in this paper. The first scheme is input-based that intends to reduce farmer's input purchasing costs, while the second is output-based that aims to lower farmer's output processing costs. By analyzing a stylized model that captures the yield heterogeneity across farmers who engage in quantity competition, we find that both schemes can improve farmers' income. However, these two schemes have different side-effects. First, the input-based subsidy scheme narrows the income gap between farmers, but the output-based scheme widens this gap. Second, the output-based subsidy scheme outperforms the input-based subsidy scheme in terms of total farmer income and farmer productivity. We find these results continued to hold when the farmer's yield rate is uncertain.

2 - Competition in a Variety Seeking Market with Brandname Awareness

Ying Wei, Jinan University, Management School, Huiquan Building, Room 722, Guangzhou, 510632, China, yingwei@jnu.edu.cn, Liyang Xiong, Yulan Wang

We model variety-seeking as a decrease in consumers' willingness to pay for repetitive purchase. Under a three-stage Hotelling-type framework, we show that variety seeking intensifies the price and service competition when both firms are equally known; however, it softens the competition with differentiated equilibria when one firm is better known than the other. Under both scenarios firms increase the optimal service level in the second period to prevent consumers from switching, if keeping prices committed across periods.

3 - The Influence of Social Comparison on Supply Chains' Profits

Juan Li, Nanjing University, 5 Ping Cang Xiang, Nanjing, China, juanli@nju.edu.cn, Ling Shi, Di Zhang

This paper is to investigate how distributional and peer-induced social comparison affects the profits of the members in a one wholesaler-two retailers supply chain. The suppliers' comparison with retailers (distributional social comparison) decreases the market share, thus reducing their own profit. This finding holds true for both all-male and all-female group; peer-induced social comparison increases the market share, thus increasing the profits of suppliers and the retailers have no loss. However, this finding holds true only for all-female group, there is no change for members in all-male group; the peer-induced social comparison is more salient than distributional social comparison.

4 - Joint Inventory and Pricing Coordination with Incomplete Demand Information

Miao Song, The Hong Kong Polytechnic University, Department of Logistics and Maritime Studies, The Hong Kong Polytechnic University, Hong Kong, miao.song@polyu.edu.hk, Ye Lu, Yi Yang

In retailing operations, retailers face the challenge of incomplete demand information. We develop a new concept named K-approximate convexity, which is shown to be a generalization of K-convexity, to address this challenge. This idea is applied to obtain a base-stock list-price policy for the joint inventory and pricing control problem with incomplete demand information and even non-concave revenue function. A worst-case performance bound of the policy is established. In a numerical study where demand is driven from real sales data, we find that the average gap between the profits of our proposed policy and the optimal policy is 0.27%, and the maximum gap is 4.6%.

5 - Incentive Provision for Demand Information Acquisition in a Dual-Channel Supply Chain

Song Huang, South China Agricultural University, Guangzhou, China, huangsong@scau.edu.cn, Xu Guran, Binqing Xiao

This paper studies an endogenous adverse selection model in a dual-channel supply chain setting, in which the manufacturer can offer a menu of contracts to induce the retailer to costly acquire private demand information. We derive the manufacturer's optimal incentive provision decision and show that although the increase of acquisition cost results in higher distortion effect on the retailer's selling quantity, such a distortion effect can be alleviated in a dual-channel setting. The manufacturer's incentive provision exhibits a threshold policy. When demand variation is high and information acquisition cost is low, acquiring demand information does not necessarily benefit the retailer.

■ TB02

101B, 1st Floor

Topics in Inventory Management and Pricing Management

Invited: Supply Chain Inventory Management

Invited Session

Chair: Wei Chen, University of Kansas, Lawrence, KS, 66049, United States, wei.chen@ku.edu

1 - Fixed-Dimensional Stochastic Dynamic Programs: An Approximation Scheme and an Inventory Application

Wei Chen, University of Kansas, 1300 Sunnyside Ave, Lawrence, KS, 66049, United States, wei.chen@ku.edu, Milind Dawande, Ganesh Janakiraman

We study fixed-dimensional stochastic dynamic programs in a discrete setting over a finite horizon. Under the primary assumption that the cost-to-go functions are discrete L-convex, we propose a pseudo-polynomial time approximation scheme that solves this problem to within an arbitrary prespecified additive error of > 0 . The proposed approximation algorithm is a generalization of the explicit-enumeration algorithm and offers us full control in the trade-off between accuracy and running time.

2 - Multi-Product Ordering Policy under Forecast Updates

Ke Mao, Xingangxilu, Guangzhou, China, 516602190@qq.com
Ke Mao, Sun Yat-sen University, Guangzhou, China, 516602190@qq.com, Ke Fu

This paper considers that a retailer sells multiple products which have a long supply lead time and a short selling season. Before the sales season, the retailer can update its forecast and place multiple orders whose costs depend on the timing. The demands are stochastic and are correlated with each other. We derive the optimal ordering policy and analyze the decomposition property of the optimal stock levels under various conditions. We conduct numerical experiments to demonstrate the significance of our findings.

3 - Manufacturer's Pricing and Service Mechanisms When a Gray Marketer is a Service Free-rider

Zhen Shao, University of Science and Technology of China, Hefei, China, szpolly@mail.ustc.edu.cn, Xin Wang

In response to an increasing threat from gray markets, manufacturers often adopt value-added services as a differentiation and competitive strategy in the marketplace. Unfortunately, the gray marketer can gain a free ride from the service provided by the manufacturer. To study how the manufacturer can respond to the gray market when a costly service is offered by the manufacturer, we analyze a game-theoretical model where a manufacturer sells a product in a low-price market and a high-price market in presence of a gray marketer. We incorporate key parameters capturing the cost of the service, the intensity of the competition, and the gray market responsiveness to the manufacturer's service.

■ TB03

101C, 1st Floor

Industrial IoT and ML Applications

Invited: Machine Learning and Big Data Analytics

Invited Session

Chair: Young M. Lee, Johnson Controls, Milwaukee, WI, 53202, United States, young.m.lee@jci.com

1 - Infusing AI and IoT for Industry 4.0

Shao Chun Li, M.S., IBM China Research Lab, China, lishaoc@cn.ibm.com, Jian Wang, Jie Ma, Yi Peng Yu

AI and IoT are playing the important roles in Industry 4.0 to make industry more automated, informative, and intelligent. In the session, we will present how to apply deep learning to anticipate equipment failures to allow for advance scheduling of corrective maintenance, thereby preventing unexpected equipment downtime. For sensor-based equipment (e.g. oil pumping system), we transform sensor data to image data, then apply well-trained CNN to detect failures. For event-based equipment (e.g. ATM), we took RNN perspective to point process and invented a brand new end-to-end analytics framework. For both categories, we got competitive prediction performance.

2 - Data-driven Modeling and Forecast of Noisy Nonlinear Dynamics

Youngdeok Hwang, PhD, Sungkyunkwan University, 25-2 Sungkyunkwan-ro, Seoul, Korea, Republic of, yhwang.skku@gmail.com

Data-driven modeling of a complex physical process is of current interest due to its direct relevance to cognitive manufacturing. Although domain knowledge on the underlying physical process has been playing a key role in understanding manufacturing processes, it is often impractical or impossible to build physics models from the first principles. Here, we propose a Recurrent Neural Network (RNN) based model for the nonlinear system identification and forecast of a stochastic process with an underlying physical process. The proposed RNN aims to directly estimate the probability distribution of the stochastic process by using a penalized maximum log likelihood method. It is shown that the RNN is essentially a state-space model, in which the underlying process is modeled by a set of linear dynamical systems. Also presented is a Monte Carlo procedure for a multiple-step prediction.

3 - Condition Based Predictive Model for Smart Connected Chillers

Young M. Lee, Johnson Controls, 507 E Michigan St, Milwaukee, WI, 53202, United States, young.m.lee@jci.com, Kelsey C. Schuster, Steven Vitullo, Youngchoon Park, Sudhi Sinha, Zhongyi Jin, Henan Wang, Sugumar Murugesan

A chiller is one of the most critical HVAC equipment in building and consumes about half of all the energy in building. With the advance of IoT technology, chillers can now be equipped with numerous sensors that collect the operation data in real time for condition based predictive maintenance. We describe machine learning analytics that can predict chiller shutdown before it happens and trigger preventive action to avert shutdown and prevent costly damage to its components using connected chiller sensor data. The analytics also automatically analyzes chiller vibration data to assess the overall health of chiller and components, and determines predictive maintenance actions.

4 - Detecting Glaucoma from Early Stage Using Machine Learning Techniques

Shao Hsin Chang, National Tsing Hua University, Hsin Chu City, Taiwan, u10000136@gmail.com, W.M. Tina Chang, Ing-Chou Lai, Yuchih Shih, Tsung-Yuan Kuo, Tai Lung Chen

Motivated by glaucoma's status as the second leading cause of blindness, the increasing numbers of glaucoma patients, the difficulty of early glaucoma detection, and the disease's irreversibility, we propose strategies for constructing tools such as automated classifiers or fundus image glaucoma-defects enhancers to effectively differentiate between normal and glaucomatous eyes. We propose a new fundus image glaucoma-defects enhancer using the retinal nerve fiber layer (RNFL) defect. We have shown that the RNFL defect can be enhanced by applying the multiscale retinex, convolution, and pooling techniques. Results show that the proposed approach has both sensitivity and specificity beyond 98%.

■ TB04

101D, 1st Floor

Topics in Military OR: Health Monitoring and Scheduling Systems

Invited: Military, Defense, and International Security

Invited Session

Chair: Greg H. Parlier, North Carolina State University, 255 Avian Lane, Madison, AL, 35758, United States, gparlier@knology.net

1 - Naval Platform Evolution and Equipment Health Monitoring

Scott Koshman, Ottawa, ON, Canada, scottkoshman@hotmail.com

Modern approaches to materiel management include the use of equipment health monitoring to provide feedback on equipment process and condition. A naval platform provides a non-stationary context, lending challenges to interpretation and continual analytics. As a precursor to an input into logistical decision support processes, the presenter explores the interaction of sensor data with ongoing changes in circumstances.

2 - Condition Based Maintenance for Mission-Based Forecasting

Greg H. Parlier, North Carolina State University, 255 Avian Lane, Madison, AL, 35758, United States, gparlier@knology.net

Mission-based forecasting (MBF) is a new concept for demand planning which relates resource investment levels and distribution policies directly to mission performance outcomes for military platforms, thereby enabling the “resources-to-readiness” linkage. MBF fully capitalizes on big data opportunities: predictive analytics, innovative forecasting methods, condition based maintenance (CBM) diagnostic and prognostic algorithms, and the Internet of Things. Analytical demonstrations and field tests indicate MBF will dramatically improve forecast accuracy, reduce both backorders and excess inventory, and eliminate costly work-arounds while increasing equipment readiness in military organizations. MBF has been applied to both US Army aviation and ground systems, and extended to other Military Services.

3 - Exam Scheduling at United States Military Academy West Point

Frederik Proske, Operations Research Analyst, GAMS Software GmbH, P.O. Box 4059, Frechen, 50216, Germany, FProske@gams.com

Each term the United States Military Academy (USMA) needs to schedule its exams. About 4000 cadets taking 5 - 8 exams each, need to be placed in 11 timeslots. Due to the short time frame, a feasible solution in the sense that no cadet takes more than one exam per time slot cannot be obtained with a single exam version per course. So called makeups, alternative exams in another period, solve this problem. Makeups are also used to improve additional objectives which occur at USMA like the number of consecutive exams per cadet. We consider two solution strategies: an IP approach as well as a nonlinear approach based on LocalSolver. We report numerical experiments for both methods based on real world data from USMA.

■ TB05

102, 1st Floor

Practice VII

Sponsored Session

Chair: C. Allen Butler, Daniel H. Wagner Associates, Inc., 2 Eaton Street, Hampton, VA, 23669, United States, Allen.Butler@va.wagner.com

1 - Applying Advanced Analytics to U.S. Naval Problems

C. Allen Butler, Daniel H. Wagner Associates, Inc., 2 Eaton Street, Hampton, VA, 23669, United States, Allen.Butler@va.wagner.com

Anti-Submarine Warfare (ASW) capabilities for the U.S. Navy and its allies. In this talk, we discuss two Wagner Associates' ASW-related projects for the U.S. Navy. The first, entitled Coordinated ASW Mission Planning (CAMP), harkens back to the early days of the company, when Daniel H. Wagner, the founder of the company, focused on assisting the U.S. Navy in the search for threat submarines. The second project, Fusion and Optimization for Command and Control of Unmanned Systems (FOCUS), is exploring the use of computer science formal methods in designing and recommending mission plans for mixed teams of manned and unmanned systems in complex contested environments.

2 - Applications of Computational Behavior Science in an Interpretable AI Fashion for Maximally Supported, Minimally Disruptive Medicine

Pei-Yun Sabrina Hsueh, IBM T.J. Watson Research Center., Yorktown Heights, NY, United States, phsueh@us.ibm.com

Behavioral factors are the key contributors to mental health risk and morbidity, accounting for 41 percent of global disease burden. Recent studies documented the importance of accounting for individuality and heterogeneity in human health behavior through personalized approaches. In practice, varying behavioral responses are often revealed in patient care history. The rise of consumer

awareness and the prevalence of personal health technologies (e.g., mobiles, sensors, wearables) have further enabled the accumulation of personal health data for interpretation. However, today's care programs are structured around population-level evidence, but not personal understanding. What if healthcare professionals can take advantage of the revealed behavioral understanding to further engage target patients and personalize their care plans? To address the multi-level challenge, recently, in addition to traditional clinical and epidemiological methods, novel AI and machine learning algorithms are being proposed. The goal of this talk is to review the development of an interpretable behavioral learning pipeline that captures individual predictive pathways from observational behavior data. As the black-box nature of AI/ML has widened the gap between how humans and machines make decisions, we will also outline the lessons underlying current practice for making AI/ML more interpretable and actionable in health informatics. Example showcases will help illustrate how to support precision health applications that are maximally patient-centric yet minimally disruptive.

■ TB06

103, 1st Floor

Tutorial: Responsible Operations: Models, Relevance and Impact

Tutorial Session

1 - Responsible Operations: Models, Relevance and Impact

Jayashankar M. Swaminathan, University of North Carolina, Kenan-Flagler Business School, Operations, Chapel Hill, NC, 27599-3490, United States, msj@unc.edu

There is a growing movement across various industries around developing and optimizing business models that not only focus on financial goals but also impact the society and the environment in a positive manner. These topics focus on a wide range of for-profit and non-profit operations on environmental issues such as remanufacturing, alternative energy and carbon emissions as well as social issues such as child labor, humanitarian operations, agriculture and healthcare. Research models on responsible operations that incorporate optimization and data can have an influential role in positively impacting the society and world at large. In this tutorial, I will provide an overview of the types of problems in this domain, the unique dimensions that need special attention and discuss currently available methods and identify opportunities for future research in this area.

■ TB07

105, 1st Floor

Smart Transportation in Industrial Parks

Invited: Operations and Decisions in Smart Manufacturing and Logistics

Invited Session

Chair: Gangyan Xu, PhD, Harbin Institute of Technology, Shenzhen, Shenzhen, China, gagexgy@gmail.com

Co-Chair: Xuan Qiu, PhD, Hong Kong University of Science and Technology, Hong Kong, adaqiuxuan@gmail.com

Co-Chair: Yongchang Wei, Zhongnan University of Economics and Law, Wuhan, China, ivanwilts306@163.com

Co-Chair: Mukund Nilakantan Janardhanan, University of Leicester, Leicester, n/a, United Kingdom, jmukund88@gmail.com

1 - An Inventory Routing Problem for Supply Hub in Industrial Park (SHIP): a Math-based Heuristic

Saijun Shao, The University of Hong Kong, Pokfulam Road, Hong Kong Island, Hong Kong, AL, Hong Kong, aaron.shao@sj@gmail.com

Industrial parks are increasingly formed by manufacturers to enjoy competitive advantages. In many cases, a third party called Supply Hub in Industrial Park (SHIP) is established to provide logistics services for the member manufacturers. Raw materials are procured and stored at SHIP, and then delivered to manufacturers when needed. This paper addresses the inventory routing problem (IRP) faced by SHIP, where inventory and transportation decisions are made simultaneously to minimize the overall cost. SHIP-IRP is different from classical IRPs in the sense that inventory levels at both the supply side (SHIP) and the demand side (manufacturers) need to be considered. We propose a math-based heuristic for SHIP-IRP, where variables representing inventory decisions at SHIP are handled with an optimization solver, and variables associated with inventory decisions at manufacturers and transportation decisions are tackled with local search heuristics.

2 - A Data-driven Integrated Management System for Spare Parts

Yongchang Wei, PhD, Zhongnan University of Economics and Law, Wuhan, China, ivanwilts306@163.com

Abstract not available.

3 - A Study of Order Allocation in Kiva-based Order Picking System

Ying Yu, The University of Hong Kong, Hong Kong, yuying429hk@126.com, Chenglin Yu, George Q. Huang

As an essential component of any logistics network, distribution center plays an important role in realizing fast and reliable E-commerce logistics service. And order picking is an important process which will impact the distribution center's performance and logistics service quality directly. The kiva-based-order picking system is flexible, economical and efficient, the industry is keen to introduce this new solution to their E-commerce distribution center, but they found there are few theories to refer. This paper introduces a matrix-based clustering algorithm for order allocation in the kiva-based order picking system and verifies the algorithm efficiency by simulation example.

4 - A Cloud-based Ubiquitous Object Sharing Platform for Heterogeneous Logistics System Integration

Ming Li, The University of Hong Kong, Hong Kong, liming8738@gmail.com, Gangyan Xu, Peng Lin, George Q. Huang

The infrastructure intelligence gradually becomes the straw for logistics enterprises to grasp with the aim of optimization. The integration of logistics systems with existing enterprise information systems (EISs) is the critical step to achieve the intelligent infrastructure. Unfortunately, the integration is always a time-consuming process, especially for small and medium enterprises (SMEs). Aiming at simplifying the system integration, this paper proposed a cloud-based ubiquitous object sharing platform to share the integration across SMEs based on the concept of sharing economy. It acts as a middleware system to make heterogeneous logistics systems universal plug-and-play for EISs.

■ TB09

201B, 2nd Floor

Data Mining and Statistics with Emerging Applications

Invited: Data Mining

Invited Session

Chair: Kathryn Steckle, University of Texas at Dallas, 1, Richardson, TX, United States, ksteckle@utdallas.edu

Co-Chair: Gerhard Wilhelm Weber, Poznan University of Technology, Chair of Marketing and Economic Engineering, Ul Strzelecka 11, Poznan, 60-965, Poland, gerhard.weber@put.poznan.pl

Co-Chair: Xuying Zhao, University of Notre Dame, 361 Mendoza College Of Business, Notre Dame, IN, 46556, United States, xzhao1@nd.edu

1 - Evaluation and Selection of Clustering Methods using a Hybrid Group MCDM Approach

Sasan Barak, Technical University of Ostrava, Faculty of Economics, Sokolská třída 33, Ostrava, 70800, Czech Republic, sasan.barak@gmail.com

Since the evaluation of clustering methods generally involves numerous criteria, it can be designed as a multiple criteria decision making (MCDM) problem. In this paper, an MCDM-based framework is proposed to evaluate and rank a number of clustering methods. The proposed approach employs three group MCDM algorithms and Borda method which capable of evaluating and ranking multiple clustering models on manifold datasets (cases). Moreover, clustering comparison with regard to both external and internal evaluation indicators is implemented. The results of comparative experiments on ten data sets with six clustering methods indicate the effectiveness of the proposed hybrid clustering method.

2 - A Data Mining Based Forecasting Methodology

Tulin Inkaya, Uludag University, Industrial Engineering Department, Gorukle Kampusu, 16059, Turkey, tinkaya@uludag.edu.tr, Pratiwi E Puspita, Mehmet Akansel

Sales forecasting has a vital role in balancing supply and demand. In this study, a data mining based forecasting methodology is proposed for a forklift distributor. The sales data of the items include time series sequences with unequal lengths and intermittency. Firstly, items with similar sales patterns are clustered using dynamic time warping distance, and cluster representatives are found. Secondly, important features are selected using multivariate adaptive regression splines, and support vector regression is used for forecasting. Also, novel features are proposed to identify the intermittency. Finally, the proposed approach is evaluated according to its inventory performance.

3 - Merging Heterogeneous Demand with Density-based Subspace Clustering

Edward W. Sun, Kedge Business School, 680 Cours de la Liberation, Talence, Talence, 33405, France, edward.sun@kedgebs.com, Yi-Ting Chen, Yi-Bing Lin

To manage behavioral anomalies, we propose a novel density-based subspace clustering approach (i.e., a three-stage iterative optimization procedure) that runs a penalized likelihood estimation of parameters to modify the EM algorithm for the multivariate Gaussian mixture (MGM) model and simultaneously determines the number of components to be mixed for the underlying Gaussian mixture model, the mixing weights, and the parameters of the Gaussian distribution components. We discuss the characteristics of the proposed method and illustrate its performance with an empirical investigation of real mobile usage data.

4 - Rural Area Public Transportation Bus Service System Improvement by using Smart Card Data

Tsung-Lin Cho, Department of Business Administration, National Dong Hwa University, Hualien, Taiwan, 610632003@gma.ndhu.edu.tw, Chih-Peng Chu, Cheng-Chieh Chen, Wei-Ying Wu

Public transportation route coverage rate, frequency of service in rural area is far lower than that of urban area but distance between service stops is far, therefore, the usage of public transportation is much lower than urban area. In this article, we analysis the passenger travel pattern through the data offered by a bus corporate, from 2015 to 2017. Applying data mining technique K-means algorithm to analysis passengers travel pattern. This study develops customer friendly service, such as all-stop service, express service, short-term service or skip stop service to improve passenger satisfaction.

■ TB10

201C, 2nd Floor

Optimization Modeling and Analytics

Invited: Operations Analytics and Optimization for Manufacturing, Logistics and Energy Systems

Invited Session

Chair: Hongrui Liu, PhD, San Jose, CA, United States, hongrui.liu@sjsu.edu

1 - Large Scale Spectral Clustering using Diffusion Coordinates on Landmark Based Bipartite Graphs

Guangliang Chen, San Jose State University, San Jose, CA, 95192, United States, guangliang.chen@sjsu.edu

Spectral clustering has emerged as a very promising clustering approach due to its flexibility and capability to separate non-convex, non-intersecting manifolds. The main disadvantage, however, is its high computational complexity associated to a required matrix eigenvalue decomposition. As a result, there has been considerable effort in the machine learning and data mining communities to develop fast, approximate spectral clustering algorithms that are scalable to large data sets. Motivated by the document-term co-clustering framework by Dhillon (2001), we propose a landmark-based scalable spectral clustering approach in which we first use the selected landmark points and the given data to form a bipartite graph and then run a random walk on it to obtain diffusion coordinates for clustering. We develop an efficient implementation of the algorithm and demonstrate its superior performance (in terms of clustering accuracy and CPU time) on several benchmark data sets while comparing with the state-of-the-art methods.

2- Time-frequency Current Analysis of Servo Motors with Permutation Entropy Algorithm for Abnormal Detection of Industrial Robots

Tao Wang, PhD, Guangdong University of Technology, Guangzhou, China, 466586789@qq.com

In order to detect the abnormalities of the industrial robots, we propose a method based on Multiple-Frequency Empirical Mode Decomposition (MFEMD) and Permutation Entropy (PE) algorithm. First, MFEMD is used to decompose the servo motor current into a series of Intrinsic Modal Functions (IMF components). Then, the permutation entropy algorithm is used to analyze abnormal mutation of the IMFs obtained by MFEMD extraction. MFEMD adds multiple frequency masking signals to solve the problem of mode mixing in EMD and then effectively reduce the effect of mode mixing. The result shows that this method can realize the abnormal detection of industrial robots.

3 - Practical Mathematical Methods for Political Redistricting and Competitive and Fair Elections

Hongrui Liu, San Jose State University, San Jose, CA, 95192, United States, hongrui.liu@sjsu.edu, Ayca Erdogan, Royce Lin, Hsiao-Shen Jacob Tsao

A major reason for the current political polarization in the US is partisan political redistricting or “gerrymandering” for congressional elections. Population equality, contiguity and compactness for any district are required by the US constitution. Political reforms for decreasing partisan influence alone will not suffice; the non-partisan commission staff needs software tools to help achieve these requirements and to explore or achieve fair representation, competitiveness, etc. However, the mathematical solution processes produced so far have not been practical for real-world use. We propose a new approach that is mathematically rigorous, easier for the staff to understand and practical for software implementation.

■ TB11

201D, 2nd Floor

Financial Engineering II

Contributed Session

Chair: Chao Shi, Shanghai University of Finance and Economics, 100 Wudong Rd., Yangpu District, Shanghai, 200433, China, shichao@connect.ust.hk

1 - Optimal Timing and Terms of Mergers and Acquisitions Based on a Real Options Approach

Katsushige Sawaki, Research Adviser, Chubu Region Institute for Social and Economic Research, 4-14-2 Sakae, Naka-ku, Nagoya, Aichi, 460-0008, Japan, katssawaki@gmail.com, Kyoko Yagi, Kimitoshi Sato

The purpose of this paper is to develop a valuation framework for mergers and acquisitions by explicitly incorporating the synergy effect of merging the target firm. We show that there exist optimal timing and term depending on the profit flows at the time of the merger. We also explore when a merger likely takes place.

2 - Kelly Criteria under Model Uncertainty

Yuhong Xu, Associate Professor, Soochow University, Shizijie 1#, Suzhou, 215006, China, yuhong.xu@hotmail.com

Kelly criteria for a wealth process to reach a goal are studied under ambiguous market. I show that ambiguity aversion of a rational individual decreases her market participation when expected return and volatility are uncorrelated, and there is a small exception for synchronous return and volatility. The aggregate premium of being short a discounted reward is computed explicitly which is decomposed into two parts. An investor's pessimism leads to negative volatility premium. However the risk premium is positive. As a result, in an underestimated pricing economy, investors could still make positive premium via appropriate allocation among assets.

3 - An Application of Sparse-group Lasso Regularization to Equity Portfolio Optimization and Sector Selection

Jingnan Chen, Beihang University, Beijing, China, jchen@buaa.edu.cn, Gengling Dai, Ning Zhang

We propose a modified mean-variance portfolio selection model that incorporates the sparse-group lasso regularization in machine learning. This new model allows investors to incorporate their preference over equity sectors and helps investors select sectors based on assets' past performances. Besides, it has stabilizing and sparsifying effect on the entire portfolio. We connect our model to a robust portfolio selection problem, and investigate effects of the sparse-group lasso regularization both theoretically and empirically. We develop an efficient algorithm to find the optimal portfolio and evaluate its out-of-sample performance across different datasets.

4 - Asymptotic Expansion Pricing of Discretely Monitored Barrier Options under Stochastic Volatilities with Jumps on Returns

Chao Shi, Assistant Professor, Shanghai University of Finance and Economics, 100 Wudong Rd., Yangpu District, Shanghai, 200433, China, shichao@connect.ust.hk

We propose an expansion algorithm for pricing discretely monitored barrier options under stochastic volatility models. It turns out that the celebrated Hilbert transform recursion algorithm proposed by Feng and Linetsky (2008) becomes the leading term and building block in our expansion formula under stochastic volatility models. Our expansions are automatic and fast. Numerical results show that our algorithm is efficient and robust.

■ TB12

201E, 2nd Floor

Metaheuristics in Transportation

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Sin C. Ho, The Chinese University of Hong Kong, Hong Kong, sinho@hku.hk

1 - Large Neighborhood Search for the Static Multi-vehicle Bike-repositioning Problem

Sin C. Ho, The Chinese University of Hong Kong, Shatin, Hong Kong, sinho@se.cuhk.edu.hk, Wai Yuen Szeto

This talk addresses the multi-vehicle bike-repositioning problem, a pick-up and delivery vehicle routing problem that arises in connection with bike-sharing systems. We propose a hybrid large neighborhood search for solving the problem. The heuristic is evaluated on three sets of instances with up to 518 stations and five vehicles. The results of computational experiments indicate that the heuristic outperforms other existing algorithms.

2 - A Static Multi-vehicle Bike Repositioning Problem: Exact Loading And Unloading Strategies And An Enhanced Artificial Bee Colony Algorithm

Wai Yuen Szeto, University of Hong Kong, Department of Civil Engineering, Hong Kong, ceszeto@hku.hk, C.S. Shui

This study investigates a bike repositioning problem (BRP) that determines the routes of the repositioning vehicles and the loading and unloading quantities at each bike station to firstly minimize the positive deviation from the tolerance of total demand dissatisfaction and then service time. To reduce the computation time to solve the loading and unloading sub-problem of the BRP, this study examines a novel set of loading and unloading strategies and further proves them to be optimal for a given route. This set of strategies is then embedded into an enhanced artificial bee colony algorithm to solve the BRP. The results demonstrate the properties of the problem and the effectiveness of the solution method.

3 - A Hybrid Rolling Horizon Artificial Bee Colony Algorithm Approach for Dynamic Green Bike Repositioning Problem

Chin Sum Shui, University of Hong Kong, Composite Building, Seat 16, LG 208, Hong Kong, samshui2004@hotmail.com
Chin Sum Shui, The University of Hong Kong Shenzhen Institute of Research and Innovation, Shenzhen, China, samshui2004@hotmail.com, Wai Yuen Szeto

We propose a dynamic green bike repositioning problem which reduces the total unmet demand of the bike-sharing system and total fuel and CO2 emission cost of the repositioning vehicle over a specific service time horizon. We adopt a rolling horizon approach to aggregate the proposed problem into a set of stages, in which a static bike repositioning sub-problem is solved in each stage by a combination of the enhanced artificial bee colony algorithm and two tailor-made heuristics. Numerical examples showed that weight setting is important for achieving a balance between the two objectives.

■ TB13

201F, 2nd Floor

Operations and Economics Interface VI

Invited: Operations and Economics Interface

Invited Session

Chair: Hsiao-Hui Lee, University of Hong Kong, Hong Kong, hhlee@hku.hk

1 - Cross-licensing and Innovation in a Supply Chain

Jingqi Wang, The University of Hong Kong, Room 806, K.K. Leung Building, The University of Hong Kong, Hong Kong, jingqi@hku.hk, Tingliang Huang

Qualcomm, the largest smartphone chipmaker in the world, was recently fined RMB 6.088 billion by the Chinese government for alleged anti-competitive conducts including requiring downstream phone manufacturers to cross-license their patents to Qualcomm and its customers. Qualcomm's cross-licensing practice has also received similar charges or scrutiny in other countries. Motivated by this practice, we study the impacts of cross-licensing in a supply chain in which an upstream supplier requires its downstream competing manufacturers to cross-license. We find that cross-licensing may incentivize the weak manufacturer to make more innovation investment. While the weak manufacturer always benefits from cross-licensing, the strong one may be hurt. Moreover, the supplier does not always benefit from cross-licensing. We also show that cross-licensing does not always hurt social welfare or consumer surplus. Our results have managerial implications to firms in high-tech industries, as well as to policy makers around the world.

2 - Strategic Product Recall

Hsiao-Hui Lee, University of Hong Kong, K.K. Leung Building,
Room 814, Pok Fu Lam, Hong Kong, hhlee@hku.hk,
Wenzheng (Wendy) Mao, Zhanyu Dong

Product recalls are the most commonly used but double-edged tools for managing product-harm crises, as such recalls release bad signals on product quality and result in heterogeneous impacts on market demand for recalls released at different stages of market cycles. Therefore, the timing of a product recall becomes a strategic decision for firms facing product-harm crises and deserves further investigation. This paper examines the timing of a recall as a strategic decision by using both the analytical modelling and empirical analysis approaches. Specifically, when a product defect is discovered at an early stage of a market cycle, a firm could strategically delay the recall time to mitigate the negative shock evoked by this recall. This prediction has been confirmed by the data, which validates the effectiveness of a properly delayed recall on firm sales.

3 - Does Business Method Innovation Create Value?**A Study of Public U.S. Firms in the Supply Chain**

Tian Chan, Emory University's Goizueta Business School,
1300 Clifton Road, Atlanta, GA, 30322, United States,
tian.chan@emory.edu, Anandhi S. Bharadwaj, Deepa Varadarajan

Ever since Amazon patented their "1-click" ordering method, there has been significant interest in understanding the value potential of business method patents. In this study, we examine the financial performance of public US manufacturers, and find that firms investing in high-quality business method patents generate higher market value.

■ TB14

202A, 2nd Floor

Strategic Location Analysis for Safety and Logistics

Sponsored: Location Analysis

Sponsored Session

Chair: Felipe Aros-Vera, Ohio University, Athens, OH, 45701,
United States, aros@ohio.edu

1 - Police Patrolling of Hot Spots while Considering Traditional Location-based Response Objectives

Rajan Batta, University at Buffalo (SUNY), 410 Bell Hall, Buffalo,
NY, 14260, United States, batta@buffalo.edu

Abstract not available.

2 - Locating Strategic Hubs for Maximizing Logistics and Transportation Efficiency using Spatial-temporal Logistics Interaction Model

Tanmoy Kundu, National Taiwan University, Taipei, Taiwan,
tan.kundu@gmail.com, Jiuh-Biing Sheu

This work presents a novel methodology to address the dynamic and stochastic challenges that underlie the problem of international logistic network reconfiguration. The problem background is motivated by the recent transnational multi-interval logistics distribution flows induced by the One Belt-One Road (OBOR) initiative. A spatial-temporal logistics interaction model is proposed to forecast time-varying logistics distribution flows and to locate the strategic hubs for maximization of logistics and transportation efficiency. A three-layer supply chain framework is considered for modeling the spatial-temporal logistics distribution flow. Further, numerical forecasts based on two cases of Chinese oil supply chain is carried out to account for the effectiveness of the proposed model. Analytical results suggest various development strategies for the practitioners and the policy makers in optimizing their locations, logistics and transportation decisions.

3 - Facility Location for Resiliency in Interconnected Systems

Felipe Aros-Vera, Ohio University, 277 Stocker Center, Athens,
OH, 45701, United States, aros@ohio.edu, Shital Thekdi

Understanding interdependencies and cascading effects is of key importance for the design of critical infrastructure and further response and recovery from natural or man-made disasters. This paper studies these interdependencies using network design and risk-management tools. In addition, empirical evidence of interdependencies was identified after Hurricane Maria in Puerto Rico.

4 - A Robust Optimization Approach to P-hub Median Problems

Mihiro Sasaki, Nanzan University, 18 Yamazato, Showa, Nagoya,
466-8673, Japan, mihiro@nanzan-u.ac.jp, Akihiro Hattori

We consider p-hub median problems that include demand uncertainty. Using a robust optimization approach, we formulate the problem as a mathematical programming problem that includes second order cone constraints. We show some computational results using CAB data set and with different parameters in order to consider various scenarios.

■ TB15

202B, 2nd Floor

Technology-enabled and Knowledge Intensive Service

Sponsored: Service Science

Sponsored Session

Chair: Furen Lin, PhD, National Tsing Hua University, Taiwan,
frlin@iss.nthu.edu.tw

1 - Diagnosing Service Success and Failure Incidents in Sharing Economy: A Case of Logistic Sharing Company

Shiuli Huang, PhD, National Taipei University, New Taipei City,
23741, Taiwan, slhuang@gm.ntpu.edu.tw

This study uses the critical incident technique and open card sorting to analyze and categorize those service failure and success incidents which are collected from business users of a logistic sharing company. Skilled interviews are implemented, and thirty-five business users are invited to provide critical negative and positive use experiences. In addition, recovery strategies provided by the company are also gathered. After collecting these data, sorting processes are used to categorize failure, success incidents, and recovery strategies. The results can provide suggestions for managers of sharing economy companies to avoid or recover the failures and attain the successes.

2 - Design Thinking with Open Data: A Data Evidence-based Approach

Cathy Lin, PhD, National Kaohsiung University, Kaohsiung, 811,
Taiwan, cathy@go.nuk.edu.tw

Design thinking has been a comprehensive design method from 1990, which derived from the design science that treats design as a search process. In the process, the main focus is to put users' interests at the center of problem-solving, come up with innovative ideas, then prototype before rollout a product or service. On the other modern discipline on data science, open data has become a new driving force for social movement because data can reveal a better understanding of social reality. Therefore, this study tries to bring design thinking and open data together, build a common ground for design science and open science. More specific, a data evidence-based design approach is proposed to harmonize the human- and data- center approach to see how data can be as evident in the design thinking process.

3 - Perceived Service Quality and User Value Co-creation in Academic Libraries: Self-directed Learning Readiness as a Moderator

Pei-shan Hsieh, Tunghai University, 407, Taiwan,
pesin72826@gmail.com, Fu-ren Lin

In response a digital environment, the academic library must redefine its role and create better services. It must work actively not just to create value for the user but to involve the user in value co-creating value for service quality improvement. Therefore, this study examines the effects of user participation and citizenship behavior after perceived service encounters in the library. Furthermore, the study examines how users' self-directed learning readiness moderate the effects of perceived service quality on perceived value and value co-creation. This research results could assist academic libraries to be more user-centered and support users engage in numerous learning activities.

4 - Fault Detection and Diagnosis of Photovoltaic Arrays in Real-time via Machine Learning

Chung-Chian Hsu, National Yunlin University of Science and
Technology, Douliu, 64002, Taiwan, hsucc@yuntech.edu.tw, Chi-Tse Deng, Arthur Chang

Break down on solar panels or equipment can result in reduced power production. Being able to monitor solar power generation and the PV arrays status in real-time is important. We used a machine learning technique for online monitoring. Irradiation is retrieved in real-time. We then identify several moments in the past which had irradiations closest to the read value. The average production of those moments is taken to compare with the real production. A significant difference signifies potential problems. We devised methods to further confirm the problem and diagnose its type. Experimental results showed the proposed approach is feasible and able to detect and diagnose faults in real-time.

■ TB16

203A, 2nd Floor

Optimization II

Contributed Session

Chair: Bogdan C. Bichescu, The University of Tennessee, 229 Stokely Management Center, 916 Volunteer Blvd, Knoxville, TN, 37996-0525, United States, bbichescu@utk.edu

1 - A Satisficing Approach for the Surgery Scheduling Problem

Yu Wang, Shenyang Agricultural University, 120 Dongling Road, Shenyang City, Liaoning Province, China, wangyuguomei@163.com, Yu Zhang

We consider the problem of mitigating overtimes in a weekly scheduling surgery department for the risk-averse managers. The problem considers the surgery allocation problem with regard to uncertain surgery durations and parallel operating rooms capacity. We characterize hospital administrators' risk-averse behaviors based on the utility theory and develop a novel mathematical model for the surgery scheduling problem, in which both the overtime probability and overtime quantity are considered in our decision criterion. An exact hill climbing algorithm is designed. Numerical experiments prove the effectiveness of our method.

2 - Computing in the Cloud and High Performance Computing with GAMS

Franz J. Nelissen, Managing Director, GAMS Software GmbH, P.O. Box 4059, Frechen, 50216, Germany, fnelissen@gams.com

The General Algebraic Modeling System (GAMS) has evolved continuously in response to user requirements, changes in computing environments and advances in the theory and practice of mathematical optimization. The requirements of applications in areas like energy systems have increased to a level that is sometimes beyond the range of local computing resources. In this talk, we will look into some options to run GAMS models in different Cloud environments. We will also report on a project that uses High-Performance Computing resources to solve super-large energy system models using massive parallel computing.

3 - Bilevel Joint Optimisation for Product Family Modular Architecture Considering Sustainable Design

Yujie Ma, Tianjin university, Nankai District, Tianjin Wei Jin Road 92, Tianjin, 300110, China, mayujie413@163.com

product family architecture take advantage of common modules and individual modules in providing product variety. due to consumers and governments are increasing pursuit a balance between low fulfilment costs and eco sustainable. This paper uses bilevel programming to solve product family architecture and eco sustainable design. The leader optimization problem is to choose the common modules and individual modules to Comprehensive evaluation of utility per cost. A follower optimization problem copes with eco sustainable problem. A nested genetic algorithm is proposed for solving this leader and follower model.

4 - Preference Robust Optimization for Decision Making under Uncertainty

Jonathan Yu-Meng Li, Assistant Professor, Telfer School of Management, University of Ottawa, 55 Laurier Avenue East, Ottawa, ON, K1N 6N5, Canada, jonathan.li@telfer.uottawa.ca, Erick Delage

Decision making under uncertainty can often be formulated as optimization problems where the parameters are uncertain and the goal is to seek solutions that generate most preferable random payoffs. It is however non-trivial to find a functional representation that captures one's true preference system. In this talk, we introduce preference robust optimization as a way of accounting for ambiguity about the decision makers' preferences. We show how preference robust optimization models can be tractably solved as convex programs when parametric uncertainty is described using scenarios and preference information takes the form of pairwise comparisons of discrete lotteries.

5 - ARIMA Mining: Time Series Analysis and Forecasting by Mathematical Programming

Bogdan C. Bichescu, Associate Professor, The University of Tennessee, 229 Stokely Management Center, 916 Volunteer Blvd, Knoxville, TN, 37996-0525, United States, bbichescu@utk.edu, George G Polak

We present a novel approach to time-series analysis that relies on optimization modeling and the decomposition of a time series into autoregressive, moving average, white noise, and anomalous nonstationary terms. The latter two are modeled using wavelets. The selection of appropriately-lagged terms is achieved via optimization models based on fit maximization criteria while constraining the number of AR and MA terms to achieve desired parsimony. In numerical results, the forecast accuracy of our models is found to be competitive with that of a widely-used open source implementation of ARIMA.

■ TB17

203B, 2nd Floor

Land Logistics and Warehousing

Invited: Maritime Operations

Invited Session

Chair: Min Huang, Northeastern University, Shenyang, 110004, China, mhuang@mail.neu.edu.cn

Co-Chair: Hanbin Kuang, Northeastern University, Shen Yang, 110819, China, kuanghanbin@ise.neu.edu.cn

1 - Conflict Analysis in Supply Chain Management

Hanbin Kuang, Northeastern University, P.O. 135, Systems Engineering Institution, No. 3-11, Wenhua Road, Heping District, Shenyang, 110819, China, kuanghanbin@ise.neu.edu.cn, Min Huang

Modern logistics provides a prosperous development environment for the fourth party logistics. The opportunity and challenge coexist, the development of the fourth party logistics requires the cooperation of all stakeholders involved in the whole logistics supply chain. However, the conflict between the vested interests in existing logistics supply chain and the fourth party logistics suppliers is inevitable. In this research, the conflict over the fourth party logistics development is modeled. Specifically, corresponding decision makers and their options are identified, and decision makers' preferences over the feasible states are estimated based on option prioritization. Then, a stability analysis is carried out based on the graph model for conflict resolution, and a directed graph for the fourth party logistics conflict is generated by using the decision support system entitled GMCPlus. Based on the calculation results, the interpretation on these calculated equilibria are provided, and the evolution of the conflict is analyzed.

2 - Patient Assignment Scheduling in a Cloud Healthcare System

Hongfeng Wang, Northeastern University, China, wanghongfeng@ise.neu.edu.cn, Yafei Li

Integrated healthcare system has been identified as one of "must-do" strategies in future healthcare. This paper focuses on the planning and scheduling problem in a cloud healthcare system arising in recent years, which is regarded as an integrated healthcare system by the technique of Internet. In order to describe the relationship among medical process and resource, a Petri net model of cloud healthcare is presented and simulated by CPN Tools. Through analyzing the presented Petri net, a patient assignment scheduling problem is investigated due to its importance for allocating the bottleneck medical resource of cloud healthcare system efficiently. A mathematical model is established and a greedy-based heuristic algorithm is design for the investigated patient assignment scheduling problem. Experimental results on test instances from the actual data of a cloud hospital validate the effectiveness of the proposed model and algorithm.

3 - Rollout Algorithms for Resource Allocation in Humanitarian Logistics

Canrong Zhang, Tsinghua University, Tsinghua Campus, Building E, Shenzhen, China, crzhang@sz.tsinghua.edu.cn, Lina Yu

Large-scale disasters and catastrophic events typically result in a significant shortage of critical resources, posing a great challenge on allocating limited resources among different affected areas to improve the quality of emergency logistics operations. This paper pays attention to the performance of resource allocation which includes three metrics: efficiency, effectiveness and equity. A nonlinear integer model is first proposed, and then an equivalent dynamic programming model is developed. An approximate dynamic programming algorithm called rollout algorithm is proposed. Extensive numerical experiments are conducted to test the performance of the proposed algorithms.

4 - The Study of Location Assignment in Rack Storage System: A Case Study Of Battery Warehouse

Ramidayu Yousuk, Lecturer, Kasetsart University, 50 Ngamwongwan Rd. Chatuchak, Bangkok, 10900, Thailand, ramidayu.y@ku.ac.th

Battery manufacturer faces with rapid growth in production volume. Due to space limitation, a new warehouse is viable option and has been built in order to expand the storage area. The objective here is to locate the proper location assignment in rack storage with minimum total distance by comparing 4 different options which are random, fixed, combination, and commodity location system. The conclusion has been drawn from the result of mathematical model. The combination location system has resulted in the least total distance and the random location system is the best in space utilization. Lastly, VBA in Microsoft Excel has been employed to create the user-friendly tracking system for the new warehouse.

■ TB18

North Lounge, 3rd Floor

Managing Patient Inflow at Hospitals

Invited: Healthcare Systems and Applications

Invited Session

Chair: Ying Xu, Singapore University of Technology and Design, Singapore, 487372, Singapore, xu_ying@sutd.edu.sg

Co-Chair: Shrutivandana Sharma, Singapore University of Technology and Design, Singapore, 138682, Singapore, shrutivandana@sutd.edu.sg

1 - Capacity Rationing and Ambulance Diversion in Emergency Departments

Tianshu Lu, University of Toronto-Rotman School of Management, 105 St George Street, Toronto, ON, M5S 3E6, Canada, Tianshu.Lu15@Rotman.Utoronto.Ca, Opher Baron, Jianfu Wang

Capacity rationing and ambulance diversion are two important practices in emergency department (ED) management. We model these practices as a two classes non-preemptive priority M/M/c+M queue where high- and low-priority customers correspond to acute and non-acute patients, respectively. We model capacity rationing by reserving k servers to high priority customers, and ambulance diversion by blocking high priority customers from entering the system when the total number of patients is higher than $c+m$. We derive an exact solution for different performance measures of interest for this queue using queueing Markov chain decomposition (QMCD). These performance measures include expected number of patients, distribution of queue length, and blocking probability (i.e., ambulance diversion rate). Numerical results demonstrate how system parameters impact patients' waiting and provide insights on the control of capacity rationing and ambulance diversion in EDs.

2 - Appointment Scheduling with Unpunctual Patient Arrivals

Zhichao Zheng, Singapore Management University, 50 Stamford Road, Lee Kong Chian School of Business, Singapore, 178899, Singapore, danielzheng@smu.edu.sg, Qingxia Kong, Chung-Piaw Teo

Typical healthcare appointment scheduling problems assume that patients arrive punctually according to assigned appointment time, which is rarely true in practice, especially in outpatient clinics. Unpunctual arrivals lead to over-congestion of waiting rooms, long idle time and overtime work of physicians. In this paper we study the design of healthcare appointment systems when patient arrivals deviate from the scheduled appointment times by some random amounts. We use a network flow model to capture the dynamics of the system and develop a copositive optimization model to solve the appointment scheduling problem. Our analysis using clinical data suggests it is important to account for unpunctual patient arrivals in the design of appointment policies.

3 - How Do Patients' Perception and Self-interests Affect Emergency Department Crowding in Hospitals?

Shrutivandana Sharma, Singapore University of Technology and Design, 8 Somapah Road, Engineering System & Design, Singapore, 487372, Singapore, shrutivandana@sutd.edu.sg, Ying Xu, Manu Gupta

We investigate the crowding problem in hospitals' emergency departments (EDs) from the perspective of demand management. We propose a novel congestion game model that provides the first systematic methodology to simultaneously analyze the effects of ED resource allocation as well as patients' perception and self-interests when they can choose between ED and primary care. We perform extensive numerical experiments to study the impact of perception errors and patients' self-interests on ED demand and resulting crowding, and compare them with optimum social welfare maximizing patient flows.

4 - Simulation Model to Assess the Impact of a Centralized Scheduling Policy for Imaging Procedures in Ontario Canada

Christian Silva, University of Toronto, 81 St. Mary Street, Toronto, ON, M5S1J4, Canada, christian.silva@mail.utoronto.ca, Michael Carter

Due to constrained capacity, wait times for imaging procedures in Ontario are frequently higher than the provincial target. A novel approach for Ontario hospitals that centrally schedules outpatients and assigns them between locations is expected to be more efficient. Computer simulation was used to evaluate the impact of this approach by comparing individual hospital models versus a centralized model with imaging demand data from two Ontario hospitals. Results show how the proposed policy can lead to reduced and uniform wait times in the system. We also analyzed what are the different variables that drive better system performance. Final recommendations are given on how to apply this policy.

■ TB19

South Lounge, 3rd Floor

Data and Literature: A Quality and Informatics Perspective

Sponsored: Health Informatics, Quality and Safety, and Simulation
Sponsored Session

Chair: Bunyamin Ozaydin, University of Alabama-Birmingham, 1720 2nd Avenue S, SHPB 590H, Birmingham, AL, 35294, United States, bozaydin@uab.edu

1 - Stochastic Time Consistent Measures for Dynamic Quality Management of Big Data Systems

Edward W Sun, Senior Professor, Kedge Business School, 7 Boulevard de Dunkerque, Talence, Marseille, 13002, France, edward.sun@kedgebs.com, Yi-Ting Chen, Li-Bing Lin

Big data systems for reinforcement learning have often exhibited problems (e.g., failures or errors) when their components involve stochastic nature with the continuous control actions of reliability and quality. We propose a dynamic coherent quality measure focusing on an axiomatic framework by characterizing the probability of critical errors that can be used to evaluate if the conveyed information of big data interacts efficiently with the integrated system (i.e., system of systems) to achieve desired performance. We illustrate their properties that suffice stochastic time-invariance and show their superiority when working on big data systems.

2 - Text-mining Analysis of Research at the Intersections of Healthcare Quality and Safety, Informatics, and Simulation

Bunyamin Ozaydin, Assistant Professor, University of Alabama at Birmingham, 1720 2nd Avenue S, SHPB 590H, Birmingham, AL, 35294, United States, bozaydin@uab.edu, Ferhat Zengul, Sue Feldman

This study reports the findings of the analysis of the evolution of research in the research at all possible intersections of Informatics, Quality and Safety, and Simulation by utilizing text-mining and natural language processing (NLP). For the analyses, we used the Text Explorer module of JMP Pro 13 and an iterative semi-automated process involving tokenizing, phrasing, and terming. Preliminary results suggest that among the three main areas included, a much higher proportion of research is conducted in the area of Quality and Safety.

3 - Health Informatics, Quality and Patient Safety, and Simulation: A Systematic Review

Sue Feldman, UAB, 1720 2nd Avenue South, SHPB 590K, Birmingham, AL, 35294, United States, sf8588@gmail.com, Ferhat D. Zengul, Bunyamin Ozaydin, Shikha S. Modi

We report the findings of the synthesis of the empirical research on the triad of Health Informatics, Quality and Safety, and Simulation. The study was guided by the preferred reporting items for systematic reviews and meta-analyses (PRISMA). Multiple searches were performed in four databases by searching presence of all three dimensions of the explored triad within the abstract or the title. Preliminary results suggest that the research in the triad focuses on simulation education and computerized simulation, and when coupled with informatics how each can improve patient safety or quality.

■ TB20

401, 4th Floor

Queueing Models and their Applications

Sponsored: Applied Probability

Sponsored Session

Chair: Hanqin Zhang, National University of Singapore, Singapore, 119245, Singapore, bizzhq@nus.edu.sg

1 - Functional Law of the Iterated Logarithm for Multi-server Queues with Batch Arrivals and Customer Feedback

Yongjiang Guo, School of Science, Beijing University of Posts and Telecommunications, Beijing, China, yongerguo@bupt.edu.cn, Renhui Pei, Yunan Liu

A functional law of the iterated logarithm (FLIL) and its corresponding law of the iterated logarithm (LIL) are established for a multi-server queue with batch arrivals and customer feedback. The FLIL and LIL, which quantify the magnitude of asymptotic fluctuations of the stochastic processes around their mean values, are developed in three cases: underloaded, critically loaded and overloaded, for five performance measures: queue length, workload, busy time, idle time and departure process. Both FLIL and LIL are proved using an approach based on strong approximations.

2 - Stochastic Monotonicity and Comparability of Markov Chains with Block-monotone Transition Matrices and Their Applications to Queueing Systems

Hai-Bo Yu, Beijing University of Technology, China,
haibo@bjut.edu.cn

Motivated by various applications in queueing theory, this article is devoted to the stochastic monotonicity of Markov chains with block-monotone transition matrices. We characterize the block-monotone matrices in the sense of the block-increasing order and block-increasing convex order; characterize the Markov chain with general transition matrix by martingale; the stochastic comparison results for the Markov chains associated with discrete-time GI/G/1 queue, and bounds of the Markov chain are provided.

3 - Impact of an Emergency Order Opportunity on Supply Chain Coordination

Xue-Ming Yuan, Singapore, bizyxm@nus.edu.sg, Meimei Zheng, Jie Lin

We consider a manufacturer-retailer supply chain in the pre-selling and selling seasons, where the manufacturer can offer the retailer an emergency order opportunity with limited commitment quantity, in addition to the regular order from the retailer before the selling season. The manufacturer needs to prepare for it in the pre-selling season: producing more than the regular order or reserving its capacity for the responsive production. It is found that when the emergency order opportunity is provided, the manufacturer might be worse off although the retailer is always better off. We derive the conditions where both manufacturer and retailer can benefit from the emergency order.

4 - An Optimal Batch Removal Strategy of Unusable Bicycles in Large-Scale Bicycle Sharing Systems

Quan-Lin Li, Yanshan University, Qinhuangdao, China,
liquanlin@mail.tsinghua.edu.cn, Rui-Na Fan

During the last decade bicycle sharing systems have emerged as a public transport mode devoted to short trip. In the present design and operations of bicycle sharing systems, it has become a basic and interesting topic on how to dynamically remove unusable bicycles from stations such that the probability of problematic (empty or full) stations keeps as low as possible. In this paper, we provide an optimal batch strategy for removing unusable bicycles and also give a novel corresponding way to add necessary new (repaired or purchased) bicycles into the bicycle sharing system. We establish a queueing network of virtual nodes, and give the product-form solution to the steady-state probabilities of joint queue lengths at the virtual nodes. Based on this, we can assess the quality of service which leads to setting up an optimal problem of batch strategy for removing those unusable bicycles. Finally, we use some numerical examples to show the effectiveness and computability of our modeling and method.

■ TB21

Joy, 4th Floor

Quality Control and Reliability

Invited: Theory & Practice on Circular Economy

Invited Session

Chair: Yeneneh Tamirat Negash, PhD, Taichung, 41354, Taiwan,
yeneneh@asia.edu.tw

1 - Copula-based Process Yield Analysis for Auto-correlated Profiles

Yeneneh Tamirat Negash, Asia University, 500, Lioufeng Rd.,
Taichung, 41354, Taiwan, yeneneh@asia.edu.tw

The copula approach is a method for modeling nonlinearity, asymmetry and tail dependence in several fields; it can be used in the study of dependence or association between random variables. The primary objective is to use the concept of copulas to model autocorrelation in profile data and develop the theory of process capability indices in order to cover practical situations where the existing body of knowledge is insufficient. In this paper at least five types of copula functions: Normal, Farlie-Gumbel-Morgenstern (FGM), Clayton's, Frank's, and Gumbel's copula for specifying dependence between random variables are used and measured by Kendall's tau.

2 - Strategies of Mitigating Customer's No-shows at Restaurants

Kuo-Pin Li, PhD Student, Department of Business Administration,
Asia University, 500 Lioufeng Road, Wufeng, Taichung, 41354,
Taiwan, 09877leo@gmail.com, Shieh-Liang Chen,
Wen-Hong Chiu, Wen-Cheng Lu

No-show reduction at restaurants can not only mitigate losses incurred when customers fail to honor a booking but also affect consumers' reservation behaviors. This study analyzed the ability of restaurant booking policies to mitigate no-shows as well as their negative impacts. A survey was conducted to understand the booking policies of the Taiwanese restaurant industry. The findings indicated that each sector of the restaurant industry possesses unique characteristics.

3 - The Antecedents of Patronage Online Reservation Platform of EzTable Restaurant

Wen Cheng Lu, 500 Lioufeng Rd, Wufeng, Taichung, Taiwan

EzTable is the largest online reservation platform of restaurants in Taiwan. The purpose of this paper is to explore the antecedents of consumer's patronage at EzTable. The total valid is 519 consisting of 105 online patrons and 414 non-patrons.

■ TB22

Elegance, 4th Floor

MCDM Tutorial

Sponsored: Multicriteria Decision Making

Sponsored Session

1 - Explain the Philosophy of the DANP-mV Model and the Concept of MRDM Methodology

Gwo-Hshiung Tzeng, National Taipei University, Taipei, Taiwan,
ghtzeng@gm.ntpu.edu.tw

The DANP-mV model has a kind of potential philosophy that is using a systematic method to generate the improving strategy from the nature of problem. Thus, applying this model to different stories will create different innovations than in the past. MRDM (Multiple Rule-based Decision Making) model was proposed, that is, based on the integration of this model with DRSA (Dominance-based Rough Set Approach). For the decision rules of the original DRSA technology, add the generated causality information to provide decision makers with clearer consumer information.

Tuesday, 1:30PM - 3:00PM

■ TC01

101A, 1st Floor

Retail Management

Contributed Session

Chair: Yunjuan Kuang, The Hong Kong Polytechnic University,
Hung Hom, Kowloon, Hong Kong, 305250, Hong Kong,
yunjuan.kuang@connect.polyu.hk

1 - Personalizing the In-store Experience – An Experimental Research Design

Anne-Sophie Riegger, EBS Universität, Wiesbaden, Germany,
anne-sophie.riegger@ebs.edu, Katrin Merfeld, Sven Henkel

Technological advancements offer unprecedented opportunities for brick-and-mortar retail to bring the advantages of online shopping to physical stores. A digitally enabled personalization of the in-store experience can be observed in innovative retail formats and is expected to disrupt the customer experience. However, it remains unclear how consumers perceive this kind of personalization. To address this research gap, we conducted a series of experiments in the context of fashion retailing. Preliminary findings suggest impacts on cross- and up-selling. Consequent academic and managerial implications are drawn.

2 - The Launch of Store Brands when Retailers Compete

Hui Xiong, Huazhong University of Science and Technology,
School of Management, 1037 Luoyu Road, Wuhan, 430074,
China, zsxjh@163.com, Lu Hsiao, Ying-Ju Chen

In this paper, we consider retailers' decision of introducing store brands in a competitive environment. Specifically, the retailer can choose to sell both the store brand and the national brand, or only one of them. Our findings demonstrate that the retailer should introduce a store brand, when the demand of the store brand is high and the competition among store brands and the national brand is fierce enough. Moreover, the wholesale prices of the national brand for both retailers are identical, when one of them introduces a store brand. Furthermore, the manufacturer may increase the wholesale price of the national brand, to counterbalance the loss due to the lost sale.

3 - Omnichannel Selling with the Consideration of Strategic Consumers

Ciwei Dong, Zhongnan University of Economics and Law, Wuhan, China, dongciwei@zuel.edu.cn, Xiutian Shi, Edwin Cheng

Retailers nowadays increasingly integrate independent selling channels, moving from the multi-channel paradigm to the omnichannel paradigm. In this paper, we study omnichannel selling with the pre-order option and returns policy for a retailer in the presence of strategic consumers. We identify the conditions under which omnichannel selling is beneficial for the retailer.

4 - Optimal Selling Strategy for a Retailer with Omnichannel Retailing

Yunjuan Kuang, The Hong Kong Polytechnic University,
Hung Hom, Kowloon, HONG KONG, 305250, Hong Kong,
yunjuan.kuang@connect.polyu.hk, Ciwei Dong, Chi To Daniel Ng

This paper studies the channel decision of a retailer who sells online and offline. We identify three options, which are basic (two separate channels), ROPO (Research Online and Purchase Offline) and BOPS (Buy Online and Pickup in Store), and characterise the conditions of each option being optimal.

■ TC02

101B, 1st Floor

Inventory Management III

Contributed Session

Chair: Emre Berk, Bilkent University, Faculty of Business Administration, Ankara, 06533, Turkey, eberk@bilkent.edu.tr

1 - Newsvendors' Equilibrium Strategies Under Price and Lead-time Competition

Zhengping Wu, Associate Professor, Syracuse University, 721 University Ave, Syracuse, NY, 13244, United States, zwu12@syr.edu, Yiqi Sun, Wanshan Zhu

Lead-time has been increasingly used as a competitive weapon, in addition to price, to attract customers. This talk considers multiple newsvendors selling substitutable products to the same market where customer demand depends on price and lead-time, and analyzes the newsvendors' equilibrium price, inventory, and lead-time decisions.

2 - Inventory Policies for Perishable Products with Expiration Dates and Advance Cash Credit Payment Schemes

Ya-Lan Chan, Assistant Professor, Asia University, Taichung, Taiwan, yalan@asia.edu.tw

For perishable products, the seller usually asks for the buyer to prepay a fraction of the purchasing cost as a good-faith deposit, to pay some cash upon the receipt of the order, and then a permissible delay is granted on the remaining of the purchasing cost. In addition, it is evident that the deterioration rate ages to 100% as time reaches the expiration date. In this paper, we incorporate the above two important and relevant facts to find the optimal cycle time and the fraction of no shortages such that the total profit is maximized. Several managerial insights are presented.

3 - Coordinating Inventory and Pricing Strategies under Total Minimum Commitment Contracts

Quan Yuan, Zhejiang University, Hangzhou, China, quanyuan@zju.edu.cn, Xiting Gong, Frank Y Chen

We study the joint inventory and pricing control for a finite-horizon periodic-review system with total minimum commitment (TMC) contract. Under this system, the buyer commits to purchase a minimum quantity of a product from the supplier over the entire planning horizon. It maximizes inventory and pricing decisions simultaneously in each period. We partially characterize the optimal policy for additive multiplicative demand model. We then characterize the optimal policy for additive demand. We further propose heuristic policies, which numerical tests show to perform very well. Finally, we use our results to examine the value of dynamic pricing.

4 - Newsvendor Model Revisited with Crowdfunding

Emre Berk, Bilkent University, Faculty of Business Administration, Ankara, 06533, Turkey, eberk@bilkent.edu.tr

I revisit the classical newsvendor model under different crowdfunding scenarios. My objective is to relate the novel financing schemes to the existing models as much as possible and to illustrate where and how modifications are needed in the classical newsvendor setting. I consider single and two-period settings. Theoretical findings as well as some illustrative examples will be discussed.

■ TC03

101C, 1st Floor

Optimization and Machine Learning for Big Data-driven Problems

Invited: Machine Learning and Big Data Analytics

Invited Session

Chair: Chun-An Chou, Northeastern University, Boston, MA, 02115, United States, ch.chou@neu.edu

Co-Chair: Zhe Liang, Tongji University, Shanghai, 200433, China, liangzhe@tongji.edu.cn

1 - A Stochastic Programming Model for the Integrated Fleet Assignment and Crew Scheduling Model

Zhe Liang, Tongji University, 265 Anbo Road, Building 61, Shanghai, 200433, China, liangzhe@tongji.edu.cn

We study an integrated fleet assignment and crew pairing problem. We assume the demand of each itinerary is stochastic. Therefore, we also consider the number of crews for each fleet in the integrated model. The results show that the model provide better solutions than the traditional method.

2 - Mixed-integer Optimization to Identify Response Patterns for Alzheimer's Disease Diagnosis

Chun-An Chou, Northeastern University, 360 Huntington Ave, 334 SN, Boston, MA, 02115, United States, ch.chou@neu.edu, Ruilin Ouyang, Albert Yang, Jong-Ling Fuh

Alzheimer's disease (AD) is a progressive brain disorder with slow memory loss correlated to cognitive deficits in the elderly population. Recent studies have shown some potentials to discover brain biomarkers or patterns of cognitive dysfunction across different phases of AD using electroencephalography (EEG). In this study, we present a LASSO-based optimization model using the multiscale entropy (MSE) from EEG signals to capture and understand the spatio-temporal patterns of altered complexity of EEG signals about AD pathology with respect to varying severity level, compared to normal controls.

3 - Time Series Analysis using Augmented Simplex Projection and Simulated Annealing

Ming-Che Hu, National Taiwan University, No 1, Sec 4, Roosevelt Rd., Bioenvironmental Systems Engineering Building, Taipei, 10617, Taiwan, mchu@ntu.edu.tw, Yuan-Hung Kuan, Yi-Hsuan Shih, Shien-Tsung chen

This research aims to perform nonlinear time series analysis of hydrological data forecast using augmented simplex projection and simulated annealing. The existing simplex projection for spatial-temporal and multivariate analysis are still limited. Therefore, the study newly develops the augmented simplex projection and simulated annealing on multivariate lagged coordinates. The proposed methods are applied to analyze hydrological data forecast. The augmented spatial-temporal time series analysis presents an innovative application of hydrological forecast. The approach provides forecast information and for decision-making of water resources systems.

4 - A Deep Learning Approach to Bank Direct Marketing

Che Lin, National Tsing Hua University, Department of Electrical Engineering, Hsinchu, 30013, Taiwan, che.lin@gmail.com, Te-Cheng Hsu, Jia-Siang Chen, Wei-Zhu Chen, Yu-Hsuan Chien, Sz Wei Wu, Mahsa Ashouri, Galit Shmueli

We utilized powerful deep learning algorithms combined with oversampling and feature extraction techniques, applied to behavioral financial data, for direct marketing. This paper describes an implementation of prediction models combined with practical business and analytic goals. Real-world data used in model training and testing were collected from a Portuguese bank marketing campaign. Our model achieved a lift index of 91.76%, which is comparable to the random forest (92.03%) and better than naive Bayes (80.89%) and logistic regression (89.72%). We find that increasing the amount of training data available improves performance of the deep learning algorithm. Therefore, we believe that our model will potentially outperform the random forest with sufficiently large samples. With this close integration of business analytics and deep learning, our model can be thought of as a prototype for direct marketing and can be finally implemented in FHC systems to deal with large amounts of data.

■ TC04

101D, 1st Floor

Special Session: Military Operations Research: Past, Present, Future

Invited: Military, Defense, and International Security

Invited Session

Chair: Greg H. Parlier, North Carolina State University, 255 Avian Lane, Madison, AL, 35758, United States, gparlier@knology.net

1 - Military Operations Research: Past, Present, Future

Greg H. Parlier, Colonel USA retired, Past President, INFORMS MAS, 255 Avian Lane, Madison, AL, 35758, United States, gparlier@knology.net

Emerging conditions warrant a comprehensive evaluation of the current state of Military Operations Research (MOR). At a time when OR appears to be at a crossroads, the trajectory of the profession should be assessed. This paper offers a framework for such a review and addresses past, present, and future practice. Enduring principles are derived and applied to recent experience. Opportunities to apply strategic analytics to present challenges are described. Future directions are suggested to guide transformational endeavors during a period of disruptive change.

■ TC05

102, 1st Floor

Marketing

Contributed Session

Chair: Aijing Xing, Tohoku University, Kawauchi, Aoba-ku, Sendai, Japan, Graduate School of, Sendai, 980-0853, Japan, sdxingaijing@sina.com

1 - The Impact of Diverse Social Media on TV Viewership: A Empirical Study of Data Fusion

Ling-Jing Kao, Associate Professor, National Taipei University of Technology, No.1, Sec. 3, Zhongxiao E. Rd., Taipei, 10608, Taiwan, lingjingkao@mail.ntut.edu.tw, Chih-Chou Chiu, Yu-Fan Lin, Po-Wen Hsiao

Several challenges must be overcome to study consumer behavior in the new media era. First, incomplete data is common because users only reveal limited personal information. Second, due to the lack of personal information, typical data fusion technique built upon common variables in multiple samples is not applicable. In this study, a hierarchical Bayesian model is proposed to address these issues. A TV viewership of individual household provided by CCTE, data collected from Facebook fan page and Youtube channel was applied to illustrate the proposed solution. The empirical result shows that program preview on social media does influence consumer's willingness to watch program on television.

2 - A Zero-inflated Inverse Gaussian Model for Customer Lifetime Value Modelling

Mee Chi So, Associate Professor, University of Southampton, Southampton Management School, Southampton, SO17 1BJ, United Kingdom, m.so@soton.ac.uk, Christine S.M. Currie, Christopher Bayliss

Customer lifetime value (CLV) is an important metric in customer relationship management and has been used successfully in markets in which customers have frequent transactions. We develop a new probabilistic model for estimating the CLV of customers and we demonstrate our method using real data from a vehicle ferry operator. The zero-adjusted model we introduce here (ZAIG) is based on generalized additive models for location, scale and shape with the probability of future inactivity being modelled explicitly. ZAIG is found to out-perform ordinary least squares regression and provide an effective classification of customers, which is essential for marketing activity.

3 - Values Driving Consumer Preferences in Emerging Markets

Nancy Wong, Professor, University of Wisconsin-Madison, 1300 Linden Drive, 4216, Madison, WI, 53706, United States, nywong@wisc.edu, Rajeev Batra, S. Arunachalam, Michael S. Lee

Preferences in emerging markets are changing, due to growth in disposable income, and changes in geo-demographic, socio-cultural factors. Yet we lack insights on what drive these changes. Using survey data from seven Southeast Asian countries, we examined how economic development impacts the effects of religious and traditional values, materialistic consumer values, and collectivistic values on brand preferences and importance of brand attributes. We found that these relationships change or remain invariant against the backdrop of rising income, education, and internet use, as well as the growth of youth demand.

4 - Immediate Sale or Stock-up: Value of Rent-to-Own Contracts

Chen Hu, Tsinghua University, Beijing, China, huc17@mails.tsinghua.edu.cn, Yongbo Xiao, Jianbin Li

Rent-to-own is an innovative selling strategy, which gives customers an option to purchase after the rental phase. Compared to traditional selling strategy, stock-up and immediate sale, rent-to-own helps the seller to reduce inventory costs of delay selling as well as to lock his potential customers. In this paper, we aim to discuss the seller's optimal selling strategy among rent-to-own and immediate sale, stock-up, involving all situations considering the uncertainty of future market price and consumers' valuation along with the existence of speculators.

5 - Interpretable Perceived Topics in Online Customer Reviews for Product Management

Aijing Xing, Dr, Tohoku University, Kawauchi, Aoba-ku, Sendai, Japan, Tohoku University, Graduate School of Economics and Management, Sendai, 980-8576, Japan, sdxingaijing@sina.com, Nobuhiko Terui

Online customer reviews contain useful and important information, because customers tend to praise or criticize certain features or attributes of goods in their reviews. We propose a model that extracts the perceived topics from textual reviews under the restrictions of their interpretability and predictability of product satisfaction as current product evaluation and expectation as future possible demand by supervised learning. The empirical analysis on food reviews shows that our proposed model performs better than alternative models, and it suggests product managers the necessity of improving some specific attributes to fulfill customer needs.

■ TC06

103, 1st Floor

Tutorial: Data Integrated Stochastics: Models and Methods

Tutorial Session

1 - Data Integrated Stochastics: Models and Methods

George Shanthikumar, Purdue University, West Lafayette, IN, United States, shanthikumar@purdue.edu

This tutorial will review the current data integrated approaches for predictive and prescriptive analysis of stochastic systems. In particular we will review: 1) approaches such as Multi-Armed Bandit, Regularization in Sample Average Approximation and Data Driven Robust Optimization for generating prescriptive solutions to stochastic systems, and 2) some of the Machine Learning approaches used for predictive analysis of stochastic systems. We will then provide a framework for data integrated methodology for predictive and prescriptive analytics for stochastic systems. Specific attention will be paid to overcoming structural and statistical errors. This is achieved through Operational Statistics and Objective Operational Learning which are built on the basis of data integration and cross validation. We will illustrate how, 1) regularization in sample approximation approaches and data driven robust optimization with cross validation relates to Operational Statistics, and 2) multi-armed bandit and machine learning approaches compares to Objectives Operational Learning. Applications in pricing and revenue management, inventory control, queueing systems performance evaluation and staffing in service systems will be demonstrated.

■ TC07

105, 1st Floor

Smart City Applications

Contributed Session

Chair: Huayi Chen, Nanjing University of Aeronautics and Astronautics, 29 Yudao Street, Nanjing, 210016, China, huayichen@nuaa.edu.cn

1 - City Identity and Life Satisfaction Perception using Geo-tagged Data

Fernanda de Oliveira Capela, PhD Student in Engineering Management, Stevens Institute of Technology, 1210 Hudson Street, Apt 514, Hoboken, NJ, 07030, United States, fcapela@stevens.edu

The identity of a city is defined not only by its infrastructure, but also by the perception of its community. This work proposes to describe the identity of global cities based on the perception of its people by using geo-tagged data from public platforms. We develop a method to define which attributes of the data reflect aspects of the traditional quality of life indicators, implement it to identify life satisfaction based on data posted online, and represent it in a spatial distribution for each city.

2 - A Market Driven Approach to Building Smart Communities

ShiKui Wu, Lakehead University, 955 Oliver Road, RB 1041, Thunder Bay, ON, P7B 5E1, Canada, shikui.wu@lakeheadu.ca

Communities have been equipped with information technologies to offer products and services more efficiently to community members, including utilities, education, healthcare and transportation. The mutual benefits among community members are still limited and often unsustainable. The present work aims to design e-markets that facilitate and govern resource allocation and sharing among members and to build smart and more sustainable communities.

3 - Air Pollution Forecast using an Autoregressive Hidden Markov Model

Ku Chih-Hsuan, National Tsing Hua University, Taichung Taiwan, Hsinchu, Taiwan, kubalabalabala@gmail.com, Liao Chung-Shou

In recent years, the air quality issue has become a significant problem to everybody. In order to keep monitoring the air quality, this study proposes an autoregressive hidden Markov model for forecasting the concentration levels of PM_{2.5}. The key insight is that the PM_{2.5} value and the correlated factors with PM_{2.5} are all time-series data, which leads to a good combination of the autoregressive model and HMM. The empirical studies on Taichung area, Taiwan show that using AR-HMM in predicting the concentration levels of PM_{2.5} has a better prediction performance than using a conventional HMM.

4 - Determination of Optimal Cutting Parameters in Multipass Turning with Specific Energy Model Consideration

Soon Tat Ong, Student, National Taiwan University, Room 566A, No. 1, Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan, r05546035@ntu.edu.tw

The optimization of energy cost in machining industry is easily overlooked due to low cost rate comparatively. Along with the ever-increasing energy prices, especially in Taiwan, the energy cost should be included in optimization of machining cost. The numerical examples show that the energy cost plays a significant role that affects optimal values of cutting parameters. Besides, a spring up energy consumption model is been implemented to replace the ordinary cutting power consumption model, which separated the power that affects by machining conditions and general operation.

5 - Modeling Systematic Technology Adoption with Heterogeneous Agents and One Representative

Huayi Chen, Dr., Nanjing University of Aeronautics and Astronautics, 29 Yudao Street, Nanjing, 210016, China, huayichen@nuaa.edu.cn

Traditional systematic technology adoption models commonly assume the existence of only one global decision-maker. This paper builds a systematic technology adoption model with heterogeneous interacting agents. This paper also builds a well-calibrated representative-model to imitate heterogeneous agents' aggregate behavior. With the comparison of the reactions in the representative-model and the heterogeneous-agent model under different policy interventions, this paper explores whether a well-calibrated representative can represent the heterogeneous agents in terms of modelling systematic technology adoption.

■ TC08

201A, 2nd Floor

Artificial Intelligence

Contributed Session

Chair: Shokoufeh Mirzaei, California State Polytechnic University, Pomona, 24020 Gold Rush Dr, Diamond Bar, CA, 91765, United States, smirzaei@cpp.edu

1 - Data Enhancement by Probabilistic Causal Inference for Machine Learning on Weak Data

Yifang Liu, Uber Technologies, San Francisco, CA, United States, ifnliu@gmail.com

Machine learning, especially in the context of human economics behaviors, often needs to be performed on weak data, which involves missing values, data inconsistency, mislabeled examples, or highly-imbalanced examples. This work proposes a data enhancement technique by probabilistic causal inference for machine learning on weak data.

2 - Collaborative Dual Evolving Network for Graph-free Label Propagation

Younghoon Kim, Korea University, Anam Dong 5 ga, Creative Hall, Seoul, 136-713, Korea, Republic of, younghoon.kim11@gmail.com, Seung Bum Kim

Label propagation is a graph-based semi-supervised learning method which propagates the information of labeled observations to unlabeled observations. Although the label propagation-based methods have shown promising performance, because of the curse of dimensionality issue, the methods have some limitations in learning with large-scale unstructured data like image. To address the problem, we propose a label propagation method using dual deep convolutional neural networks. The networks iteratively learn propagating path and label candidate observations.

3 - Convolutional Autoencoder-based Multichannel Signal Monitoring Method

Mingu Kwak, Korea University, Seoul, Korea, Republic of, rhkralrs@gmail.com

Unexpected breakdown of the equipment significantly reduces productivity. The development of monitoring system that can detect abnormal conditions early is essential. In this study, we propose the multivariate monitoring method based on a convolutional autoencoder algorithm that can effectively reconstruct sensor data. The proposed monitoring method identifies the equipment status and detects critical variables that cause the alarms. We evaluate the performance of the proposed method with actual sensor data collected from construction equipment.

4 - Semi-supervised Learning with End-to-End Graph Convolution

Hyungu Kahng, Korea University, 145, Anam-ro, Seongbuk-gu, Seoul, 02841, Korea, Republic of, drlego9@gmail.com

Although graph-based methods become a powerful tool for semi-supervised learning, we often overlook the fact that its predictive performance heavily depends on the quality of the graph representation. In this study, we propose an end-to-end differentiable graph convolutional network that addresses the

learning problem of graph representations of semi-supervised learning. Experiments on benchmark data demonstrate that the proposed method can appropriately reflect the manifold structure of data and thus, yield better performance than the alternatives.

5 - Feature Selection for Quality Assessment of Protein Structures using Support Vector Machine

Shokoufeh Mirzaei, Assistant Professor, California State Polytechnic University, Pomona, 3801 W Temple Ave, Pomona, CA, 91768, United States, smirzaei@cpp.edu, Itzhel Dimas, Silvia Crivelli

The computational protein structure prediction is used by biologists to lead drug design and discovery efforts. The computational protein structure prediction is a multi-step process in which the quality assessment of structures is the final step. Although in recent years there have been improvements in protein structure prediction, many of the good quality structures are overlooked due to the shortcoming of quality assessment methods. In this paper, Support Vector Machine and a backward feature elimination method is used to develop an accurate quality assessment method. The results show that the model proposed in this paper outperforms literature in loss and error minimization.

■ TC09

201B, 2nd Floor

Supply Chain Management I

Contributed Session

Chair: Adel Hatamimarbini, De Montfort University, Leicester, LE1 9BH, United Kingdom, adel.hatamimarbini@dmu.ac.uk

1 - Dual Channel Game Between E-tailer and Express Provider

Shengnan Qu, Tongji University, Jiading Campus of Tongji University, Shanghai, China, shnqu@tongji.edu.cn, Yihong Hu

We consider a stackelberg game between an e-tailer and an express provider when the e-tailer operates dual sales channel or the express provider introduces online sales channel. By game-theoretic analysis, we demonstrate that the e-tailer and the express provider can adopt strategy separately or simultaneously when certain condition is satisfied.

2 - Optimal Decisions for a Supply Chain with Information in and out of a Smart Factory

Meimei Zheng, Shanghai Jiao Tong University, 800 Dongchuan Road, Minhang District, Shanghai, 200240, China, meimeizheng2009@gmail.com, Kan Wu

Due to the applications of Internet of Things and big data, more information in and out of a smart factory can be collected and shared between manufacturers and retailers through the vertical and horizontal integration. In this study, we consider two types of information: the capacity information for the later rush production through the vertical integration and the demand information shared between the retailer and manufacturer through the horizontal integration. We investigate the optimal decisions in a supply chain with and without capacity or demand information and propose a coordination mechanism for the supply chain with both vertical and horizontal integration.

3 - On the Coordination of a Vendor and a Buyer under Inventory Dependent Demand

Yat-wah Wan, National Dong Hwa University, Graduate Inst of Logistics Management, 1 Sec 2 Da Hsueh Road, Shou-Feng, Hualien, Taiwan, ywan@mail.ndhu.edu.tw, Juhwen Hwang

This paper analyzes the coordination of a two-tier supply chain such that the customer demand increases with the amount of inventory available. There are non-zero fixed costs leading to non-concave maximization objective functions. The integrated chain, the vendor-leading Stackelberg game, and the variants of the Stackelberg game with profit sharing and holding cost sharing mechanisms are analyzed. In each case, the optimal quantities and their sensitivities, the optimal ordering quantities, the optimal wholesale prices, etc., are derived.

4 - The Supplier Selection under Joint Innovation Based on Early Quality Characteristics of Testing Samples

Chieh Lee, Assistant Professor, Yuan Ze University, 135 Yuan-Tung Road, Taoyuan, 32003, Taiwan, chiehlee@saturn.yzu.edu.tw, Taichih Huang

The intercompany cooperation, firms within same supply chain can focus on their core functions and supply chain can stay flexible and competitive. In this study, we focus on how to select suitable suppliers under joint innovate production with the quality characteristics of their early testing samples. We perform the LCA analysis and found that the success of the joint innovation project does not depends on the supplier's size, size of research and development team, and other research resources. We developed an evaluating system that can easily distinguish the best supplier based on the quality characteristics of their testing samples.

5 - Benchmarking in Supply Chain Management using DEA

Adel Hatamimarbini, De Montfort University, Leicester,
United Kingdom, adel.hatamimarbini@dmu.ac.uk
Seyed Mojtaba Sajadi

This paper explores a general model for supply chain performance assessment where the decomposition of productive efficiency is introduced in the entire supply chain vs chain level effects. Moreover, we provide a synopsis and constructive guidance on the type of models that could be appropriate for supply chain management. We also study a real application of performance assessment to a multi-national supply chain in the paper and pulp sector.

TC10

201C, 2nd Floor

Data Analytics for Engineering System Improvement

Invited: Operations Analytics and Optimization for Manufacturing,
Logistics and Energy Systems
Invited Session

Chair: Xi Zhang, Peking University, xi.zhang@pku.edu.cn

Co-Chair: Jianguo Wu, Peking University, 298 Chengfu Road, Haidian,
Room 512, Founder Building, Beijing, 100871, China,
j.wu@pku.edu.cn

1 - Spatiotemporal Transfer Learning for 3D Dynamic Field Modeling

Xi Zhang, Peking University, 298 Chengfu Road, Founder Building
512, Beijing, China, xi.zhang@pku.edu.cn, Di Wang

In this study, we consider the ubiquitous missing data problem in current sensor networks and attempt to take complete advantage of existing sensor data for thermal field estimation. To achieve accurate thermal field estimation using limited sensor observations, we develop a mixed-effect model framework in which the dynamic field is decomposed into a mean profile and a local variability. In particular, we establish a field transfer learning approach to identify spatiotemporal correlation by integrating a multitask learning (MTL) framework into an autoregressive (AR) model using neighboring data sources from homogeneous fields. Our proposed approach is verified through an actual case study of thermal field estimation during grain storage.

2 - Adaptive Minimal Confidence Region Rule for Multivariate Initial Bias Truncation in Discrete-event Simulations

Jianguo Wu, Peking University, 298 Chengfu Road, Founder
Building Room 512, Beijing, 100871, China, j.wu@pku.edu.cn

Initial bias truncation is critically important for system performance assessment and warm-up length estimation in discrete-event simulations. Most of the existing methods are for univariate signals, while multivariate truncation has been rarely studied. To fill this gap, this paper proposes an efficient method, called adaptive minimal confidence region rule (AMCR) for multivariate initial bias truncation. It determines the truncation point by minimizing the modified confidence volume with a tuning parameter for the mean estimate. An elbow method is developed for adaptive selection of the tuning parameter. Theoretical properties of the AMCR rule have been derived for justification and practical guidance. The effectiveness and superiority of the AMCR rule over other existing approaches have been demonstrated through thorough numerical studies and real application.

3 - Nonlinear Autoregressive Neural Network Based Prognostics for Systems under Dynamic Operating Conditions

Xiaoning Jin, Assistant Professor, Northeastern University, 334
Snell Engineering (MIE), 360 Huntington Ave., Boston, MA,
02115, United States, xi.jin@northeastern.edu, Anqi He

This study focuses on a new prognostic modeling method based on nonlinear autoregressive neural network (NARNET) for computing remaining useful life (RUL) of deteriorating systems under dynamic operating conditions. Our approach consists of two processes: (1) an offline training process is developed to model the degradation behavior and determine the failure zones based on the dataset of hundreds of identical units with run-to-failure sensor measurements; (2) an online prediction and testing process, where we predict the RUL of a test unit. We particularly investigate how the degradation rate indicated by sensor measurements is affected by the unit-specific operation conditions. The operating conditions are forecasted by a NARNET model based on the unit's operating history. We show that the prognostic model that integrates the operation condition prediction provides more accurate and efficient RUL prediction. The aircraft turbine engine degradation dataset is utilized to illustrate the model and test the model performance model.

4 - Improvements of Longstaff-schwartz Algorithm Inspired from Machine Learning

Chenru Liu, Student, Peking University HSBC Business School,
University Town, Nanshan, Shenzhen, 518055, China,
1501213463@sz.pku.edu.cn, Jaehyuk Choi

The Longstaff-Schwartz (LS) algorithm is an industry standard practice for pricing American or Bermudan options under Monte-Carlo simulation. Inspired from machine learning methods, this paper aims to improve the LS algorithm. We use leave-one-out-cross-validation (LOOCV) and k-fold cross-validation to efficiently remove in-sample bias at no extra cost of generating a separate simulation set. We further show that exercise boundary becomes more stable with bagging and random forest, where the exercise decision is either from majority vote or probabilistic out of multiple decisions.

TC11

201D, 2nd Floor

Finance - Theory & Empirics

Contributed Session

Chair: Xia Xu, Emlyon Business School, 23 Avenue Guy de Collongue,
Écully, 69130, France, xu@em-lyon.com

1 - Exploring Profit Satisficing Approval Thresholds for Lending to the Underbanked

Michael Hernke, Lecturer, Wisconsin School of Business,
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This article describes a spreadsheet modeling approach to loan approval decisions supported by logistic regression models. The analysis supports the goals of lenders that seek to help underserved groups access capital with reasonable terms. Given scoring model results for loan applications, the approach utilizes a spreadsheet simulation model and data table of the profit implications of a full range of loan approval cutoffs to explore how lenient a cutoff policy could be while still maintaining some degree of profitability. The method supports an emphasis on prudently increasing the number of loans made and costs avoided by their customers, who if rejected can access credit only at much higher cost.

2 - On the Relationship Between Consumer Sentiment and Stock Returns

Zhenhu Jin, Professor of Finance, Valparaiso University,
1909 Chapel Dr., Valparaiso, IN, 46383, United States,
zhenhu.jin@valpo.edu

This paper examines the relationship between the University of Michigan consumer sentiment index and the S&P 500 index. A bivariate regression model and Granger Causality are used to gain a better understanding of this relationship. We find that a significant positive relationship between the University of Michigan Consumer Index and the S&P 500 Index.

3 - Is it Efficient to Buy the Index? A Worldwide Tour with Stochastic Dominance

Xia Xu, Emlyon Business School, 23 Avenue Guy de Collongue,
Écully, 69130, France, xu@em-lyon.com

The paper extends the model of Kuosmanen(2004) and develops an operational approach to test for stochastic dominance efficiency of a given portfolio at orders higher than two. Applying this approach to equity indices representing seventeen developed and developing markets across the globe, we find that all of these indices are inefficient, nearly always at order three and very often at order two, implying that all of the prudent and most of the risk averse investors would be better off not investing in these market indices. The indices are often dominated by individual industry sub-indices. A simple trading rule based on past dominance information improves the average out-of-sample return profile.

■ TC12

201E, 2nd Floor

New Trends in Maritime Transportation Operations Management

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Hans Wang, The Hong Kong Polytechnic University, Hong Kong, hans.wang@polyu.edu.hk

1 - Stochastic Bulk Ship Scheduling in Industrial Shipping

Lingxiao Wu, The Hong Kong Polytechnic University, Hong Kong, lingxiaowu513@gmail.com, Shuaian Wang

This paper studies a ship scheduling problem for an industrial corporation that controls a fleet of bulk ships under stochastic environments. The considered problem is an integration of three interconnected sub-problems from different planning levels: the strategic fleet sizing and mix problem, the tactical voyage planning problem, and the operational stochastic backhaul cargo canvassing problem. To obtain the optimal solution for the problem, this paper provides a two-step algorithmic scheme. In the first step, the stochastic backhaul cargo canvassing problem is solved by a dynamic programming (DP) algorithm, leading to optimal canvassing strategies for all feasible voyages of all ships. In the second step, a mixed-integer programming (MIP) model that jointly solves the fleet sizing and mix problem and the voyage planning problem is formulated using the results from the first step. To efficiently solve the proposed MIP model, this paper develops a tailored Benders decomposition method.

2 - Reducing Air Emissions from Ships: Policy Development

Shuaian Wang, The Hong Kong Polytechnic University, Hung Hom, Hong Kong, wangshuaian@gmail.com

Air emissions from ships have attracted less attention than other modes of transport such as truck and airline. This seminar will provide a comprehensive review of regulations related to shipping emissions, including sulphur oxides (SOx), nitrogen oxides (NOx), and carbon dioxide (CO₂). Possible research opportunities for operations management/operations research scholars will also be discussed.

3 - Port Operations Planning: Latest Development

Lu Zhen, Shanghai University, School of Management, 99 Shang Da Road, Shanghai, 200444, China, lzhen@shu.edu.cn

Due to the offshoring of manufacturing activities in Asia (particularly in China), the amount of container transportation has been growing by at about three times the world's GDP growth during the past three decades. It is an urgent task to increase the efficiency of port operations so as to maximize the throughput of ports. Because port operators are usually paid by a handling charge per container, the indicator of throughput is essential for the port operators' revenue. This presentation introduces some decision problems in container port operations management. Some OR (operations research) based decision models and algorithms are proposed for increasing the efficiency of the quay side as well as the yard side operations in ports. Some trends for the future researches in this area are also discussed in this presentation.

4 - An Evaluative Framework for Future High Bay Container Terminals

Nima Zaerpour, Assistant Professor, California State University San Marcos, 333 S Twin Oaks Valley Rd., San Marcos, CA, 92096-0001, United States, nzaerpour@csusm.edu

Container terminals play a major role in the growth of international trade. They need to accommodate the increasing number of containers while their space is limited, particularly close to major cities. One approach, often used in practice, is horizontal expansion through expensive land reclamation projects. In contrast, vertical expansion uses the available land more efficiently by storing containers in high-bay warehouses. In this paper, we study a next generation container terminal consisting of container storage towers. We show that compared to a traditional container block, the container tower can increase the annual throughput, while saving on the required footprint.

■ TC13

201F, 2nd Floor

Operations and Economics Interface VII

Invited: Operations and Economics Interface

Invited Session

Chair: Chen-Nan Liao, National Taiwan University, cnliao@ntu.edu.tw

1 - Feature Engineering and Machine Learning for Lumpy Demand Modeling

Hao-Chun Chuang, Associate Professor, National Chengchi University, 64, Section 2, ZhiNan Road, Wenshan District, Taipei City, Taiwan, chuang@nccu.edu.tw

Working with a top five electronics distributor in the world, we develop forecast and replenishment techniques under lumpy/erratic demand. Grounded on feature engineering and machine learning, our techniques substantially outperform sophisticated univariate time series models.

2 - Improving Care with Learning through Patients Experiences on Facilitated Networks for Cancer

Jiun-Yu Yu, National Taiwan University, No 85, Sec 4, Roosevelt Road, Department of Business Administration, Taipei, Taiwan, jyyu@ntu.edu.tw

Cancer patients are experiencing a number of pain points in their current journey through the cancer care continuum. In order to understand thoroughly the causes of the pain points, multiple research methods are applied. In-depth interviews are conducted with cancer patients and medical professionals and are analyzed using Grounded Theory. In addition, text mining technique, Latent Dirichlet allocation (LDA) is employed to investigate the post and comments on a Facebook Group particularly for cancer patients. The integration of qualitative and quantitative analysis generates unique insights about the underlying causal loop structure that creates those pain points. To fundamentally solve the problem, the theory of basic psychological needs is incorporated. The perspective of healthcare facilitated networks is proposed, and the design guidelines for this model is developed.

3 - The Effect of Surprise Gift on Customer Retention: A Field Experiment

Peng-Chun Chen, Taiwan, d03724004@ntu.edu.tw

To investigate the effectiveness of giving customers "surprise" gift in raising repeat customer rate, we conduct a field experiment in an online platform. We manipulate varying degree of surprise to address how customers receiving gifts with different emotional intensity would influence their subsequent purchase behavior such as revisit the platform, open promotional newsletter, repurchase so on and so forth.

■ TC14

202A, 2nd Floor

Urban Operations Research

Sponsored: Location Analysis

Sponsored Session

Chair: Hidetoshi Miura, Nanzan University, Japan, hmiura@nanzan-u.ac.jp

1 - Sustainable Land Use Model Focused on the Lifetime of Both House and Human

Hiroko Watanabe, The University of Tokyo, Ce-408, 4-6-1, Komaba, Meguro, Tokyo, 153-8505, Japan, hiroko@iis.u-tokyo.ac.jp, Yudai Honma

In this research, a new sustainable land use model, which focuses on the lifetime of houses and human, is proposed. Recently, future visions of sustainable society have frequently been discussed. System collaboration between architecture and urban planning should be required to achieve the seamless design of our societies. From this viewpoint, we consider a land use model regarding not only the lifetime of human but also houses. In Japan, it is pointed out that a short lifetime of houses is one of the serious problems for sustainable urban planning. Their lifetimes, which are less than 50 years, might trigger unexpected sympathetic vibration between human lifetimes. It would be an undesired factor for declining society. We try to illustrate such mathematical relations based on Z-transform.

2 - An Evaluation Method of Regional Public Building Stock Based on the Influence of Removal of Buildings on the Public Interest

Tohru Yoshikawa, Tokyo Metropolitan University, 1-1 Minami-Osawa, Hachioji, 192-0397, Japan, yoshikawa-tohru@tmu.ac.jp

To develop a method to evaluate the regional public building stock, this study proposes a method to measure the influence of removing buildings. The influence is defined as the decrease in the public interest by the removal. The public interest is given by the utility to residents when a certain number of facilities are located using the existing buildings. The study compares two objective functions as the utility, consumer surplus and expected number of visitors. The difference in the selection of the buildings that should be removed between the two objective functions is analyzed.

3 - Route Crossing and Merging in a Grid-type Network Model on Various Routing Systems

Hidetoshi Miura, Nanzan University, Nagoya, Japan, hmiura@nanzan-u.ac.jp

Given a road network laid out in a square grid pattern and a set of origin-destination pairs, various routes of the same length may be considered. The objective of this research is to find the flow distribution to minimize the number of path crossing and merging. We construct a theoretical model to treat spatial distributions of traffic flow crossing and merging in a road network given by an $n \times n$ square grid with uniform demand for each node pair, and show the dependency of the result on routing strategies.

4 - Facility Location Model for Truck Platooning

Daisuke Watanabe, Tokyo University of Marine Science and Technology, 2-1-6 Etchujima, Koto-ku, Tokyo, 135-8533, Japan, daisuke@kaiyodai.ac.jp

Truck platooning is major solution for improving the efficiency in truck transportation. There is a need for locating the facility for the formation of truck platooning. In this presentation, we will present the optimal location model for truck platooning.

TC15

202B, 2nd Floor

Service Science II

Contributed Session

Chair: Jingrong Zhu, Beijing Institute of Technology, Beijing, China, 13164200416@163.com

1 - A Heuristic Algorithm for the Tourist Trip Design Problem with Hotel Selection

Weimin Zheng, Assistant Professor, School of Management, Xiamen University, No. 422, Siming South Road, Xiamen, 361005, China, zhengweimin@xmu.edu.cn

Urban tourism is one of the most popular forms of tourism, but has received a disproportionately small amount of attention from scholars of either tourism or of the city. This study focuses on the design of personalized multi-day trips for tourists, which plays a fundamental role in improving tourists' travel experiences, and improving the tourism competitiveness of cities. This problem can be modeled as a tourist trip design problem (TDP) with hotel selection (TTDPHS), an extension of the orienteering problem (OP). A heuristic algorithm is designed to solve this problem, and a case study at Xiamen was conducted to evaluate the performance of this algorithm.

2 - Strategic Decision of the Platform's Logistics Service Openness with Spillover Effect

Yihong Hu, Tongji University, Room 1406, No 1 Zhangwu Road, School of Economics and Management, Shanghai, 200092, China, yhh@tongji.edu.cn, Shengnan Qu

We studies the strategic decision of the platform's logistics service openness to the third party sellers under both positive and negative spillovers from online sales to the traditional sale. We show that a Pareto improvement is possible for the platform and the sellers when product competition is intense and delivery service cost coefficient is moderate. The logistics service openness strength the platform's market position and ensures optimal pricing and demand is not influenced by the product competition level. Our analysis offer insights into the incentive that drive the platform to open its logistics service.

3 - Robust Design of Service Systems with Delay Announcement and Interactive Automated Service

Miao Yu, Shenyang Jianzhu University, No.9, Hunnan East Road, Hunnan New District, Shenyang City, Liaoning, China, Shenyang, China, yumiao1213@126.com

More and more companies have started building customer contact center over the Internet rather phone calls. Besides lining up for agent service, customers have the option of interactive self-help response and getting faster service. A distinctive feature of the service center is that customers can get service through two kinds of channels. Managers are typically inclined to drive customers to use

automated service in order to reduce manpower costs. In such a system, delay announcements play an important role in guiding customer behavior and have an impact on system performance.

4 - The Difference of Choice and Preference for Health Care Provider between Outpatient and Inpatient in China

Jingrong Zhu, Beijing Institute of Technology, South Zhongguancun Street, Beijing, China, 13164200416@163.com

To predicting future traffic of hospitals, we use real data from Guiyang, China, which lists the records of more than 200000 patients to fourteen different hospitals to describe how patients choose their hospitals. Both outpatient and inpatient preference are analyzed for this mixed urban/rural area. The mixed logit models is used to fit the data. The results show that our-and-in-patients have different preference for hospital with different characters. There is preference heterogeneity for all the characters of hospitals. The severity of the disease significantly affects patients choice.

TC16

203A, 2nd Floor

Combinatorial Optimization

Contributed Session

Chair: Juntaek Hong, Department of Industrial and Management Engineering, Postech, 77, Cheongam-ro, Nam-gu, Pohang-si, 37673, Korea, Republic of, junetech0@gmail.com

1 - Mathematical Programming for Data Classification

Omar Souissi, Associate Professor, Institut National des Postes et Télécommunications, Rabat, Morocco, souissi@inpt.ac.ma

Data classification problems have been intensively studied by several groups of researchers including computer scientists, statisticians... Within the context of widespread use of databases and the explosive growth in their sizes "Big Data", new challenges are introduced in order to permit to several organizations to take benefits and efficiently utilizing their data. The main objective of this paper is to review published works which propose mathematical programming approaches in order to solve data classification problems with Support Vector Machine. Thus, we aim to highlight a field understudied by the optimization research community which can make significant contributions.

2 - The Solution Attractor Theory of Local Search System: The Traveling Salesman Problem Case

Weiqi Li, Associate Professor, University of Michigan-Flint, 303 E Kearsley, Flint, MI, 48502-1950, United States, weli@umflint.edu

A local search algorithm can be treated as a discrete dynamical system, and therefore its search behavior can be studied from the perspective of dynamical systems. The attractor theory in dynamical systems provides the necessary and sufficient theoretical foundation to study the search behavior of local search systems. The solution-attractor theory of local search system is introduced. In a local search system, search trajectories converge into a solution attractor in the solution space. This solution-attractor theory not only provides a model to describe the search behavior of a local search system, but also offers an important method to solve the TSP efficiently with optimality guarantee.

3 - Approximation Algorithms for the Covering-type Linear Programming with Violations

Yotaro Takazawa, Tokyo Institute of Technology, Tokyo, Japan, takazawa.y.ab@m.titech.ac.jp

We study the covering-type k -violation linear program where at most k of the constraints can be violated. This problem is formulated as a mixed integer program and known to be strongly NP-hard. In this paper, we present a simple $(k+1)$ -approximation algorithm using a natural LP relaxation. We also show that the integrality gap of the LP relaxation is $k+1$. This implies we can not get better approximation algorithms when we use the LP-relaxation as a lower bound of the optimal value.

4 - Nodes Constrained Spanning Tree Problems

Xiaojuan Jiang, Phd Candidate, Postech, 77 Cheongam-Ro, Nam-Gu, Pohang, 37673, Korea, Republic of, xjiang@postech.ac.kr, Kangbok Lee

Two types of Minimum Nodes-Constrained Spanning Tree problem, named as the Minimum Internal Spanning Tree problem (MIST) and the Minimum Terminal Spanning Tree problem (MTST), are considered. Given a metric graph $G=(V, E)$ with a cost function $w: E \rightarrow \mathbb{R}^+$ and one subset R of V , MIST asks for a minimum weighted spanning tree such that any vertex in R is not a leaf. After NP-hardness being proved, an exact algorithm is first presented with computational time $O(n^{2k+1} \log n)$, where $|V|=n$ and $|R|=k < n-1$. Also, a polynomial time 2-approximation algorithm is designed with an instance to show the tightness. For MTST, every vertex in R must be a leaf. A polynomial time algorithm is proposed with optimality.

5 - Path Partitioning Problem with Terminal Node Constraints

Juntaek Hong, Graduate Student, Postech, 77, Cheongam-ro, Postech Eng. bldg 4-410, Nam-gu, Pohang-si, 37673, Korea, Republic of, hongjt3000@postech.ac.kr, Kangbok Lee

In steelmaking process, a unit of molten steel is called 'charge', and a series of charges are continuously casted and this unit is called 'cast'. Some pairs of charges cannot be processed consecutively. Some charges cannot be positioned at the first or the last in a cast. Our objective is to minimize the number of casts to include all charges, which is equivalent to path partitioning problem with terminal node constraints, which it is NP-hard. An MIP formulation for the problem is proposed. Some subtour elimination constraints are added as lazy constraints, and their results are presented.

■ TC17

203B, 2nd Floor

Future Shipping Solutions

Invited: Maritime Operations

Invited Session

Chair: Rommert Dekker, Erasmus University-Rotterdam, Rotterdam, 3000 DR, Netherlands, rdekker@ese.eur.nl

1 - A Sub-gradient Method for Optimizing Buffer Times in Liner Shipping Schedules

Rommert Dekker, Erasmus University-Rotterdam, Burg. Oudlaan 50, P.O. Box 1738, Rotterdam, 3000 DR, Netherlands, rdekker@ese.eur.nl, Willem Jaarsveld, Judith Mulder

Buffer times are entered into shipping schedules to increase punctuality. Optimizing them is difficult as in the operational phase ships may speed up in case of delays. In literature simplifying assumptions were made, like always switching to the maximal speed. MDP models were also proposed, but they lead to a MIP formulation. We present a sub-gradient approach to avoid a MIP formulation. Our main idea is to convert results from a discrete-time MDP to a continuous time formulation. It results in a fast algorithm. Finally we compare the methods for an existing ship schedule.

2 - Emerging Needs for Resilience Enhancement of Maritime Transportation in Large-scale Disasters

Kenji Watanabe, Nagoya Institute of Technology, Nagoya, Aichi, Japan, kewatanabe2@gmail.com

After several severe earthquakes and tsunami disasters in Japan, many vulnerabilities of our networked socioeconomic activities have been founded from many operational and logistical disruptions not only in damaged areas but also non-damaged areas. Those were caused by the increasing interdependencies in our society through widely spread supply chains and networked logistics. With environmental and CO2 reduction aspects, many enterprises have tried to shift their logistics by motor transportation to ones by train cargo and ships. However, each transportation style has different merits and demerits in normal and emergency situations. Based on the above circumstances, discussions on modal-mixture or inter-modal have been escalated from operational level to strategy level to establish operational resilience in BCM (Business Continuity Management). In this session, those key elements will be discussed through a case study on national resilience enhancement efforts of Japanese Government.

3 - Fuel Mixture Optimization Under the Emission Rules and the Immature LNG Bunker Market

Okan Duru, Nanyang Technological University, 50 Nanyang, N1-01C-95, Singapore, 638798, Singapore, duruokan@yahoo.com, Roy Tan, Prapisa Thepsithar

This paper investigates the development of the liquefied natural gas (LNG) as marine bunker fuel and the fuel mixture problem led by the lack of suppliers and facilities in various ports. Considering the emission requirements, bunker prices (both traditional and LNG) and trading routes, ship operators will face an optimization problem to achieve efficiency and cost reduction in such uncertainties. In this paper, an optimized fuel mixture model is proposed to be employed by ship operators to decide bunkering choice subject to relevant fuel mixture ensuring emission requirements and reducing the fuel cost.

4 - A Matheuristic Algorithm for Heavy Product Ship Routing Problem

JongHwa Lee, PhD Candidate, Postech, 77, Cheongam-ro, Nam-gu, Pohang, 37673, Korea, Republic of, jet226@postech.ac.kr

This research considers a practical heavy products ship routing problem with various characteristics such as time windows of delivery order, allowance of split delivery, allowance of loading port change after overland transportation, order cargo ready time, ship available time, order cargo-ship eligibility, ship-port eligibility, loading amount-ship eligibility, loading amount-port eligibility, limited number of port stops in a route, and multi objectives. A specialized mathematical programming model and a matheuristic algorithm are proposed and their effectiveness is demonstrated.

■ TC18

North Lounge, 3rd Floor

Healthcare Systems

Invited: Healthcare Systems and Applications

Invited Session

Chair: Susan F. Lu, Purdue University, Purdue University, West Lafayette, IN, 47907, United States, lu428@purdue.edu

1 - The Effects of Home Health Visit Length on Hospital Readmission

Hummy Song, The Wharton School, University of Pennsylvania, 3730 Walnut Street, 560 Jon M. Huntsman Hall, Philadelphia, PA, 19104, United States, hummy@wharton.upenn.edu, Elena Andreyeva, Guy David

This study uses a novel dataset on home health care visits to quantify the effects of the length of a post-acute home health visit on hospital readmissions for patients with conditions that are subject to readmission penalties under the Hospital Readmission Reduction Program. Using an instrumental variable approach, we find that an extra minute relative to the average length of a patient's home health visits reduces their readmission likelihood by about 8 percent.

2 - Do For-Profits Achieve Better Financial Performance than Nonprofits? Evidence from U.S. Nursing Homes

Susan F Lu, Purdue University, Krannert 441, West Lafayette, IN, 47907, United States, lu428@purdue.edu, Lauren Xiaoyuan Lu

In the last two decades, for-profit ownership has gained an increased presence in the U.S. healthcare sector. There has been a long debate about how the performance of for-profit healthcare organizations compare with nonprofit ones. Although extensive studies have compared quality performance across ownership forms, little has been done to investigate whether there exists a difference in financial performance between for-profits and nonprofits, and if so, what operational drivers the difference can be attributed to. Using U.S. nursing home data from 2006-2015, we conduct a longitudinal study on nursing homes that were converted from nonprofit to for-profit.

3 - Optimizing Colorectal Cancer Screening Policies using a Combination of Fecal Occult Blood Test and Colonoscopy

Zhichao Zheng, Singapore Management University, 50 Stamford Road, Lee Kong Chian School of Business, Singapore, 178899, Singapore, danielzheng@smu.edu.sg, Jing Li, Mabel Chou, Ming Dong

Over the years, various countries have adopted a combination of fecal occult blood test (FOBT) and colonoscopy as the preferred protocol for colorectal cancer (CRC) screening and surveillance. Current guidelines recommend three consecutive FOBTs annually after age 50 and immediate colonoscopy if there is at least one positive outcome from the three FOBTs regardless of other factors or screening history. It is unclear from literature about the values of having the FOBT as a pre-screening method before colonoscopy, and there is still related debate going on in practice. We propose a finite-horizon, partially observable Markov decision process model to optimize the CRC screening policy that combines FOBT and colonoscopy. Compared to the screening protocol that uses colonoscopy alone, we demonstrate that when FOBT sensitivity is not too low, adding annual FOBTs can help identify CRC in a timely manner and increase expected total quality-adjusted life years, while at the same time significantly reduce the number of colonoscopies required.

■ TC19

South Lounge, 3rd Floor

Quality and Safety Tools put into Practice

Invited: Health Informatics, Quality and Safety, and Simulation

Invited Session

Chair: Sue Feldman, UAB, 1720 2nd Avenue South, SHPB 590K, Birmingham, AL, 35294, United States, sf8588@gmail.com

1 - Optimizing the Lives Saved Tool (list)

Apaar Sadhwani, PhD, Researcher, Google, Mountain View, CA, United States, apaars@google.com, Lawrence M Wein

The Lives Saved Tool (LiST) is a widely used model for estimating the effect of scaling up interventions on maternal and child mortality. We embed LiST in a prescriptive framework, to identify the optimal set of interventions for a given budget in order to reduce mortality. We study several optimization strategies, and find that a greedy strategy offers both near-optimal performance and ease of implementation. Moreover, we find that optimization is critical to achieve the goal of reduced child mortality (for example, 80% potential mortality reduction with just 1% of budget for all interventions).

2 - Analyzing Physicians' Navigation Patterns in an EHR Simulation Study

Danny Wu, Assistant Professor, University of Cincinnati, 231 Albert Sabin Way, ML0840, Cincinnati, OH, 45229, United States, wutz@ucmail.uc.edu, Zhe Shan, Smruti Deoghare, Katheine Blondon

Despite the wide adoption of electronic health record (EHR) systems, their design may not well support clinicians' information collection and documentation. In a study of 30 physicians in a simulated nightshift setting (hand-offs and cross-coverage of 6 patients), we analyzed the root causes of the sign-out errors. In this study, we present EHR navigation patterns analyses using process mining and data visualization techniques and examine their relationship with the physician errors. We discuss design guidelines for EHR interface redesign.

3 - Implementation of a Septic Shock Protocol

Sue Feldman, University of Alabama at Birmingham, 1716 9th Ave S, Birmingham, AL, 35233, United States, sfeldman@uab.edu, Lauren Shivers, Leslie Hayes

This study explored the intersection of health informatics and healthcare quality and safety to convert a paper process protocol to an electronic and integrated protocol. The purpose was to understand the user experience of a computerized septic shock protocol (SSP) relative to the workflow of Pediatric Intensive Care Unit (PICU) clinicians and the standardization of care. PICU clinicians were interviewed and given surveys asking opinions on the current SSP, as well as the current electronic health record (EHR) being used. This session will report on the findings from the interviews and the pre and post surveys.

■ TC20

401, 4th Floor

Stochastic Dynamic Optimization

Sponsored: Applied Probability

Sponsored Session

Chair: Jefferson Huang, Cornell University, Ithaca, NY, 14850, United States, jh2543@cornell.edu

1 - Dynamic Production Scheduling in Multi-stage Tandems Systems with Machine Health Information

Chih-Chuan Chang, National Taiwan University, Taichung, 420, Taiwan, r05546033@ntu.edu.tw, Cheng-Hung Wu

This research studies scheduling problems in multi-stage production systems with unrelated parallel machines. Unrelated parallel machines are machines functioning similarly but with different processing rates, which are caused by machine deterioration. To minimize average cycle time, a heuristic algorithm was developed by combining linear programming decomposition with dynamic programming. The algorithm is computationally efficient and performs well in large systems. Comparing with other methods, cycle time and throughput are both significantly improved in simulation analysis.

2 - An Empirical Dynamic Programming Algorithm for Continuous MDPs

William Haskell, National University of Singapore, 111 Clementi Road, Kent Vale Block C, Apt. # 05-04, Singapore, 129792, Singapore, wbhaskell@gmail.com, Rahul Jain, Yu Pengqian, Hiteshi Sharma

We propose universal randomized function approximation-based empirical value iteration (EVI) algorithms for Markov decision processes. The 'empirical' nature comes from each iteration being done empirically from samples available from simulations of the next state. This makes the Bellman operator a random operator. A parametric and a non-parametric method for function approximation using a parametric function space and the Reproducing Kernel Hilbert Space (RKHS) respectively are then combined with EVI. Both function spaces have the universal function approximation property. Basis functions are picked randomly. Convergence analysis is done using a random operator framework with techniques from the theory of stochastic dominance. Finite time sample complexity bounds are derived for both universal approximate dynamic programming algorithms. Numerical experiments support the versatility and effectiveness of this approach.

3 - Dynamic Scheduling and Maintenance of a Deteriorating Server

Jefferson Huang, Cornell University, 205 Pleasant St, Ithaca, NY, 14850, United States, jh2543@cornell.edu, Douglas Down, Mark E. Lewis, Cheng-Hung Wu

Motivated by a quality control problem in semiconductor manufacturing, we consider a stochastic scheduling problem in the context of a multi-class queue with a single server whose service capacity deteriorates randomly over time. We show that the system may be unstable under a natural extension of the c -rule, and provide a sufficient condition for this rule to be optimal. We also consider the problem of jointly deciding whether to perform service or preventive maintenance, for which we provide insights into the structure of optimal policies and heuristics.

4 - Managing Inventory for a Multidivisional Firm with Cash Pooling

Yi Yang, Zhejiang University, Hanzhou, China, yangyizju@zju.edu.cn, Kevin Shang, Jianan Wang

We consider a multi-divisional firm in which each division replenishes its inventory and the headquarter coordinates the cash flow through a master account over a finite horizon. The demands of the divisions are stochastic and may be correlated. The objective is to find an optimal joint inventory replenishment and cash retention policy which maximizes the firm's working capital. We show that this problem is equivalent to minimizing the total system cost. Due to curse of dimensionality, the optimal policy is difficult to obtain. Nevertheless, we characterize the properties of the optimal policy and develop a simple heuristic that possesses these properties. A numerical study shows that the heuristic is near-optimal. We explore managerial insights through the heuristic. Among others, we find that the value of cash pooling is most significant when the demands of the divisions are negatively correlated.

■ TC21

Joy, 4th Floor

Service Quality and Customer Satisfaction

Invited: Theory & Practice on Circular Economy

Invited Session

Chair: Massoud Moslehpour, PhD, Asia University, Taichung, 41354, Taiwan, writetodrm@gmail.com

1 - Service Innovation Model of the God of Wealth Temple in Taiwan

Chia-Hao Chang, Asia University, Taichung, Taiwan, 106240002@live.asia.edu.tw, Weh-Hao Chiu

The purpose of this study is to explore the service connotation and service innovation model of the religious industry in Taiwan. The research method is based on the case study method, and the research work of the God of Wealth (Guang-Tien) Temple in Taichung, Taiwan. In order to analyze the structure, the data collection is based on secondary data and interviews with experts to collect multiple sources of information, to introduce the major service innovation events as the analysis unit. The research results includes six innovations in the focus work, while the consumption chain work forms the integrated service innovation with the new form work and the focus work.

■ TC22

Elegance, 4th Floor

Multiple Objective Decision Making (MODM)

Sponsored: Multicriteria Decision Making

Sponsored Session

Chair: Hsu-Shih Shih, Tamkang University, New Taipei, 25137, Taiwan, hshih@mail.tku.edu.tw

1 - Multiobjective Tradeoff for Managing Recycling Fund under Uncertainty

Hsu-Shih Shih, Professor, Tamkang University, 151 Yingzhung Rd., Management Sciences, New Taipei, 25137, Taiwan, hshih@mail.tku.edu.tw

The study focuses on how to efficiently manage a recycling fund through the tradeoff between environmental and economic objectives. Considering a minimal requirement for recycling quality, we identify a compromise recycling rate and industry profits, and suggest Taiwanese government to take a step on our recommendation.

2 - Use of Multi-objective Connection Scan Algorithm in Intermodal Transportation Network

Yuh Wen Chen, Professor and Dean, Da-Yeh University, Institute of Industrial Eng. and Mgt., No.168, University Rd., Da-Yeh University, Chang Hwa, 51591, Taiwan, profchen@mail.dyu.edu.tw, Vertic Eridani Budi D

A good linkage of traveling information and physical connection with local transport services for intercity travel is facilitating more people to travel and promoting the international tourism. This paper expects to make the public transportation easier by an integrated system, which is designed based on the optimization principles of minimizing the time and cost simultaneously. Connection Scan Algorithm(CSA) is launched by the basis of real time tables from transporters rather than abstract data in theoretical networks. Therefore, the multi-objective optimization is taken into account for giving advance traveling information to the travelers for better decision on line and in advance.

3 - Scenario Derivations for Developing the SOC Design Service Industry in the Post Moore's Law Era

Chi-Yo Huang, Professor, National Taiwan Normal University, Taipei, 10610, Taiwan, cyhuang66@ntnu.edu.tw

The Moore's Law, which has successfully predicted the number of devices that can be fabricated on a chip doubled every 18 months, is reaching the theoretical physical limits. How future semiconductor technologies may migrate from the aspects of SOC design services were seldom discussed. Therefore, the author aims to develop the scenarios for the development of SOC design service industry in the post Moore's law era. The Dominance-Based Rough Set Approach (VCDRSA) and the DEMATEL based network process (DNP) will be used to develop, evaluate and select the scenarios. The scenarios being derived can serve as the basis for Taiwanese design service industry and firm strategy definitions.

4 - Decentralized Determination of Design Variables among Cooperative Designers for a General Aviation Aircraft Product Family

Evans Sowah Okpoti, Hanyang University, Department of Industrial Engineering, 17 Haengdangdong, Seoul, 133-791, Korea, Republic of, okpoti2@hanyang.ac.kr, In-Jae Jeong, Seung Ki Moon

The objective of this paper is to provide a mechanism to determine design variables among cooperative designers in a decentralized decision-making environment where decision authority and information are dispersed among autonomous designers. We demonstrated this using a General Aviation Aircraft product family design problem by applying an augmented Lagrangian-based algorithm such that the designers achieve a common goal without having a global view of the entire decision environment. The results showed that quality solutions can be obtained in decentralized environments with less information exchange and comparatively minimal designer computational effort.

5 - Column Generation in Biobjective Linear Programming

Andrea Raith, University of Auckland, 70 Symonds Street, Department of Engineering Science, Auckland, 1010, New Zealand, a.raith@auckland.ac.nz, Siamak Moradi, Matthias Ehrgott

Biobjective LPs can be solved by the biobjective simplex method which iteratively moves between efficient basic solutions by selecting a variable to enter the basis with maximum ratio of improvement of one objective and deterioration of the other. We show that a column generation approach can be integrated with this simplex method to dynamically identify which decision variables to include in the problem. New variables to enter the basis are generated by solving a column generation subproblem that finds the required variable of maximum ratio. Formulations of the required column generation subproblems for a particular biobjective LP are explored and their performance is compared.

Tuesday, 3:30PM - 5:00PM

■ TD01

101A, 1st Floor

Operations Management II

Contributed Session

Chair: Qi Fu, University of Macau, FBA/AIM, Macau, 111, Macao, gracefu@umac.mo

1 - Measuring Industrial Agglomeration

Chenyuan Cao, Student, Wenzhou-Kean University, 88 Daxue Rd, Ouhai District, Wenzhou, 325060, China, caoc@kean.edu, Haoran Ling, Zeyu Huang

Industrial agglomeration, a worldwide economic phenomenon, is one of the most prominent geographical features of economic activities. This study adopts the micro-data of Wenzhou automobile and motorcycle enterprises to measure industrial agglomeration in different spatial scale. In terms of technology, we categorize automobile and motorcycle enterprises into five sub-categories and consider DO index a proxy for spatial agglomeration to explore the formation mechanism of industry agglomeration and corresponding economic benefits.

2 - Make the Second Purchase from the Spot Market under Selling Price-sensitive Stochastic Demand

Xiangling Hu, Associate Professor, Grand Valley State University, 3103 L. William Seidman Center 401 W. Fulton, Grand Rapids, MI, 49504, United States, hux@gvsu.edu, Jaideep Motwani

We assume that a retailer stocks a specific quantity of a product from the spot market and then sell the product to the customers during the selling season. The retailer has already made a purchase but has the option to make a second purchase if there is a potential profit increase on account of the purchase. However, due to the stochastic spot market purchasing price and the selling price dependent random demand, the retailer needs to determine whether a second purchase is necessary. In this paper, we develop model to answer the problem

and also run simulations to analyze the inventory decisions and profits when a second purchase is possible.

3 - Corporate Greening on Product Complexity and Operational Efficiency: The Role of Knowledge Exploration and Exploitation

Lik Man Daphne Yiu, The Hong Kong Polytechnic University, Hong Kong, daphneyiu@gmail.com

Moving beyond environmental compliance, firms integrating green practices into operational processes stress on sustainability opportunities. We explore how U.S. manufacturing firms could possibly reduce product complexity and improve operational efficiency through corporate greening, using ISO 14001 adoption as a proxy. We argue that firms might need to explore new knowledge for more opportunities and exploit their existing knowledge to elevate the benefits of ISO 14001, reducing complexity and improving efficiency.

4 - Application of Crowdsourcing to Resolve Ambiguity in the Procurement Process

Mehdi Rajabi Asadabadi, University of New South Wales, Canberra, 2600, Australia, rajabi689@yahoo.com, Morteza Saberi, Elizabeth Chang

There is commonly a level of ambiguity involved in buyer-supplier relationship. This causes misunderstanding and consequently receiving unsatisfactory products. To date insufficient studies have been undertaken that investigate this aspect of the procurement process. A number of previous studies focus on requirement specification and elicitation. However, these have a software engineering focus. This issue in the procurement process and proposals has been investigated and an integrated framework using intelligent techniques have been proposed. The research contributes to the contract theory by leveraging intelligent techniques in automated or semi-automated contract monitoring.

5 - Costly Information Acquisition under Horizontal Competition

Qi Fu, University of Macau, Taipa, Macao, gracefu@umac.mo, Yongquan Li, Kaijie Zhu

We analyze endogenous acquisition of costly information for two firms that sell homogenous products. Prior to determining its production quantity, either firm has an opportunity to purchase a forecast. There exists a correlation between the two forecasts acquired by the firms. We model the problem as a two-stage game in which the firms first decide whether to acquire their respective forecasts and then decide their production quantities. We derive the equilibrium outcome on information acquisition and production quantity.

■ TD02

101B, 1st Floor

Queueing Models

Contributed Session

Chair: Boray Huang, Eindhoven University of Technology, P.O. Box 513, School of Industrial Engineering, Eindhoven, 560 0MB, Netherlands, b.huang@tue.nl

1 - Joining a Line Based on the Expectation of a Long Waiting

Chih-Chin Liang, Associate Professor, National Formosa University, No.64, Wenhua Rd., Huwei Township, Yunlin County, 63201, Taiwan, lgcwow@gmail.com

Service companies attend to the management issues about the unavoidable waiting situation and establish many management policies to make consumer willing to wait or stay. This study was applying brainwave experiments with two queueing situations and to detection the real reaction of consumers. The analytical results of questionnaire showed that providing waiting time information will bring consumer positive emotion, but no significant difference in the grouping variables: personal time style, the tolerance of waiting, and the decision to queue. Additionally, providing the information of the number of waiting people before the participants will decrease the consumer negative emotion.

2 - How (not) to Allocate Affordable Housing

Nicholas A. Arnosti, Columbia Business School, 3022 Broadway, Uris Hall rm 402, New York, NY, 10027, United States, naa2165@columbia.edu, Peng Shi

We study the dynamic allocation of objects to agents. The common practice of using independent lotteries encourages agents to enter many lotteries, resulting in inefficient matching. We consider several alternatives, and reach three main conclusions. First, very different systems may produce identical outcomes. Second, when an agent's level of need is unobservable, there is often a tradeoff between matching (assigning agents to items that are a good fit) and targeting (assigning items to agents with the greatest need). Third, it is generally preferable to prioritize good matching over effective targeting. Our findings suggest that independent lotteries are rarely advisable.

3 - Incentivized Ride Matching as Stackelberg Games

Qi Wu, Assistant Professor, Chinese University of Hong Kong,
William M.W. Mong Engineering Building, Rm 507, Shatin, NT,
Hong Kong, qwu@se.cuhk.edu.hk

We study supply-side subsidies as alternative strategies to surge pricing using a queueing game approach. We assume the driver supply is finite and reusable, and derive the equilibrium dynamics. We first establish the endogenous forces driving the imbalances between supply and demand with zero monetary incentive. We then study the intrinsic capacity bounds when incentives are provided through stackelberg games. We further investigate how incentives accumulate in agents wealth account and how they are distributed across population.

4 - Sequencing the Appointment Arrivals: Snowball and Voucher Effects

Boray Huang, Assistant Professor, Eindhoven University of
Technology, P.O. Box 513, School of Industrial Engineering,
Eindhoven, 5600MB, Netherlands, b.huang@tue.nl,
Ahmad R. Pourghaderi

We study an appointment-based queue with two classes of customers whose excessive service times are stochastically ordered. The objective is to find the optimal sequence of arrivals to minimize the total waiting time of customers. We identify and prove an important property, the First Half Rule (FHR), of the optimal sequence. The FHR sheds light on the interaction between two effects in sequencing heterogeneous customers or services: The snowball effect which drives the stochastically faster customers toward the beginning of the optimal sequence, and the voucher effect which pushes the faster customers toward to the end of the sequence.

TD03

101C, 1st Floor

Predictive Analytics in Service and Education

Invited: Machine Learning and Big Data Analytics

Invited Session

Chair: Galit Shmueli, National Tsing Hua University, Institute of
Service Science, Hsinchu, 30013, Taiwan, galit.shmueli@gmail.com

Co-Chair: Soumya Ray, National Tsing Hua University, Hsinchu, 30013,
Taiwan, soumya.ray@iss.nthu.edu.tw

1 - What Should We Watch Tonight? Reintroducing Recommendation Systems to Social Science through the Lens of Power and Transparency

Arturo H. Cano Bejar, PhD Student, National Tsing Hua
University, Hsinchu, Taiwan, arturocano@iss.nthu.edu.tw,
Ray Soumya

Research on recommendation systems has traditionally emphasized algorithmic accuracy in predicting users choices. But researchers have largely disregarded the socio-technical components that guide these choices. We seek to redefine and reexamine recommender systems from the social science perspectives of transparency, power, control, and effort. And we will see how these factors can influence the personalization and design of recommender systems.

2 - Co-creating Value from Predictive Analytics: A Case Study of Platform as a Service

Tuan Thanh Nguyen, National Tsing Hua University, Hsinchu,
Taiwan, tuan.kellan@iss.nthu.edu.tw

With the emergence of sharing economy, the service ecosystems hotel industry have become more complex than ever. Service providers are required to consider the role of multiple service platforms in the ecosystem. In this project, we explore how predictive analytics together with in-depth interviews can be utilized to co-create sustainable values for strategic solutions. Based on our empirical data, we found multiple platform issue is the key factor in service rejection. We suggest the service provider re-design service process based on predictive results.

3 - How Many First Grade Classrooms Next Year? Forecasting School-Level Demand in Taiwan

Mahsa Ashouri, National Tsing Hua University, Hsinchu, Taiwan,
mahsa.ashouri@iss.nthu.edu.tw

Deploying forecasting analytics using data collected by a management information system (MIS) is important for school resource planning, especially for teacher hiring. We developed and compared forecasting models for the number of first grade classrooms at each school in Taiwan using data collected by a new education MIS, for generating 1- to 5-year ahead forecasts.

4 - Why Learners Fail in MOOCs? Predicting Learning Engagement using Theory-oriented Constructors

Tonny Meng-lun Kuo, National Tsing Hua University, Hsinchu,
Taiwan, tonnykuo@iss.nthu.edu.tw

This study explores why learners are not highly engaged in MOOCs from the perspective of academic hardness and learning engagement. The interplay of online academic hardness and online learning engagement is mapped through both structural equation model and predictive model. Our explanatory and predictive analysis found that commitment is the most important factor of online academic hardness, significantly influencing learning engagement. Moreover, the role of challenge contributes much to cognitive and emotional engagement. Other interesting findings and instructional implication will be discussed in the paper.

TD04

101D, 1st Floor

Transforming US Army Supply Chains: A Project Update

Invited: Military, Defense, and International Security

Invited Session

Chair: Greg H. Parlier, North Carolina State University, 255 Avian
Lane, Madison, AL, 35758, United States, gparlier@knology.net

1 - Transforming US Army Supply Chains: A Project Update

Greg H. Parlier, North Carolina State University, 255 Avian Lane,
Madison, AL, 35758, United States, gparlier@knology.net

For nearly three decades the US Government Accountability Office has attributed long-standing Department of Defense supply chain inadequacies to poor demand forecasting, ineffective inventory management, and inadequate strategic planning. To address these persisting problems the US Army established the project to Transform Army Supply Chains (TASC) in order to investigate the nature, causes, and consequences of demand uncertainty and supply variability. The TASC project developed an enterprise framework to facilitate analysis, synthesis, evaluation and design for the sustainment enterprise, then identified and tested several “catalysts for innovation”. This tutorial provides a project overview and update on the most recent developments.

TD05

102, 1st Floor

Retail Operations Management

Invited: Operations and Marketing Interface

Invited Session

Chair: Jianbin Li, Huazhong University of Science & Technology,
Huazhong University of Science & Technology, Wuhan, 430074, China,
jbl@hust.edu.cn

1 - Joint Pricing and Inventory Control with General Production Costs

Peng Hu, Huazhong University of Science and Technology,
Wuhan, China, hu_peng@hust.edu.cn, Ye Lu, Miao Song

This study considers a periodic-review joint pricing and inventory control problem for a single product, where replenishment production incurs a setup cost together with either convex or concave variable cost, and the objective is to maximize the expected discounted profit over the whole planning horizon. We partially characterize the optimal policy by introducing two novel convex-like properties. As the optimal policy for the multi-period problem is too complicated to be implemented in practice, we develop well-structured heuristic policies, and establish worst-case performance bounds. Furthermore, our numerical studies show that our heuristic policies perform extremely well.

2 - Pricing and Recall Effort Strategies in a Supply Chain with Product Recall

Bin Dai, Wuhan University, bin_dai@whu.edu.cn, Shimiao Chen

In a supply chain with product recall, where both the manufacturer and the supplier make recall effort to reduce the impact of product recall, we aim to optimize pricing and recall effort strategies under various situations. Furthermore, we investigate the effect of quality improvement or promotion effort on the pricing and recall effort strategies as well.

3 - Pricing Strategy and Coordination in a Dual Channel System in the Presence of BOPS

Niu Yu, Wuhan Textile University, Wuhan, China,
nyu@wtu.edu.cn, Jianbin Li

We consider a dual channel supply chain with an online retailer (or supplier) and a physical store (retailer) in the presence of BOPS. The online retailer not only sells a single product by herself but also sells through the physical store. We study the impact of the BOPS (buy online and pick up in store) on pricing strategies and coordination in the dual channel system.

4 - Mixed Bundling Strategies for Complementary Products under Uncertain Supply: The Vehicle Quota System in Singapore

Xiaomeng Luo, Southwestern University of Finance and Economics, Chengdu, China, luoxm@swufe.edu.cn, Chongshou Li

In Singapore, potential vehicle owners have to obtain vehicle licenses, which are known as Certificate of Entitlements (COEs), via an open bid auction before purchasing new vehicles. The demand for COE is usually much higher than its supply and therefore, vehicle retailers have the chance to price discriminate by bundling the vehicle with the COE. Considering the consumer heterogeneity and uncertainty of obtaining the COE, we incorporate three sales strategies adopted by vehicle retailers: pure separate strategy, pure bundling strategy, and mixed strategy; and figure out which strategy will contribute most to vehicle retailers under different circumstances.

5 - Supply Level Competition and Strategies Comparison with Capacity Allocation Mechanisms under Oligopoly Market

Jianbin Li, Huazhong University of Science & Technology, 1037 Building in Luoyu Road, Wuhan, 430074, China, jbli@hust.edu.cn, Xueyuan Cai

We consider a distribution system with one supplier and two retailers. The supplier will implement allocation mechanisms ("order-inflation" and "truth-telling" mechanisms) or improve her wholesale price when the capacity can't match demand. Conventional wisdom thinks that the supply chain is hard to obtain equilibrium with "order-inflation" mechanisms and the impact to the supplier by "order-inflation" mechanisms is not the same as that by "truth-telling" mechanisms. But we show that this is not true in our setting where each retailer faces a oligopoly market and places order to the supplier considering the capacity constraints. We study the retailers' equilibrium behavior and show how the supplier can optimize her wholesale price under a given allocation mechanism. Furthermore, we investigate how the uniform, proportional, and lexicographic allocation mechanisms compare from the supplier's and the supply chain's standpoints. Finally, we extend to N retailers and gain similar results to 2 retailers.

TD06

103, 1st Floor

Tutorial: Tales from the Crypt: Lessons Learned in Implementing Optimization Systems

Tutorial Session

1 - Tales from the Crypt: Lessons Learned in Implementing Optimization Systems

Ranganath S. Nuggehalli, UPS, 2311 York Road, Timonium, MD, 21093-2215, United States, RNuggehalli@ups.com

Though the field of operations research was founded in practice, today there exists a substantial gap between its theoretical capabilities and real world impact. The field of operations research/management science/advanced analytics has never been more relevant than it is today. Our profession is in a unique position to solve the myriad problems that face our societies. The estimated \$250 billion benefits generated by the by the 266 Edelman finalists since 1976, while very impressive, only represent the tip of the real savings produced by the operations research projects. Yet, a large number of systems are either never completed or fail to provide the full benefits. The never ending need for increased efficiency, availability of abundant data, and relatively inexpensive computing power makes it a golden age for the profession provided we make use of the opportunity and deliver real world benefits. This interactive session will draw on the author's more than 25 years of experience on implementing operations research systems and discuss the factors that contribute to the successful implementation and deployment of operations research systems.

TD07

105, 1st Floor

Simulation and Optimization for Design and Control of Complex Systems

Invited: Operations and Decisions in Smart Manufacturing and Logistics

Invited Session

Chair: Giulia Pedrielli, PhD, Arizona State University, Phoenix, AZ, United States, giulia.pedrielli@asu.edu

1 - Distributed Optimization for Scheduling Shared EV under Uncertain Demand and Wind Power Supply

Qing-Shan Jia, Tsinghua University, Department of Automation, Cfs, Beijing, 100084, China, jiaqs@tsinghua.edu.cn, Junjie Wu

We address the problem of shared EV scheduling under uncertain demand and wind power supply in micro-grid in this paper. We regard wind power as the source of renewable energy, which is generated by wind turbines mounted on buildings. Major contributions of this work are as follows. First, we formulate the shared EVs scheduling problem in the framework of Markov decision process (MDP). Second, a distributed optimization algorithm is proposed to find out the optimal policy. Third, we demonstrate the performance of the proposed method by numerical experiments.

2 - Dynamic Sampling Allocation under Finite Simulation Budget for Feasibility Determination

Yijie Peng, PhD, Peking University, pengyijie@pku.edu.cn, Zhongshun Shi, Leyuan Shi, Chun-Hung Chen, Michael Fu

Given a set of alternatives whose performance is estimated via stochastic simulation, we consider the problem of determining the subset of alternatives that have means smaller than a fixed threshold. A dynamic sampling procedure that possesses not only asymptotic optimality but also desirable .

3 - An Introduction to Simulation Analytics for Learning-based Real-time Control

Haobin Li, National University of Singapore, 1 Engineering Drive 2, Singapore, 117576, Singapore, li_haobin@nus.edu.sg, Xiao Jin, Loo Hay Lee

Considering real-time decision making, both simulation and optimization procedures are computationally expensive. A learning-based simulation analytics is to be developed to solve the problem by mapping the environmental parameters to the optimal decision via simulation under such scenarios. In contrast with the conventional simulation-based optimization, the proposed method decouples the process of decision-making from the process of optimization, so that any delay during decision-making shall not occur due to time spent on the simulation-based optimization. The presentation shall illustrate its linkage with conventional methodologies and address important research opportunities.

TD08

201A, 2nd Floor

Next Generation Air Transportation

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Jianfeng Mao, The Chinese University of Hong Kong, Shenzhen, 2001 Longxiang Blvd., Shenzhen, 518172, China, jfmao@cuhk.edu.cn

1 - Benefits and Challenges of Including Complex Routes when Solving the Multi-hub Express Shipment Service Network Design Problem

Jose Miguel Quesada, Université Catholique de Louvain, Av Moliere 325, Uccle, 1180, Belgium, jose.quesada@uclouvain.be, Jean-Charles Lange, Jean-Sebastien Tancrez

The Express Shipment Service Network Design problem consists on defining a network of flights that enable the delivery of packages of an express company. Models addressing it normally include one-leg, multi-leg and ferry routes. Assessing the value of more complex route types is an open question of practical importance. We present a model with five complex routes: two-hub routes that connect gateways with two hubs; transload routes that transfer packages between aircrafts; inter-hub routes that connect hubs; and early and late routes that have relaxed release and due times, but can only carry a limited amount of packages. We assess their economic impact by solving an extensive set of experiments.

2 - An Integrated Fleet Assignment and Crew Pairing Problem with Insufficient Crew Constraints

Lei Zhou, Tongji University, Shanghai, China,
zhejiangzhoulei@163.com, Zhe Liang

We study an integrated fleet assignment and crew pairing problem. The traditional integrated problems assume that the number of crews is sufficient to fly any set of flights provided by the fleet assignment decisions. However, this is not true for some airlines, e.g., the number of crews for some old fleet type is sufficient, but not enough for the new fleet type such as Boeing 787 and Airbus A380. Therefore, we also consider the number of crews for each fleet in the integrated model. The results show that the model provide better solutions than the traditional method.

3 - An Improved Time Space Network Algorithm for the Recovery of Disturbed Flights

Qiannan Tian, Huazhong University of Science and Technology,
1037 Luoyu Road, Wuhan, China, 1056686923@qq.com,
Kunpeng Li

Disrupted flight recovery problem is due to bad weather, aircraft failures, airport close and other external conditions of uncertainty often resulted in some flights are delayed or even cancelled, the original flight schedules unfeasible, which requires operation center to recovery the interrupted flights quickly. However, the problem is a combinatorial optimization problem with very high complexity, and which belongs to the NP-hard problem. On the analysis of actual situation of the airline, considering various constraints, with an improved algorithm based on the time-space network routes generated, and the CPLEX software is applied to solve the problem.

4 - An Efficiency Measurement of Airport Performance in Asia Major Airports a DEA Approach and the Malmquist Productivity Index

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Hsin-Hui Chou

Asia Pacific extended its position as the largest region in terms of overall revenue passenger kilometers flown. The operational performance and management of Asian airports has become an issue that worth our attention. As the global aviation industry has changed, airports are transformed from simple public utilities into business entities that successfully operate in an increasingly competitive environment. This study assesses the operational efficiency of the major airports in Asia to improve operational efficiency of airports. Particularly the contribution of this study is to use M-index to conduct a vertical temporal analysis from year 2001 to 2003.

5 - Complexity Aware 4D Trajectory Planning via Collaborative Decision Making

Jianfeng Mao, The Chinese University of Hong Kong, Shenzhen,
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Trajectory-based operations are required as the core module of Next Generation Air Traffic Management. Most existing literature has mainly focused on conflict resolution in trajectory planning without considering preferences of stakeholders, i.e., aircraft operators and air traffic controllers, which may limit the effectiveness in practice. We develop a scheme of collaborative decision making for 4D trajectory planning, in which stakeholders' information and preferences can be coordinated through a negotiation process. The negotiation process is modeled as a pure-strategy game with aircraft as players and all possible 4D trajectories as strategies. The air traffic complexity is also taken into account to mitigate work intensity by considering the impact of reserving buffer safety distance, a common decision habit of air traffic controllers. An efficient maximum improvement distributed algorithm is developed to achieve an equilibrium at which a trade-off between operating cost (fuel plus delay) and complexity is optimized and coordinated among stakeholders with the guarantee of conflict-free. A case study based on real air traffic data shows that the algorithm is able to solve 4D trajectories for online application with estimated 16.7% reduction in monetary costs, and allocate abundant buffer safety distance at minimum separation point. Scalability of the algorithm is verified by computational experiments.

TD09

201B, 2nd Floor

Supply Chain Management II

Contributed Session

Chair: Araceli Zavala, Stevens Institute of Technology, 54 11th Street,
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1 - Huge Natural Disaster Initiates Panic Buying Behavior

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Disruption management is the important part in the recovery process. This paper proposes a conceptual model to address the causal relationships among internal influence and external influence, panic buying behavior and its antecedents after

huge natural disaster. We argue that the emotional contagions can moderate the relationship among panic buying behavior and affective response after a huge natural disaster.

2 - Discuss TSMC's Social Responsibility Performance from the Perspective of Dynamic Capabilities

Yi-Chih Lu, Taiwan, a60742099@gmail.com

Abstract not available

3 - Study on the Coordination Strategy of Supply Chain Under Retailer's Financial Constraints

Xianhao Xu, Huazhong University of Science & Technology,
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This paper studies a two-level supply chain based on the Newsvendor model, with suppliers acting as the leader in Stackelberg game and retailers as followers facing financial constraints. The study found that when the supplier set the delay payment limit and allow the retailer to delay the payment, the total profit of the supply chain can be increased.

4 - Identifying Product Disruptions via Social Media and its Resilience Metrics

Araceli Zavala, PhD Candidate, Stevens Institute of Technology,
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azavala@stevens.edu, Jose Emmanuel Ramirez-Marquez

Since a product recall has consequences for both the consumer and all the echelons in the SC, it is essential to have contingency plans to lessen its effects. Thus, the problem that arises is: How companies can identify product recalls rapidly and take corrective action? To do so: 1) we implement a visualization model capable of measuring the daily negative sentiment of users in social media as an indicator of a possible product recall and, 2) we propose several metrics to assess the effect of the recall in the SC given negative comments from social networks. The end objective is to evaluate the resiliency of companies when facing product disruptions.

5 - Integrating Corporate Social Responsibility, Profitability and Stock Price Crash Risk to Measure the Sustainability Performance of Business Operations

Li-Ting Yeh, Feng Chia University, Taichung, Taiwan,
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Disclosure of information about social responsibility may help firms to build strong intangible capital, effectively improving their later profitability and reducing the risk of a later stock price crash. This study develops an approach that integrates corporate social responsibility, profitability and stock price crash risk into a dynamic data envelopment analysis-slack-based measure model that can be used to evaluate the sustainability performance of business operations. Our study illustrates our approach by applying it empirically to evaluate the sustainability performance of the business operations of Taiwanese firms.

TD10

201C, 2nd Floor

Manufacturing & Supply Chains

Contributed Session

Chair: Zongjian Chen, Huazhong University of Science & Technology,
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1 - Perspective the Service Innovation Impact to Customer Satisfaction in Airport

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The results shows three variables as security check has the highest influence on customer satisfaction. We used self check in kiosk, X ray, social media communication, and micro hotels as the innovative events at the airport. In the result, all four innovation items revealed positive moderation effect especially respondents viewed security check as the most important factor in airport service which aroused the most satisfied customers while airport accessibility ranked second. Keywords: International airport, Service innovation, customer satisfaction, airport service

2 - A Comparison of Production Systems

Yong Yin, Doshisha University, Sashimono-chou 313-1005,
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In this presentation, we introduce a recent result of our research "The evolution of production systems from Industry 2.0 through Industry 4.0" which has appeared in an academic journal - IJPR. The evolution of production systems of flow line, Toyota production system (TPS), job shop, cell, flexible manufacturing system and seru will be discussed. Comparisons between seru with TPS and cell will be presented. We also give potential applications of lean and seru principles for Industry 4.0.

3 - Graduation Intelligent Manufacturing System – Synchronization with IoT-enabled Smart Tickets for Hybrid Dynamic-virtual Cell Lines

Peng Lin, The University of Hong Kong, Hong Kong,
penglin1992@hotmail.com, George Q Huang

This paper proposes a new card-based control system - Graduation Intelligent Manufacturing System (GIMS) for hybrid dynamic-virtual cell lines by analogy to ticket queuing system of graduation ceremony. Firstly, three kinds of tickets, namely job tickets, setup tickets and operation tickets are designed for synchronizing part deliveries, resources and operations. Secondly, Internet of Things (IoT)-enabled smart tickets and gateways are developed to provide location-sensitive services for automatic and intelligent generation, dispatch and usage of tickets. Finally, control mechanisms for tickets are proposed for ensuring synchronization, reducing cost and improving efficiency.

4 - A Contingency Framework for Strategic Tradeoffs Model by Contextual Logic of Analytics

Zongjian Chen, Associate Professor, Huazhong University of Science & Technology, Luoyu Road 1037, Wuhan, 430074, China,
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This paper developed the contextual logic of analytics to distinguish the concept of the strategic tradeoffs from related controversy. On this basis, a contingency framework is introduced that relates digitization of manufacturing to the performance frontier concept in manufacturing strategy. This study investigates the assumptions, rationales and methodologies of the framework for disparate strategic tradeoffs.

■ TD11

201D, 2nd Floor

Finance – Risk Management

Contributed Session

Chair: Nicholas Tay, University of San Francisco, 2130 Fulton Street, San Francisco, CA, 94117, United States, tay@usfca.edu

1 - Predicting the Probability of Labeling as “Special Treatment” for Listed Firms in China Stock Exchange

Jie Zhang, UG Student Research Assistant, Wenzhou-Kean University, 88 Road Daxue, Wenzhou, 325060, China,
zhanjie@kean.edu, Jinze Yu, Kejia Zheng, Mohammad M Mousavi

In China, stock exchanges label a firm as “special treatment (ST)” to warn about the occurrence of specific abnormality in financial, operational or other aspects of the firm. The design of reliable models to provide an early warning of labeling as ST (or financially distress) is crucial for many decision-makers, including investors and managers. This study develops a new dynamic distress prediction model which incorporates corporate governance (CG), operational and financial variables as well as market efficiency. In addition, this research proposes to apply a cross-benchmarking multi-criteria assessment framework to evaluate the CG efficiency of firms, one of the important features.

2 - A New Non-parametric Classifier

Oscar Uvalle, PhD Student, University of Edinburgh, Edinburgh, EH8 9JS, United Kingdom, ouvalle@ed.ac.uk, Jamal Ouenniche

In this research, we propose a new non-parametric in-sample-out-of-sample classifier and test its performance on a UK dataset of bankrupt and non-bankrupt firms. Empirical results show an outstanding predictive performance both in-sample and out-of-sample. In addition, the proposed framework is robust to a variety of implementation decisions.

3 - Investment Decisions and Falling Cost of Data Analytics

Hong Ming Tan, National University of Singapore, Singapore, Singapore, thm@u.nus.edu, Jussi Keppo, Chao Zhou

We study how the cost of data analytics and the characteristics of investors and investment opportunities affect investment decisions and their data analytics. We show that the falling cost of the data analytics raises investors' leverage, financially constrained or highly risk averse investors use less data analytics, and the demand of data analytics is highest with high expected return opportunities. Due to the increased leverage, the falling cost of data analytics leads to higher losses during the crises.

4 - Statistical Process Control for Portfolio Risk Management

Nicholas Tay, Professor of Finance, University of San Francisco, 2130 Fulton Street, San Francisco, CA, 94117, United States, tay@usfca.edu, Robert N. Mefford

Statistical Process Control (SPC) has been used for quality control in a wide range of manufacturing and service organizations but has not been applied to investment portfolio management. We investigate the application of SPC for asset allocation and risk management of investments. SPC is used to identify a shift in market sentiment and signal to investment managers to change portfolio allocations to-or-from riskier assets and/or to employ hedges. Measures of investment sentiment is tested for their forecast capabilities and process control charts are subsequently developed. How the SPC charts can be employed to improve portfolio performance are investigated and discussed.

■ TD12

201E, 2nd Floor

Disaster Logistics

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Douglas Alem, University of Edinburgh, 29 Buccleuch Place, Edinburgh, EH8 9JS, United Kingdom, douglas.alem@ed.ac.uk

1 - Performance Evaluation on Beijing Emergency Medical Service Systems

Zengbo Zhang, Beijing Institute of Technology, 5 South Zhongguancun Street, Beijing, 10081, China, zhangzengbo_1999@163.com

We consider the construction problem of the mixed emergency medical service systems how to deploy the number of 120 ambulance and 999 ambulance in Beijing, given a total quantity control. In this paper, we construct the Markov decision process model under which the performance of a given mixed emergency medical systems can be evaluated, as well as we adopt an optimization-based approach to discuss the appropriate ratio of the 120 ambulance to 999 ambulance.

2 - An Algorithm for Evacuation Planning in Buildings – Urban Integrated Networks

Chang Hyup Oh, Pohang University of Science and Technology, Nam-gu, Cheongam-ro 77, Pohang, 37673, Korea, Republic of, changhyup.oh@lslab.org, Young Myoung Ko

In this study, we present an efficient heuristic algorithm which provides an integrated evacuation plan including both building networks and urban networks. In the urban evacuation, evacuees arrive in source nodes at different time window according to the results of building evacuations. Moreover, the capacities of destination nodes are not infinite. We construct several building networks from real world information including a multiplex cinema and a subway station and a generated urban networks. In this presentation, we show numerical results for small size integrated networks.

■ TD13

201F, 2nd Floor

Sharing Economy

Invited: Operations and Economics Interface

Invited Session

Chair: Yanzhi Li, City University of Hong Kong, Hong Kong, yanzhili@gmail.com

1 - Market Mechanism and Cost Allocation in Peer-to-Peer Service Sharing

Yimin Yu, City University of Hong Kong, Department of Management Sciences, 83 Tat Chee Ave., Kowloon, Hong Kong, yiminyu@cityu.edu.hk, Huihui Wang

Motivated by online peer-to-peer service sharing, we consider demand allocation and pricing for the online sharing platform. On this platform, providers have service capacity and may have their own customers to be served; customers do not own capacity and hence have to procure service from providers. We model independent providers as queueing systems. We identify a pricing and demand allocation strategy that can be decentralized from a market mechanism. Moreover, based on the market mechanism, we identify an allocation scheme that is in the core of the cooperative game.

2 - Subsidy Strategies for Coordinating Supply and Demand in Sharing Economy

Bo Feng, Soochow University, Suzhou, China, neu_fengbo@163.com, Hao Jiang

Technological advances in internet and increasing use of smartphones have enabled sharing economy a massive scale by reducing search and transaction costs. Motivated by the sensitive relationship between supply and demand through platform's subsidy level, we develop a two-sided market model to study how the platform should strategically choose the subsidy object and the subsidy level in sharing economy. We consider providers heterogeneous in their time cost and customers heterogeneous in their valuation of the performance of the platform. Counter-intuitively, we find that the subsidy level for customers strictly increases with the strength of positive network effects on customer side.

3 - A Branch-and-Price Algorithm for the Bike Rebalancing Problem

Jiliu Li, School of Management, Huazhong University of Science and Technology, WuHan, China, ljl_liushao@foxmail.com, ZhiXing Luo

This paper addresses a new bike rebalancing problem that rebalances the number of bikes on the whole bike sharing system. The number of bikes on some bike stations are likely to be in lack or redundant after riding by riders. The objective is to determine a set of least-cost vehicle routes which transport bikes until rebalance of bike sharing system. This problem is a generalization of the split pickup and split delivery vehicle routing problem, which consists of determining a set of least-cost vehicle routes to serve all customers while respecting the restrictions of vehicle capacity. It involves particularly the permission a bike station can be visited by a vehicle multiple times or by multiple vehicles. To solve this problem, we propose an exact branch-and-price-and-cut algorithm, where the pricing subproblem is a variant of the resource-constrained elementary shortest path problem. And then we design a tailored and novel label-setting algorithm to solve the pricing subproblem of the resource-constrained elementary shortest path problem.

4 - Data Trading and Three-part Tariffs

Yanzhi Li, yanzhili@cityu.edu.hk, Weixiang Huang, Frank Youhua Chen

We study the problem of a telecommunications service provider that facilitates data trading among its subscribers. We show that whether the firm can benefit from the trading platform depends on the market heterogeneity, specifically, consumer valuation spread, segment proportions, and the number of consumer types. Moreover, the firm faces a trade-off between charging a higher access fee and charging a transaction fee, and it is advantageous for the firm to charge a transaction fee when the proportion of high-end consumers is not very high. Interestingly, when the firm finds the platform to be profitable, consumer surplus may also improve, and social welfare always improves.

■ TD14

202A, 2nd Floor

Behavioral Operations

Contributed Session

Chair: Rongrong Cai, Xiamen University, 422 SimingSouth Road, Xiamen, Xiamen, 361005, China, crrchn@163.com

1 - The Mediation Effect Validation Between Cross Cultural Management and Employee Identification

Chiahao Ma, PhD Student, National Cheng Kung University, No.8, Ln. 74, Guanghua Rd., Shanhua Dist., Tainan, 74154, Taiwan, chiahao.ma@gmail.com, Hsin-Hong Kang

Moderation and mediation strategic management research methods were used with the American Industrial Group in Asia as the setup of the study. Hypotheses were tested on effects of new corporate culture-based learning on the perception of social norms, learning attitude, self-efficacy, and social values. Additional hypotheses were also tested on the effects of perception of social norms, learning attitude, self-efficacy, social values, and psychological control on change intention.

2 - The Diagnosis Behavior Framework of High-tech Chinese Medicine

Mei-Chen Lo, Dr., National United University, Miaoli, Taiwan, amy.mjlo@gmail.com

Traditional Chinese medicine (TCM), is understandable, given the widespread perception of TCM as nonscientific and nonstandardized. TCM's most prominent characteristics is the use of multiple herbal ingredients containing yin-yang properties in a single prescription. People concerned about the situation have tried to chart TCM to a more scientific direction. Therefore, this study form a stringent control behavior framework of the diagnosis and treatment to help its decision-making can be included via high-tech skills/products to urge the effect and the image of TCM can be efficiency.

3 - A Process Mining Framework for Analyzing Learning Clickstream Data

Harry Wang, University of Delaware, 42 Amstel Avenue, Room 209, Newark, DE, 19716, United States, hjwang@udel.edu

Learning analytics is an emerging field of research that aims to utilize a wide range of educational data to establish a deep understanding of the learning processes and learner behavior. In this short paper, we propose a process mining framework for analyzing large-scale learning clickstream data collected from a major US university's learning management system. We address a number of modeling and analysis challenges from a process mining perspective and propose new concepts for process-centric learning analytics. Our preliminary research results show interesting findings that shed lights on future research directions.

4 - Manufacturer's Channel Structures with Product Quality Differentiation in Brick-and-mortar Channels

Rongrong Cai, Xiamen University, No. 422, SimingSouth Road, Xiamen, Fujian Pro, Xiamen, 361005, China, crrchn@163.com, Shuihua Han

We consider a manufacturer who adopts brick-and-mortar channels. Both online and offline channels allow a manufacturer to sell products either directly (Agency Selling) or indirectly (Reselling), which makes up four channel structures: (AoAs, AoRs, RoAs, RoRs). Yet, different-quality products may match to different channels. What is the best channel structure for the manufacturer who has two partially differentiated products and what are the key drivers? A manufacturer-Stackelberg leader game model is proposed for this purpose. We found mode AoAs is always the best policy. Furthermore, product quality differentiation and market power differentiation affect channel selection.

■ TD15

202B, 2nd Floor

Customer Relationship Management (CRM)

Contributed Session

Chair: Rouwen Wang, National Central University, No. 300, Zhongda Rd., Zhongli District, Taoyu, 32001, Taiwan, 103481023@cc.ncu.edu.tw

1 - Facilitating the Participation of Value Co-creation in Sharing Economy from Trust Perspective

Yongqin Xie, Sun Yat-Sen University, GuangZhou, China, xieyongq0615@qq.com

Service innovation enabled by IT in the sharing economy provides strangers with the opportunity to cocreate value by exploiting idle resources. Trust is a key challenge for the success of sharing economy. Since sharing economy encourages both online and offline interaction, technology trust and provider trust have a mixed effect on the customers' behavioral intention to participate in cocreation. The current study develops a theoretical model, to explain the effect of interaction between different types of trust on the value co-creation behavior. The result will extend the study of relationship between technology trust and interpersonal trust, which will provide suggestions for the practice.

2 - The Mechanism of Online Brandinteraction Behaviors on Purchase Behaviors

Xuehua Liao, Business School, Sun Yat-sen University, 135 Xingang East Road, Guangzhou, 510275, China, liaoxueh@mail2.sysu.edu.cn, Kang Xie, Jinghua Xiao

This research aims to address deeply on how brand community participation behavior affect purchase behavior. We gather data from an online brand community initiated by an online women's clothing enterprise in China, and also the background transaction data in the database. The dataset cover all the users' online brand community participant behavior and their purchase behavior during the last three years. This research puts forward a fresh analytical perspective into the intrinsic action mechanism of online brand community, and provides empirical evidence to shed light on the answers to unlock the participation-purchase effect confusion.

3 - Measuring the Effectiveness Change of Customer Relationship Management with Dynamic Network DEA Model

Rouwen Wang, PhD Candidate, National Central University, No. 300, Zhongda Rd., Zhongli District, Taoyu, 32001, Taiwan, h80005@gmail.com, Dong-shang Chang, Ling-Feng Shao

The purpose of customer relationship management (CRM) is to improve customer satisfaction and enhance long-term business performance. Due to the business scope of manufacturing industry has been expanded, including product design, product information, sales process, logistics operations, and after-sales service. This study investigated the satisfaction score of 1161 customers from the CRM system from 2012 to 2016. Then, Dynamic Network Data Envelopment Analysis model is used to evaluate the effectiveness of CRM. This result reveals the change of effectiveness at different times. Furthermore, the DMUs of relative ineffectiveness could be identified and make the improvement program.

■ TD16

203A, 2nd Floor

Forecasting

Contributed Session

Chair: Inga-Lena Darkow, BASF - BASF East Asia Regional Headquarters Ltd, No 1 Connaught Place, Jardine House, Hong Kong, Hong Kong, inga-lena.darkow@basf.com

- 1 - The Effect of Big Data Variables in a Diffusion Forecasting Model**
Jinah Yang, Ewha Womans University, 52, Ewhayeodae-Gil, Seodaemun-Gu, Seoul, Korea, Republic of, yangyang8476@naver.com, Daiki Min, Jeenyoung Kim

The advent of big data is helpful to analyze and predict consumers' behavior. This paper aims to examine the use of big-data in forecasting the demand for Reverse Mortgage (RM) in Korea by integrating big-data variables into the Generalized Bass Model (GBM). We use big-data variables such as search traffic, blog and online news volume as the proxy of leading variables in addition to the HPI (House Price Index) representing a lagging variable. In terms of prediction accuracy, numerical analysis shows that the GBM with leading variables provides better performance in forecasting sales of RM.

- 2 - Forecasting Cash Flow with a Hybrid Model of GLM and CNN**
Chih-Yang Tsai, Professor, State University of New York at New Paltz, 1 Hawk Drive, New Paltz, NY, 12561-2443, United States, tsaic@newpaltz.edu

Cash flow is known to be more volatile than net income, thus harder to forecast. We propose a hybrid cash flow forecasting model combining a generalized linear model (GLM) and a convolutional neural network (CNN). The GLM produces a time-series forecast on cash flow and several other financial variables. The CNN treats the cash flow forecast error left by the GLM as its response variable and attempts to predict the error for a better forecasting result. Predictor variables are transformed into a two-channel image format for the CNN. We obtain the dataset from the financial statements of all manufacturers (SIC: 2000-3999) listed on the New York Stock Exchange.

- 3 - Orders Forecasting for E-commerce Fast Moving Consumer Goods Based on China Shopping Carnivals**

Qianqian Han, School of Management Xiamen University, Xiamen, China, hanqianqian94@163.com, shuihua han

Frequent discounts and promotions lead to inaccurate demand forecasts for e-commerce companies during the shopping carnival. For the problem, considering the price and promotional factors, weighted moving average, one exponential smoothing, two exponential smoothing, ARIMA and ADL model are established using the historical sale data of several products from e-commerce company A. The results show that the ADL model has the best forecasting effect, of which forecasting error can be controlled below 13%.

- 4 - A Change Point Prediction Algorithm for Time Series Data with Periodic Structural Changes**

Dongyeon Jeong, Dongyeon, 77, Cheongam-ro, Pohang, Korea, Republic of, Dongyeon.jung@istlab.org, Young Myoung Ko

We present an algorithm for predicting change points in time-series data with periodic structural changes. Energy demand profiles in buildings or factories often show abrupt increases and decreases between peak and off-peak times. Such abrupt changes may significantly affect the performance of a prediction algorithm since a slight error in change points results in a huge error between real and predicted values. We take a probabilistic approach that provides confidence intervals in which change points can fall. Numerical experiments show the effectiveness of our algorithm.

- 5 - Scalable Forecasting Solutions in an Industrial Context – A Service Systems Engineering Approach**

Inga-Lena Darkow, Senior Manager and Visiting Associate Professor, BASF - BASF East Asia Regional Headquarters Ltd, Jardine House, No 1 Connaught Place, Hong Kong, inga-lena.darkow@basf.com, Esther Mohr, Benjamin Priese

Real-world analytics solutions often require an automated framework, enabling analytics teams to scale-up solutions to a variety of users. Based on a long-term case study (2014 to 2018) of a multinational chemical company we will provide insights into the development of a forecasting framework with hundreds of users today. We will provide empirical insights based on service systems engineering and design science research. The results show how technical and social design features of the platform influence the selection of best forecasting algorithms, user behaviors and the forecasting process.

■ TD17

203B, 2nd Floor

Future of Yard Operation in Maritime Logistics III

Invited: Maritime Operations

Invited Session

Chair: Ioannis Fragkos, Rotterdam School of Management, Burg. Oudlaan 50, Rotterdam, 3062 PA, Netherlands, fragkos@rsm.nl

- 1 - Integrated Planning of Consolidation and Stowage for Steel Coil Ship**

Yun Dong, Institute of Industrial & Systems Engineering, Northeastern University, dongyun@ise.neu.edu.cn, Lixin Tang

Consolidation plan and stowage plan of coil ship are to assign the steel coils onto ships and decide the specific loading location for each coil, respectively. In this paper, we focus on a problem of making integrated plan to try to achieve systematic optimization. First, according to the practical situation, an integer programming model is established to optimize ship loading, transportation timeliness, and operation efficiency. Then, the model is transformed to be a simplified form by reducing variable dimensions. Finally, extensive experiments are carried out to evaluate the modified model, and the numerical results demonstrate its performance improvement relative to the original model.

- 2 - Yard Layout Strategies for Double Cycling in Container Terminals**

Shengwang Liu, Jimei University, vigorlws@jmu.edu.cn, Youlin Li, Qijun Wu

Double cycling is an operation strategy of loading the containers into ships as they are unloaded, thus improving the efficiency of a quay cranes (QC) as well as the container port. However, in practice, the lack of an adaptive yard layout strategy greatly reduces its productivity. Therefore, it is urgent to study the fitting Yard layout strategy for this process. This paper, by using the FlexTerm simulation software, compares and analyses three storage strategies on inbound and outbound containers: the separate storage strategy, the same-ship same-bay mixture strategy and the same-ship different-bay mixture strategy. The results of simulation experiments indicate that: the separate storage strategy is the most suitable one, which can greatly improve the efficiency of double-cycling process in container terminal, and greatly shorten the docking time of a ship in the berth; the same-ship same-bay mixture strategy is the worst one, which usually makes the truck waiting too long.

- 3 - On Optimizing Maritime Transshipment Operations**

Ioannis Fragkos, Rotterdam School of Management, Burg. Oudlaan 50, Rotterdam, 3062 PA, Netherlands, fragkos@rsm.nl, Bert De Reyck, Emmanouil Avgerinos

This paper describes a modeling framework developed for transshipment operations, inspired by the operations of the Noble group, which is a global supply chain manager of agricultural and energy products and metals, minerals and ores. The flow of operations includes the transportation of coal from mines to jetties, where it is loaded onto river barges, which then transport the coal to ports where it is transferred onto ocean vessels. We incorporate the costs of delays and late deliveries, which amount to millions of dollars each month. Additional infrastructure can be hired on a spot basis to minimize the impact of delays, but it comes at a high cost. Our model minimizes the joint costs of such transshipment operations, including penalties and cost of spot-market resources. The complexity and scale of the model, however, puts it beyond the capabilities of state-of-the-art solvers. Therefore, we develop a column generation procedure that provides strong lower bounds, and a fast local search algorithm that delivers high quality solutions.

- 4 - Approximate Dynamic Programming for an Empty Container Repositioning Problem in a Cyclic Route**

Shaorui Zhou, Sun Yat-Sen University, 135 Xingang Xi Road, Guangzhou, China, zshaorui@126.com, Fan Wang

We study an empty container repositioning problem in a cyclic route where the ports in the route face uncertain demands. We formulate the problem as a stochastic dynamic programming problem. We study two special cases: in case 1, the route covers only two ports and we show that a threshold policy is optimal due to the separability of the value function; in case 2, the route covers three ports and we show that the optimal policy can be characterized by state-dependent threshold points. To overcome the classic curse of dimensionality, we propose an approximate dynamic programming algorithm for the general case. Finally, the numerical experiments demonstrate the efficiency of this algorithm.

■ TD18

North Lounge, 3rd Floor

Healthcare Analytics and Operations Management

Invited: Healthcare Management

Invited Session

Chair: Zhichao Zheng, Singapore Management University, Singapore, 178899, Singapore, danielzheng@smu.edu.sg

1 - Appointment System Design with Walk-in Patients

Cynthia Qingxia Kong, Erasmus University, P.O. Box 1738, Rotterdam, Netherlands, q.kong@rsm.nl, Diwakar Gupta

This paper considers an appointment system with walk-in patients. While walk-ins experience direct clinic waiting, patients with appointment experience indirect waiting. Patients are differentiated by their disutility from direct waiting time and strategically select between walk-in and appointment queues. This paper studies the optimal capacity allocation problem in the appointment system in order to maximize total system utility.

2 - Managing Appointments with Waiting Time Targets and Random Walk-ins

Na Geng, Shanghai Jiao Tong University, 800 Dongchuan Road, Mechanical Building A618, Shanghai, 200240, China, gengna@sjtu.edu.cn, Xingwei Pan, Xiaolan Xie

This paper addresses the appointment scheduling problem for outpatient department by considering walk-ins. Waiting time target, by using the nondecreasing waiting weight, is considered to ensure the service level of appointment patients. A stochastic programming model and a finite-horizon Markov Decision Process are proposed to determine the appointment schedule and real-time schedule. Structural properties of the optimal real-time schedule are proved. Case study shows the proposed approach can greatly improve the performance of the outpatient department.

3 - Dynamic Scheduling and Learning with Uncertain Customer Types

Jingui Xie, University of Science and Technology of China, Hefei, China, xiej@ustc.edu.cn, Zuo-Jun Max Shen, Zhichao Zheng

We study systems with multiple types of customers or jobs, where the type information is imperfect and will be learned dynamically. Each customer has a prior probability belonging to a certain type. Each type of customers can only be processed by the right servers, and a customer assigned to a wrong server must be re-scheduled. More information is learned from the mismatch and customer type probabilities are updated. The question is to dynamically schedule all customers to minimize the expected makespan. We obtain the near optimal policy, named Less-Uncertainty-First policy when there are two types of customers, insights from which are used to develop heuristics for more general cases.

4 - Opportunities for Multi-Specialty Care in Outpatient Settings

Shrutivandana Sharma, Singapore University of Technology and Design, 20 Dover Drive, Singapore, 138682, Singapore, shrutivandana@sutd.edu.sg, Shirlene Liew

Coordinated multi-specialty care is gaining prominence due to increasing focus of hospitals on patient-centric care. In this work we characterize demand and benefits of multi-specialty appointments in outpatient clinics using historic appointment data. We identify specialties that are better suited for multi-specialty care. We show that a significant population of patients can be offered same-day appointments in multiple specialties and that such a policy can increase patient attendance, decrease appointment lead times, and increase patient satisfaction scores.

■ TD19

South Lounge, 3rd Floor

OR and Healthcare

Sponsored: Health Informatics, Quality and Safety, and Simulation

Sponsored Session

Chair: Hsing Luh, National Cheng Chi University, Department of Math Sciences, Taipei, 116, Taiwan, sl@nccu.edu.tw

1 - An Exploratory Application of MCDA for Reimbursement Decision-making: A Simulation Exercise on Metastatic Castration-resistant Prostate Cancer (MCRPC) in Taiwan

Mei-Chi Lai, Researcher, Center for Drug Evaluation, Taipei, 115, Taiwan, mclai723@cde.org.tw, Fa-Yu Chang, Li-Ying Huang, Chao-Ming Chang, Churn-Shiouh Gau, Kai-ling Kao

Objectives: This study is aimed to adopt a Multiple Criteria Decision Analysis (MCDA) methodology for building a value framework for the evaluation of novel treatment options in metastatic castration-resistant prostate cancer, including abiraterone, enzalutamide, docetaxel and radium-223. Methods: By applying the

EVIDEM (Evidence and Value Impact on Decision Making) framework, eleven criteria were defined based on extensive literature review and expert consultation. Preferences were elicited using an analytic hierarchy process(AHP). Results: In terms of the rating of the treatment options, Docetaxel was rated the highest with an overall weighted preference value score of 71.6 out of 100.

2 - Survivability of the Comorbidities Patients with Lung Cancer by Bayesian Network Presenter

Kung-Jeng Wang, Taiwan Tech, Taipei, Taiwan, kjwang@mail.ntust.edu.tw, Yung-Shiang Lee, Ting-Yang Su

Lung cancer is one of the leading causes of tumor-related death. This study collects cases of which patients were diagnosed with comorbidities before diagnosed lung cancer, ranging from 1996 to 2010 in Taiwan. A total of 2,875 subjects were examined. Conditional Gaussian Bayesian network is used to evaluate patients' survival time. The resulting R2 of survival prediction model is 62.37%. The proposed model enables promising prediction on the survivability of patients with lung cancer and comorbidities, and achieves statistically proven queries and advices based on various risk factors.

3 - Ten-year Experience of Using Health Technology Assessments in Reimbursement Policy in Taiwan

Li Ying Huang, Center for Drug Evaluation, Taipei, Taiwan, lyhuang277@cde.org.tw, Cathy Kai-Ling Kao, Yen-Hui Wu, Churn-Shiouh Gau

Since 2007, Taiwan began conducting health technology assessments (HTA) to support National Health Insurance Administration (NHIA)'s reimbursement decisions for drugs and medical device. In this paper, we will briefly review and evaluation the structure, method, procedure and outcomes of the performance of HTA in Taiwan. Besides, we will examine the critical issues and challenges from HTA execution in the recent years. Furthermore, we will compare the differences in processes and methodologies between Taiwan and other countries.

4 - Establish Relationships Between Balance and Cognitive Functions with Clinical Tests in Elderly

Yun-Ju Lee, National Tsing Hua University, Hsinchu, Taiwan, yunjulee@ie.nthu.edu.tw, Yu-Hsiu Chu, Hsiu-I Chen, Yi-Cheng Lin

Fallings has been associated with fatal injuries in older adults with poor balance and cognitive functions, which could be easily evaluated by clinical tests. In healthcare, one solution is that identify potential risk factors and provide early intervention to avoid severe injuries. The objective of the current study was to investigate relationships between balance and cognitive functions by employing the corresponding clinical tests before, after, and 6-week later participating a virtual reality exercise training. Eleven healthy older adults were evaluated their balance and cognitive functions by five balance tests and four cognitive tests at the baseline, post-training, and retention phases. Either balance test could generally represent balance ability, however, the cognitive test is restricted to its corresponding assessment. The strong linear relationships between TUG, FSST, BBS, MMSE, and CTT suggested that associations between balance and cognitive functions could be enhanced by the virtual reality exercise training.

5 - Probabilistic Modelling of Chronic HBV Disease Progression

Hsing Luh, National Cheng Chi University, Department of Math Sciences, Taipei, 116, Taiwan, sl@nccu.edu.tw

Considering the disease progression is originally described by a Markov model, we propose a method to approximate the HBV progression with data from literature and population mortality. Numerical results show that the proposed model can be applied to obtain a more realistic life expectancy, the survival probabilities at specifically initial ages, and mortalities from various initial symptoms to death.

■ TD20

401, 4th Floor

Product Development

Contributed Session

Chair: Jiasong Chen, JMP, 1503-1506, Grand Gateway, No.1 Hongqiao Road, Shanghai, 200030, China, Jason.Chen@jmp.com

1 - Investigating Opportunity Spaces in Online Platforms**OpenIdeo Case**

Seyed Mojtaba Sajadi, University of Tehran, Kargar-e-Shomali, Tehran, Iran, Islamic Republic of, msajadi@ut.ac.ir, Mohsen Jafari Songhori

Parallel search is one of the approaches to innovation where a large number of ideas are generated and then a subset is selected for further development, with just a few coming fruition. However, repetition is a major drawback of this approach. In this research, using data from OpenIdeo that builds communities in order to generates design solutions for the world's biggest challenges, we aim to identify whether repetition in the opportunity landscape of an online platform differs from the previous non-online ideation studies, and also unique ideas are more valuable than the other ideas that are similar to many others?

2 - A Game Theoretic Model for Postponed Manufacturing of Product Family in the Supply Chain

Jun Wu, Tianjin University, Tianjin, China, junwmth@163.com

In this paper, we consider a supply chain with multiple suppliers, a single manufacturer and multiple delayed distributors. A game theoretic model is established. We also analyze the influence of manufacturer's choice on the product family design, supplier selection, delayed distributor selection, and pricing strategies on profits. Genetic algorithm is applied to obtain the solution of this model. A case study of car manufacturer to illustrate the effectiveness of the proposed methodology.

3 - Visual Tolerance Analysis for Engineering Optimization

Jiasong Chen, SAS, 1503-1506, Grand Gateway, No.1 Hongqiao Road, Shanghai, 200030, China, Jason.Chen@jmp.com

Classic methodologies of DOE are widely applied in design, manufacture, quality management and so on. However, it is not an end of DOE. One of its shortcomings is neglect of propagation of errors, which make the so-called "improved process" still produces an amount of defects continuously. Visual tolerance analysis is a right way to overcome the pity, effectively complement classic DOE and perfect the final feasible solution. With the help of visual tolerance analysis the engineers and statistical analysts could work together to find out. What is the key factor leading to propagation of errors, and how to reduce it significantly?

4 - Tapping Into Science: University Research Alliances, Technological Scope, and New Product Development

Simcha Jong, Professor and Director, Leiden University, Leiden, 2333 CA, Netherlands, s.jong@liacs.leidenuniv.nl, Kremena Slavova

This study examines how university R&D alliances can boost firms' R&D performance. Our analysis is based on a panel dataset of 220 US biotechnology firms, 1323 firm-year observations for 2003-2010. Our findings indicate that research alliances with universities have a positive impact on numbers of new drug candidates at a pre-clinical stage of development in new to the firm therapeutic areas. No such impact is found for existing therapeutic areas. Our results demonstrate a positive, significant interaction effect between research alliances with universities and firm technological scope, suggesting that firms with a broader technological scope better capitalise on university science.

TD21

Joy, 4th Floor

Smart Traffic

Invited: Theory & Practice on Circular Economy

Invited Session

Chair: Jia-Nian Zheng, Asia University, Taichung, 41354, Taiwan, jianian.zheng@gmail.com

1 - Big Data Analysis Based on E-ticket for Explore Behavior of Bus

Jia-Nian Zheng, Asia University, Taichung, Taiwan, jianian@asia.edu.tw, Yueh-Lin Tsai

In recent years, the world has gradually moved towards "mass transit-oriented development." In public transport system, the cost-effectiveness of the bus system is much greater than that of other mass transit systems. This study obtained the 2015/01-2016/02 bus related data, including 97 million e-ticket records through the Taichung City Smart Transportation Big Data Database. This study analyzed the bus driving and passenger behavior based on the electronic ticket. We explore the performance of different performance in different time, and try to improve the performance of the operators. The results were based on the No. 100 and No. 53 with high traffic volume.

2 - Applying the Big Data of Electronic Tickets to Understand the Behaviors of Passengers with the Senior Cards and with Non-senior Cards in Public Transport

Cheng-Yuan Ho, Asia University, Taichung City, Taiwan, tommeyho@asia.edu.tw, Yao-Nan Lien, Shu-Chuan Liao

More than 82 million records of e-ticket transactions of Taichung City Bus in 2015 are analyzed. The analytic results are as follows. 1) 5.26 million e-ticket users received benefits from Taichung City Government's policy; however, less than 10% users took buses for the major transportation tool. 2) Among five e-ticket types, the full-fare ticket type was the most used type since the ratios of its amount and transaction records were the highest, about 92.62% and 89.17%, respectively. 3) The passengers with senior cards usually got off buses near traditional markets, hospitals, and department stores while the one with non-senior cards got off buses near schools, shopping areas, and transfer stations.

3 - Analyzing the Regularities of Passengers According to Different Time Intervals via Local Electronic Bus System Data in Taiwan

Shin Hung Pan, Asia University, Taichung City, Taiwan, vincentpan@live.asia.edu.tw, Jing-Doo Wang, Yao-Nan Lien

It is interesting to extract and analyze the regularities of the passengers' behavior such that the government can provide public transportation support with quality

control sufficiently and consistently. This study adopts the previous work that is a scalable approach based on Hadoop MapReduce programming model to extract maximal repeats from tagged sequential data and meanwhile to compute class frequency distribution of these maximal repeats, where the types of classes are derived from the tags attached with each of sequences according to users or domain experts in advance. In this study, experimental resources of sequential data contain the records of bus traffic data in 2015 and are authorized by the Taichung city government officially. Each record for one passenger includes two pair of timestamp and bus-stop representing for when and where that passenger on and off the bus, respectively, and the sequence of ordered bus-stops within his/her trip. Most of all, the types of tags for each of sequences include the types (CardType) and identification (CardID) of electronic card, the identification of bus route (RouteID) and the bus (BusID) that carried that passenger. Therefore, it is highly expected that the combination of these tags will provide many kinds of class frequency distribution and one can inspect the behaviors of buses and passengers from various points of view.

TD22

Elegance, 4th Floor

Multidisciplinary Applications of MCDM III

Sponsored: Multicriteria Decision Making

Sponsored Session

Chair: Jei-Zheng Wu, Soochow University, Hsinchu, 300, Taiwan, jzww@scu.edu.tw

1 - Effectiveness Test to Promote the Use of Multicriteria Decision-making in the Artificial Intelligent Era

Jei-Zheng Wu, Associate Professor, Soochow University, 11f-2, No. 38, Section 1 Kuang Fu Road, Hsinchu, 300, Taiwan, jzww@scu.edu.tw

Intelligent manufacturing approaches have been developed to ensure the manufacturing excellence through soft computing, decision technologies, and evolutionary algorithms in the artificial intelligence era. Empirical evaluations of different model-based MCDM methods have emerged as a new research area of behavioral operations research. To further accomplish next-generation social intelligent manufacturing, this study discusses sets of measurement and a framework that help to promote effective MCDM from the integration of distributed and decentralized decisions.

2 - Using Fuzzy Integral Method to Measure the Competitiveness of Similar Price B&B in Sanming City

Feng Ching, Sanming University, Sanming City, China, fengching@me.com

B&B is the product of the reuse of idle space in the household, there are good and bad situations in quality. The unstable quality will affect B&B's business and even affect the entire city's tourism image. Thus, how to evaluate the competitiveness of B&B is an important issue. Past measuring methods usually use additive evaluation methods, but the lack of discussion of "synergy" is a special case in the real world. Therefore, this paper will use fuzzy integral method, a non-additive evaluation method to analyze the B & B competitiveness of Sanming City.

3 - Application of Modified Fuzzy Delphi Method to Discuss "New" Traditional Fashion Design Principles

Xiao-Mei Liu, Sanming University, Sanming city, China, 617007713@qq.com

In the past, many garment designers have tried to integrate traditional elements into their current fashion, called "new traditional fashion". It is very important to establish the design principle of "new traditional fashion". The modified fuzzy Delphi method consists of two parts: open items and confirm of important level for each factor. Open items can enhance the integrity of the structure, confirm of important level can increase the credibility of the structure. Therefore, this paper will establish the design principle of "new traditional fashion" by using the modified fuzzy Delphi method.

4 - Employee Orientation Strategy Using Multiple Criteria Decision Analysis

William Shiu, Graduate Student, New York University, New York, NY, United States, williamshiu@gmail.com, Jau Yang Liu, Fu Hsiang Chen

This study proposes a novel systematic method to incorporate critical dimensions and their associated criteria drawn from extant literature on employee orientation aspect of corporate social responsibility (CSR). With the application of the multiple criteria decision analysis, it further provides empirical evidences on the order of improvement strategy and sequence in employee care based on domain expert interviews and survey questionnaires. This research has significant implications for the planning and implementation of CSR particularly from the employee's perspective.

Wednesday, 8:00AM - 10:30AM**■ WA01**

101A, 1st Floor

Sustainable Supply Chain I

Contributed Session

Chair: Shu Guo, The Hong Kong Polytechnic University, Hunghom, Kowloon, 999077, Hong Kong, eunice77010@gmail.com

1 - The Sustainable Investment in a Supply Chain with Competition and Spillover Effect

Xiutian Shi, Nanjing University of Science and Technology, Nanjing, China, xtshi@njust.edu.cn, Ciwei Dong, Chi Zhang, Xiaoli Zhang

In this paper, we study the sustainable investment strategies in a competitive environment for a supply chain consisting of one manufacturer and two retailers. There are three investment strategies, i.e., the investment is made by the manufacturer, both retailers and only one retailer, respectively. We find that the manufacturer prefers to let both retailers to make the sustainable investment. However, the retailers may prefer not to let the manufacturer make the investment. Besides, due to the spillover effect from the competitor's sustainable investment, the free-rider can improve the profit, whereas the improvement is not significant.

2 - Reduce Carbon Emissions Across Supply Chain: The Role of Information Sharing

Sijie Zhou, Student, University of Science and Technology of China, No.96, JinZhai Road, Baohe District, Hefei, 230026, China, zhouzijie2010@163.com, Yugang Yu

This study is motivated by a few international retailers (like, Walmart and H&M) cooperating with their suppliers to reduce carbon emissions across the supply chains. Our paper investigates the operations associated with information sharing and studies its influence on environment under the real condition. We show that with Bayesian updating of demand, information sharing will benefit supplier but possibly hurt retailer. We reveal the conditions favoring information sharing: information sharing doesn't always benefit the environment, which contradicts to the popular thoughts about the advantage of collaborative contracts between retailers and suppliers.

3 - Effect of Remanufacturing Times on Supply Chain Decision in Special Equipment Aftermarket Service

Shuiye Niu, Tsinghua University, Beijing, China, blueanglelove@126.com

The improvement of remanufacturing technology has enabled many special high-end equipment to realize repeated remanufacturing. Set the remanufacturing times as the decision variable, and build a two-stage supply chain game model to target the multi-cycle manufacturing and remanufacturing hybrid production system. The optimal remanufacturing times, recovery rate, and pricing of new and remanufactured products under various production conditions are systematically explored. Results show that manufacturers can improve product remanufacturing times to increase the profitability of the entire supply chain, especially when consumers are more sensitive to repeated remanufacturing times.

4 - Fashion Mass Customization Supply Chains with Consumer Returns: Quick Response and Supply Chain Contracts

Shu Guo, The Hong Kong Polytechnic University, HK, Hong Kong, eunice77010@gmail.com

This study explores a fashion mass customization supply chain which permits unconditional consumer returns. The impacts brought by the quick response strategy as well as the different salvage values of consumer returns and unsold inventories are discussed. Besides, insights regarding applications of different supply chain contracts and industrial measures for improving mass customization operations are also generated.

■ WA03

101C, 1st Floor

Operations Management III

Contributed Session

Chair: Subrata Chakrabarty, University of Texas at El Paso, El Paso, TX, xx, United States, chakrabarty@gmail.com

1 - Leveraging Consumer Technology to Learn Demand Information

Ye Shi, Dr, University of Science and Technology of China, 96 Jinzhai Road, Hefei, 230026, China, hecralies@gmail.com, Layth Alwan, Xiaohang Yue, Srinivasan Raghunathan

Innovative supply chain collaborations have traditionally been enabled by inter-organizational systems such as electronic data interchanges (EDI) and business-to-business (B2B) platforms. However, such collaborations sometimes fail because of reasons such as lack of trust. In this paper, we examine a recent innovative program that exploits a ubiquitous consumer technology (the mobile app WeChat in this case) to acquire demand information directly from consumers. Using real-life data from Zhenxin, a company in China that has implemented the WeChat program, we demonstrate the value of the WeChat program can be substantial

2 - Concepts of Locavore Constructed through Food Supply Chains in Taiwan

Shao Chieh Lin, PhD Student, Asia University, Taichung, 41354, Taiwan, ol2310@hotmail.com
Shao Chieh Lin, PhD Student, National Chi Nan University, Nantou, Taiwan, ol2310@hotmail.com, Cheng Jen Son, Huang Y. H.

The issues of the food safety are valued by the public. Consumers care about the food production. Suppliers shorten long and opaque food supply. The 'locavore' is based on the Local Consumption of Locally Produced. However, the contemporary literature with respect to the 'locavore' is variously conceptualized. The purpose of the study is to conceptualize the local food system and the notion of 'locavore' by using a qualitative research approach from the perspective of the Food Supply Chain. This study will in-depth interviews, focus groups and content analysis to conceptualize the local food system and the notion of 'locavore'. The practical implications and future research of the food supply chain.

3 - An Empirical Investigation of Stock Market Investors' Appreciation for Inventory Leanness

Subrata Chakrabarty, Associate Professor, University of Texas at El Paso, El Paso, TX, United States, chakrabarty@gmail.com, Liang Wang

Our empirical investigation of organizations in the manufacturing industry suggests that sectors with high information technology usage are more likely to ensure that their inventory levels are responsive to information inputs, and a benefit is that shareholders have greater appreciation for inventory management in such sectors. In fast information rich sectors of industries, firms need to be agile and hence their inventory management practices need to be lean and responsive to changes. Further, in such environments, shareholders' willingness to pay a premium for an organization's stock is sensitive to the organization's inventory leanness.

4 - The Integration of Operations, Maintenance and Workforce Planning

Andrew Junfang Yu, The University of Tennessee at Knoxville, UT Space Institute, 411 B. H. Goethert Pkwy., MS 19, Tullahoma, TN, 37388-9700, United States, ajyu@utk.edu, Javad Seif

We present a novel mixed integer programming model that integrates operations, maintenance, and workforce planning. The objective is to maximize the availability of a set of identical machines over a planning horizon, subject to operations and maintenance requirements, and manpower limitations. Multiple types of maintenance are considered, while each maintenance type requires different types of skills at certain competency levels.

■ WA06

103, 1st Floor

Tutorial: The Evolution of Supply Chain Function in the Context of India

Tutorial Session

1 - The Evolution of Supply Chain Function in the Context of India

Narasimhan Ravichandran, Indian Institute of Management-Ahmadabad, Wing 2 D, Vastrapur, Ahmedabad, 380015, India, nravi@iimad.ernet.in

We document the evolution of two organizations in the complimentary area of Supply chain in the context of India. The first organization is in the commercial space selling consumables on a branded platform with multiple Stock keeping units. The presence in the multiple geographical markets over a period of time adds to the complex nature of the distribution function. The company has developed a extensive distribution network to meet the consumer expectation. Inventory management and order fill rate become the next set of priority areas. The co-ordination with sourcing of Raw material became critical for business advantage. Designing the marketing and sales schemes to support the supply chain function and gain market share was the next priority. Appropriate metrics were defined to evaluate and align the efficiency of the SCM operations. Using advances in ICT the organization has evolved a robust SC structure and systems. Today, the supply chain management principles of this organization is comparable to the best in world in FMCG segment. The second origination is service provider in the area of logistics and supply chain. The growth of the organization is tracked with the changes in the environment in the Indian context. The innovative solutions adopted by the organization makes it vibrant and competitive. The entrepreneurial spirit of the organization keeping the changes in the opportunity land scape is captured. The customer centric measures add to the competitive positioning. Both the stories are positioned in the overall context of research trends in SCM and the macro- economic environment in India. The central role played by ICT is highlighted.

■ WA07

105, 1st Floor

Scheduling I

Contributed Session

Chair: Daniel Oron, The University of Sydney, The University of Sydney, Sydney, Australia, daniel.oron@sydney.edu.au

1 - Process Innovation of Synchrotron Radiator using Time Indexed Single Machine Scheduling

Myungho Lee, Graduate Student, Postech IME, 77, Cheongam-ro, Nam-gu, Pohang-si, 37673, Korea, Republic of, hojong10@postech.ac.kr, Kangbok Lee

Synchrotron radiator is a microscope used for many scientific research areas such as protein structural analysis. In spite of its importance, there is little research on operating it. This paper provides an optimization model for a synchrotron radiator scheduling problem. Since synchrotron has multiple and independent beamlines, we formulate each beamline's operation as a single machine problem to minimize weighted total completion time, preemption cost and penalty for time preference. We use a time-indexed MIP formulation and solve it with a commercial solver in a reasonable time.

2 - A Column and Row Generation for a Generalized Cutting Stock Problem with Setup Cost

Wang Danni, Tongji University, Shanghai, China, 2929808289@qq.com, Zhe Liang

In this paper, we address a generalized cutting stock problem with setup cost, which arises in a make-to-order steel company. The problem is to cut a limited set of rectangular steel coils into a number of smaller rectangular sheets so as to minimize the total production cost (material cost + setup cost) as well as meet customers' demand. In our problem, customers may want sheets that are longer but narrower than the available coils' length. We present a column and row generation algorithm to solve this problem. The computational results show that the model can solve the small and mid size real-life problems in reasonable time.

3 - The Project Resource Leveling Problem with Uncertain Generalized Precedence Relations

Hongbo Li, Shanghai University, Baoshan District, Shangda Road 99, Shanghai University, Shanghai, 200444, China, ishongboli@gmail.com

We study the project resource leveling problem with uncertain generalized precedence relations (RLP-UGPR) where both time lags as well as activity durations are stochastic. The aim is to obtain a scheduling policy such that the usage of renewable resources is smoothed as much as possible over time. We propose a simulation-based solution framework for the RLP-UGPR. Metaheuristics are designed based on the framework. Extensive computational experiments on a large number of randomly generated instances are performed and the impact of the time variability and the project due date are examined.

4 - Characterization of Optimal Schedules in Assembly Flow Shops with Two or Three Stages

Uttarayan Bagchi, Professor, University of Texas-Austin, McCombs School of Business, 1 University Station B6500, Austin, TX, 78712-0212, United States, uttarayan.bagchi@mcombs.utexas.edu

Consider a scheduling problem where multiple customer orders await processing in one or more stages of an assembly flow shop. The scheduling objective is to minimize makespan. We generalize the extant results in the literature to include zero processing times and non-permutation schedules. We introduce two categories of schedules: semi-aligned and aligned. New results include various dominance conditions involving aligned and permutation schedules, and heuristic performance guarantees.

5 - Scheduling Resource Dependent Processing Time Jobs with Customer Fairness Considerations

Daniel Oron, The University of Sydney, Sydney, 2006, Australia, daniel.oron@sydney.edu.au

We consider several single machine scheduling problems with resource dependent processing time jobs to minimize the makespan and total completion time. Job processing times are modeled as convex functions of the amount resource they are allocated, and two new measures of fairness towards customers are introduced. We seek an optimal allocation of resources to jobs and an optimal job schedule that minimizes the scheduling criterion under the condition that the level on unfairness in the service provided to different customers is bounded. Based on interesting properties of optimal solutions, we present efficient algorithms for the problems.

■ WA08

201A, 2nd Floor

Big Data & Business Applications

Contributed Session

Chair: Ahmed Gomaa, University of Scranton, 1004 Pheasant Run Rd, South Abington Twp, PA, 18411, United States, ahmed.gomaa@scranton.edu

1 - Particles in a Box: Investor Portfolio Optimization

Sanjeev Naguleswaran, QSPectral, 2/125 Bulimba Street, Bulimba, 4171, Australia, sanjeev@qspectral.com.au, Dmitriy Kinaev

In the typical startup investment scenario, the investor is relying on picking at least one company that will provide a return high enough to offset losses even if all other companies in the portfolio fail to provide returns. Therefore, companies with a high probability of winning big need to be identified under high uncertainty. We propose that this selection can be achieved by representing the eco-system as a box and modelling companies as particles with varying energy and interactions, depending on attributes such as Industry area, Product-Market Fit, Founding Team etc. Statistical mechanical methods in the form of the Boltzman distribution can then be used to model the evolution of the system.

2 - The Effect of Review Valence and Regulatory Focus on New Product Online Review Usefulness

Peng Zhu, Nanjing University of Science and Technology, School of Economics and Management, 200 Xiaolingwei Street, Nanjing, 210094, China, p.zhu@outlook.com, Yan Zhang, Lu Li

If new products want to survive in market, comments from earlier adopters are significantly important. Past researchers have shown that people tend to weigh negative information more than positive information. What kind of influence will regulatory focus put on review usefulness of incremental innovative products and radical innovative products? Our experiments indicate that: The impact of review valence on review usefulness exists an interaction, and compared with the incremental new products, the usefulness of negative reviews on radical new products are higher, while there is no significant difference between the usefulness of positive reviews on different types of new products.

3 - Ranking Online Reviewers as a Variable in Value Creation

Satya Prattipati, University of Scranton, 1004 Pheasant Run Rd,
South Abington Twp, PA, 18411, United States,
Satyanarayana.prattipati@scranton.edu, Ahmed Gomaa

Positive online patient reviews attract and retains patients. One problem is how to put a weight on the identity of the different reviewers as they impact the provider perceived value. This paper proposes a new algorithm that ranks each reviewer by weighting the type of feedback they provide for each type of service providers. The weighting is using the level of contribution a reviewer provides and how much the reviewer engages with other online community. All variables are represented as binary matrices to be able to calculate the corresponding Eigen vector and generate a weight for the reviewers based on those variables.

4 - What are the Factors Affecting Restaurants' Sales on Take-away Platform?

Hu Huang, Xiamen University, Xiamen, China,
670800069@qq.com, Shuihua Han

The take-away platforms have several distinct differences compared to traditional restaurant reviews websites. Consumers make purchasing decisions based on these information the platforms offered, e.g. WOM, reviews, promotion, sometimes it's the only information they can obtain about the stores. Besides, consumers don't go to restaurant and the food is directly delivered to them. How these information and delivery affect the restaurants' sales on the take-away platform remain unexplored. We conducted some analysis using data we crawled from Eleme. It turns out the reviews have the deciding influence on the sales. At the same time, whether a store is certificated as premium also impact sales.

5 - Patent Quality Evaluation Model Based on Hesitant Fuzzy Soft Set

Jianli Yu, Brenau University, Gainesville, GA, United States,
yhan@tiger.brenau.edu, Qian Li, Li Zhang

The existing methods of patent quality evaluation are generally based on expert evaluation and scoring, which requires experts to give an evaluation value of all the patent indexes and their weights. However, an evaluation index system of patent quality often involves multiple evaluation indexes in different fields, for example the level of professional technical, the value of market economy and the ability of legal protection, evaluation experts have their own expertise and have difficulties in making an objective evaluation on unfamiliar assessment indicator. In addition, the high complexity of the patent itself makes evaluation index uncertain and fuzzy, experts will hesitate between several possible solutions (or values) in the process of evaluation and decision making. The hesitant fuzzy soft set can describe the essence of things more accurately, and has no restrictions on the optional objects, so that the degree of hesitation can be taken into account. Therefore, proposing a patent quality evaluation based on fuzzy soft set hesitation model, this model can solve the fuzziness of evaluation index, the hesitation of expert evaluation, the binding force of evaluation index. Establishing evaluation index system, giving the concrete steps of evaluation method, and through a case to illustrate the feasibility and effectiveness of the evaluation model.

■ WA09

201B, 2nd Floor

Supply Chain Management III

Contributed Session

Chair: Zhongyuan Hao, Polytechnic University, Room MN037, HK
Hong Kong, zy.hao@connect.polyu.hk

1 - Profit Maximization of Two Newsvendors with Inventory Transshipment under Limited Supply

Ziteng Wang, Assistant Professor, Northern Illinois University,
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zwang3@niu.edu

Inventory transshipment is beneficial to supply chain participants. We investigate the profit maximization strategies of two newsvendors when the total amount of resource is limited and inventory transshipment is conducted. We derive the best ordering decision and Nash equilibrium solution. The existence and uniqueness conditions derived clearly unveil the joint effects of having limited total supply and inventory transshipment. The benefit of inventory transshipment may vanish due to the limited supply capacity. A carefully chosen transshipment price plays an important role in keeping inventory transshipment beneficial to both news-vendors. A coordinating mechanism is designed.

2 - Sharing Demand Information under Bounded Wholesale Pricing

Hongtao Zhang, Hong Kong University of Science & Technology-
HKUST, Dept of ISOM, Clear Water Bay, Kowloon, Hong Kong,
imhzhang@ust.hk

The extant research on supply chain information sharing under wholesale pricing often assumes a model where the manufacturer can unilaterally set any wholesale price, and the retailer decides retail price or quantity while taking the wholesale price as given. Whereas this model may actually reflect the relative market power in some situations, it misses out on certain win-win opportunities that could arise from information sharing. We look into these opportunities and

investigate a new wholesale pricing mechanism that promotes information sharing between a relatively weaker retailer and a more powerful manufacturer such that both parties become better off.

3 - A Two-subperiod Ordering Decision Problem with Inventory Sharing and Transshipment

Housheng Duan, Sun Yat-Sen University, Lingnan (University)
College, No. 135, Xin'gang Xi Road, Guangzhou, 510275,
Guangzhou, China, duanhsh@mail2.sysu.edu.cn, Haiqing Song

We study a two-subperiod stocking decision problem in a decentralized inventory-sharing system consisting of a manufacturer and two independent retailers. Before the first subperiod, both retailers need to make inventory decisions. At the beginning of second subperiod, the retailer 1 decides whether to transship some quantity from retailer 2 with a transshipment price, while retailer 2 will also determine the maximum quantity he/she might to transship out according to his/her on-hand inventory and expected demand in the second subperiod. We find that the transshipment price has significant influence on the optimal inventory and maximum profit of both retailers.

4 - A Study on Information Integration from Consumer Perspectives for Halal Food Supply Chain in Japan

Daisuke Kitayama, Kanagawa University, Yokohama, Japan,
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Siti Hawa Radin Eksan, Mohd Helmi Ali

Halal foods are necessary for Muslim people living outside of their homelands. Halal certification and a Muslim friendly policy have been adopted in Japan. However, halal food integrity cannot always be guaranteed. From the consumers' perspective, information integration is important for establishing food integrity within the supply chain. Using a questionnaire survey, we investigate what information should be disclosed to Muslim consumers by suppliers, manufacturers, retailers, and restaurants in Japan. In addition, we discuss the costs of information integration in order to meet consumer needs.

5 - Impacts of Sequential Acquisition, Market Competition Mode and Confidentiality on Information Flow

Zhongyuan Hao, Assistant Professor, Nanjing University of
Aeronautics and Astronautics, Nanjing, China,
lingyuran881201@163.com, Li Jiang

We investigate information flow in a setting in which two retailers order from a supplier and sell to a market with uncertain demand. Each retailer has access to a signal. In the base setting, market competition is in quantity and a retailer can fully infer the signal the other retailer discloses to the supplier by its adjusted wholesale price. We study the signaling effect, whereby the supplier utilizes wholesale pricing as an instrument to influence the retailers' inference of the shared signals, and price competition, for their intricate impacts on the supplier's preference for sequential acquisition and the sustainability of information flow.

■ WA10

201C, 2nd Floor

Global Logistics I

Contributed Session

Chair: Yi-Ju Cheng, Asia University, No.38-1, Longmen 1st St.,
Xitun Dist., Taichung, 40755, Taiwan, tta999tw@gmail.com

1 - The Antecedents of Patronage Online Reservation Platform of EZTABLE Restaurant

Wen Cheng Lu, Asia University, Taichung, Taiwan,
series2176@gmail.com, Shieh-Liang Chen, Wen-Hong Chiu,
Kuo-Pin Li

EzTable is the largest online reservation platform of restaurants in Taiwan. The purpose of this paper is to explore the antecedents of consumer's patronage at Eztable restaurant. The total valid sample is 519 consisting of 105 online patrons and 414 non-patrons. The results of this study provide many managerial implications for online restaurant reservation system.

2 - Strategies of Mitigating Customer's No-shows at Restaurants

Kuo-Pin Li, PhD Student, Department of Business Administration,
Asia University, 500 Liufeng Road, Wufeng, Taichung, 41354,
Taiwan, 09877leo@gmail.com, Shieh-Liang Chen, Wen-Hong
Chiu, Wen-Cheng Lu

No-show reduction at restaurants can not only mitigate losses incurred when customers fail to honor a booking but also affect consumers' reservation behaviors. This study analyzed the ability of restaurant booking policies to mitigate no-shows as well as their negative impacts. A survey was conducted to understand the booking policies of the Taiwanese restaurant industry. The findings indicated that each sector of the restaurant industry possesses unique characteristics.

3 - Application of Biological Printing Service Technology in Medical Device Selection

Kuan-Chih shu, Asia University In Taiwan, 500, Lioufeng Rd., Wufeng., Taichung Taiwan, 41354, Taiwan, asiacoltd@yahoo.com.tw, James K. C. Chen

LoRa's wireless transmission technology helped the Internet of Things to complete the last piece of the puzzle. Because LoRa has eight frequency channels, it can accommodate approximately 4,800 devices per minute ($2.5 \times 4 \times 8 \times 60 = 4800$), (Flexible Frequency Table). This article focuses on how LoRa can assist service providers in technical aspects, be able to connect endpoints to existing infrastructure, have reliable systems and communications protocols, and be able to confirm link strength and practical technical limitations. The future provides a wide range of applications and services in industrial control, building automation, consumer, asset tracking and localization. In the foreseeable future, when LoRa's mobile devices are widely deployed, a large amount of terminal equipment data will be collected in real time in public clouds or deployment clouds that break into multiple prediction models to perform big data analysis and calculations. Changes in cognition and management of food, clothing, housing, and transportation in all aspects will make people's habits of living and the quality of things to judge.

4 - The Psychological Perception of the Elderly in Buying Nutraceutical Products and its Consumption Barriers

Yi-Ju Cheng, Asia University, No.38-1, Longmen 1st St., Xitun Dist., Taichung, 40755, Taiwan, tta999tw@gmail.com, Ching-Ying Huang, Cheng-Feng Cheng

The nutraceutical market becomes increasingly competitive. Large firms use the market permeation strategy and marketing promotion with high visibility in pursuit of increasing market share. In such case, to compete in the market is a critical issue for firms. Thus, understandings of consumption facilitators and constraints of purchasing intention help the enterprises to adopt the right plan. The current study attempts to identify elders' and general consumers determinants of the nutraceutical purchasing intention and thus distinguish the nutraceutical consumption facilitators from consumption constraints.

■ WA11

201D, 2nd Floor

Financial Analytics

Invited: Data Mining

Invited Session

Chair: Daniel Wei-Chung Miao, National Taiwan University of Science and Technology, Taipei, 106, Taiwan, miao.oxon@gmail.com

Co-Chair: Kenneth Pao, pao@mail.ntust.edu.tw

Co-Chair: Mu-En Wu, Taiwan, mnwu@ntut.edu.tw

1 - Data Analytics for Credit Rating, Digital Currency and Algorithmic Trading

Wei-Ho Chung, National Tsing-Hua University, Hsin-Chu, Taiwan, whchung@ee.nthu.edu.tw

The combination of Information and Communications Technology (ICT) and finance industries has gained widespread attention recently. It has developed many new applications which serve the economics and society via an efficient and innovative ways. In this tutorial, we will introduce an overview on Financial Technology (Fintech) and elaborate the data analytics on Fintech. We will address credit rating, digital currency, program trading, algorithm trading, and portfolio management. These topics are core mechanisms in many financial services and economic activities. For example, the investment position is an important factor, and we will address the Kelly Criterion and discuss its effects on the long term investment outcome. Besides, we will introduce an data driven approach for derivative pricing and management. In summary, we hope to bring the newly developed Fintech area jointly with data driven perspective to the audience.

2 - Relationship between Investors' Neural-Behavioral Responses and Finance by Identifying Coupled Systems of Stochastic Differential Equations, Using MARS

Gerhard Wilhelm Weber, Poznan University of Technology, Chair of Marketing and Economic Engineering, Ul Strzelecka 11, Poznan, 60-965, Poland, gerhard.weber@put.poznan.pl, Betül Kalaycı, Ayse Ozmen, Azer Karimov

Stochastic Differential Equations become a well-known format to express mathematical models under uncertainty in finance, neural systems and behavior. We represent mutual effects between some financial process and investors' sentiment by a coupled system of non-autonomous SDEs. We use MARS, and give a real-life application.

3 - Variable Selection and Oversampling in the Use of Smooth Support Vector Machines for Predicting the Default Risk of Companies

Yi-Ren Yeh, NKNU, Taipei, Taiwan, yryeh@nkn.edu.tw

A powerful tool for bankruptcy prognosis is vital for banks. The tool must be precise but also easily adaptable to the bank's objectives regarding the relation of false acceptances (Type I error) and false rejections (Type II error). We explore the suitability of smooth support vector machines (SSVM), and investigate how important factors such as the selection of appropriate accounting ratios (predictors), length of training period and structure of the training sample influence the precision of prediction. Moreover, we illustrate graphically how different models can be used jointly to support the decision-making process of loan officers.

4 - GPU Acceleration for Chart Pattern Recognition by the QBSH Linear Scaling Method

Chuan-Hsiang Han, NTHU, Taipei, Taiwan, chhan@mx.nthu.edu.tw

The use of chart patterns for stock trading is known as a method of technical analysis in finance. Chart patterns are often thought not to be quantifiable and their recognition is rather subjective. Our task is to provide methods for identifying any chart patterns in a genuine and automated way. Methods under investigation include the linear scaling method of Query-by-singing/humming (QBSH in short), Fourier transform and correlation. The first two methods are new while the last is traditional. QBSH is a classic problem of music information retrieval in audio processing and its linear scaling method is well documented as an efficient and robust method. Empirical data analysis and numerical GPU acceleration disclose the advantage of applying the QBSH linear scaling method for chart pattern recognition. (Joint work with C.-C. Chen, J.-S. Jang, C.-C. Wang)

■ WA12

201E, 2nd Floor

VRP

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Pascal Wissink, University of Edinburgh, Business School, 29 Buccleuch Place, Edinburgh, EH8 9JS, United Kingdom, Pascal.Wissink@ed.ac.uk

1 - A Column Generation Based Algorithm to Solve a Large-scale VRP with Multi-trips and Static Pick-up and Delivery

Gao Yuan, Dalian Maritime University, 1 Linghai Road, Dalian, 116026, China, gaoyuan0912@126.com

Online to Offline (O2O) Takeout refers to the need of transportations from shops or restaurants to their customers, which differ from traditional E-shop distribution in the decentralization of both time window and pick-up position. In this paper, we combine O2O and E-shop orders, consider a VRP with multiple trips and static pick-up and delivery, in order to find a set of routes in which the courier can fulfill O2O and E-shop orders in the same time. To solve it, we design an algorithm based on column generation with a saving algorithm as well as a neighborhood search procedure to solve the sub-problem. This algorithm can be used to solve large-scale problems.

2 - Efficiency of Sparse Sets of Routes in the Periodic Inventory Routing Problem

Geoffrey A. Chua, Associate Professor, Nanyang Technological University, S3-B2A-04, 50 Nanyang Avenue, Singapore, 639798, Singapore, gbachua@ntu.edu.sg, Luca Bertazzi, Demetrio Lagana, Rosario Paradiso

We formulate the Periodic Inventory Routing Problem as a mixed-integer linear program using route variables. In particular, a product has to be shipped from a supplier to a set of customers over an infinite time horizon. Given the plan periodicity, the problem is to determine a periodic shipping policy that minimizes the sum of transportation and inventory costs at the supplier and at the customers. To address the complexity of a formulation with all feasible routes, we show how to choose sparse yet efficient sets of routes, achieving good performance guarantees in short computational time.

3 - An Efficient Algorithm for Pickup and Delivery Problems with Ride-sharing and Multiple Transfers

Li-Heng Chang, Taipei Municipal Jianguo High School, Taipei, Taiwan, henry110688@gmail.com, To-Liang Hsu, Cheng-Hung Wu

This paper studies pickup and delivery problems with ride-sharing and multiple transfers. Primary transportation requests are pre-assigned to a fleet. Ride-sharing with secondary requests are allowed given time constraints of primary ones are satisfied. Temporary storages at intersections increase transfer time flexibility. The problem is formulated into a mixed-integer linear program, of which the objective is to maximize the fulfillment of secondary requests. The preliminary results show that transferring and ride-sharing has the potential to increase transportation efficiency.

4 - A Copula-based Approach to Modelling Dependence in the Probabilistic Travelling Salesman Problem

Pascal L. Wissink, University of Edinburgh, 29 Buccleuch Place, Edinburgh, EH8 9JS, United Kingdom, Pascal.Wissink@ed.ac.uk
Pascal L. Wissink, TNO, Anna van Buerenplein 1, The Hague, 2595 DA, Netherlands, Pascal.Wissink@ed.ac.uk, Jamal Ouenniche

This study employs discrete vine pair copula constructions to model dependencies in the stochastic customer presence of the probabilistic travelling salesman problem. We demonstrate that, although computationally intensive, the calculation of the expected length of a tour under multivariate conditions does not require the full enumeration of every possible tour. For specific parameter choices, our model reduces to the regular expression for the expected length of a probabilistic travelling salesman's tour with i.i.d. Bernoulli customer presences.

■ WA13

201F, 2nd Floor

Operations in Supply Chains

Invited: Operations and Economics Interface

Invited Session

Chair: Hao-Wei Chen, University of Toledo, University of Toledo, Ottawa Hills, OH, 43615, United States, haowei.chen@utoledo.edu

1 - Are Hazardous Substance Rankings Effective?

Wayne Fu, University of Michigan-Dearborn, College of Business, 127 Fairlane Center South, Dearborn, MI, 48126-2638, United States, waynefu@umich.edu, Basak Kalkanci, Ravi Subramanian

We empirically investigate the relationship between changes in the relative assessed hazard levels of chemicals and emissions reductions (including the use of source reduction and end-of-pipe treatment) by facilities that use these chemicals. We also examine the moderating effects of operational leanness - an attribute that prior studies have found to be associated with better environmental performance - in the setting wherein the relative assessed hazard levels of chemicals change over time.

2 - Structural Embeddedness and Firm's Sustainability

Ta-Wei Kao, University of Michigan-Dearborn, 160 Fairlane Center South 19000 Hubbard Drive, Dearborn, MI, 48126, United States, taweikao@umich.edu, Yi-Su Chen, Hung-Chung Su

The concept of structural embeddedness permeates supply chain management studies. However, very few studies relate this concept to sustainability issues. This study explores a firm's network structural characteristics on the sustainability performance.

3 - Let Retailers Tell You if the Product is Bad or Not - Product Quantity and Retailers Initiated Returns

Hao-Wei Chen, University of Toledo, 5019 W Dauber Dr, Ottawa Hills, OH, 43615, United States, haowei.chen@utoledo.edu

The retailer can utilize retailer-initiated returns (RIR) to maintain its brand value and reputation because not all dissatisfied customers choose to return items. With RIR, customers are encouraged to return items for refunds. We study how such a strategy affects the interactions between the supplier and the retailer.

■ WA15

202B, 2nd Floor

Business Applications

Contributed Session

Chair: Chi-Quyen Luong, Lioufeng Rd, Taichung, Wufeng, Taiwan, quyenlc0801@gmail.com

1 - Discovering the Factors Influencing Professional Baseball Box Office using Machine Learning

Hwai-Jung Hsu, Feng Chia University, Taichung, Taiwan, hjhsu@mail.fcu.edu.tw

In the past, the data analyses in professional baseball, i.e. sabermetrics, focus on evaluation of players and organizing a team for winning more games because good players bring wins and winning brings business. Winning might not be sufficient. The previous study about annual box office in Chinese Professional Baseball League show that the franchise reputation and playing styles matter. In this paper, the factors influencing per game attendance in CPBL are further studied using machine learning techniques. As a result, we found that game statistics have no influences to attendance. As long as it is during weekend, fans would attend the ball park to support the franchise highly address the local business.

2 - A Decision Rule-based Softcomputing Model for Predicting Delist Behavior in the Taiwan Stock Market

Mary Liao, National Taipei University, New Taipei City, Taiwan, mary0096tw@gmail.com, Gwo-Hshiung Tzeng

Market observation post system (MOPS) information is frequently used by the investor and analysts. However, this study finds that the MOPS convey only limited information content after controlling for company fortune dummy. In addition, we find that favorable investment policies can be formed by using both firm growth opportunity and fortune indicators.

3 - Generative Adversarial Network-Based Oversampling Method for Imbalanced Sequence Classification

Hankyu Lee, Korea University, Seoul, Korea, Republic of, kooigi303@gmail.com, Seoung Bum Kim

Imbalanced sequence classification is considered a very challenging research area. Most of existing oversampling methods address imbalance problems by generating synthetic samples of the minority class. However, these approaches cannot appropriately consider the overall sequence of the minority class. In this study, we propose an oversampling method based on a generative adversarial network algorithm that combines the multiple loss functions. The effectiveness of the proposed method is demonstrated by experiments on various benchmark data sets. Keywords Sequence classification, imbalance classification, oversampling, generative adversarial networks.

4 - Performance Evaluation of European Iron and Steel Industry

Pegah Khoshnevis, Kuleuven University, Brussel (1000), Belgium, pegah.hajimirzakhoshnevis@kuleuven.be, Peter Teirlinck, Eline Poelmans

In this study, we first look into the performance efficiency of Iron and Steel industry of European countries in the period 1952-2002. At the second stage, a truncated regression is used to identify the relationships between efficiency and environmental factors. Particularly, we study the environmental effects of government regulations and policies after the second world war, creation of the European Coal and Steel Community (ECSC) and steel crisis.

5 - Service Innovation and New Business Model of Mobile Cloud Services: A Case of Xiaomi Company

Chi-Quyen Luong, Asia University, Taichung, Taiwan, quyenlc0801@gmail.com, Wen-Hong Chiu, Hui-Ru Chi

In the age of Internet of Things, the integration of mobile cloud computing will bring new business opportunities. This study adopts case study method and Xiaomi is selected as the research case. The framework of business model consists of content, structure and governance. First, in terms of content, Xiaomi has used a large of the user community to redirect resources from which to create a business ecosystem. Second, in terms of structure, Xiaomi has built new retail models of online and offline to provide users with personalized and socialization features. Finally, in terms of governance, Xiaomi allows users to participate in the product development and especially emphasizes customer value.

■ WA16

203A, 2nd Floor

Stochastic Optimization

Contributed Session

Chair: Wenjie Sun, Tongji University, Room1, No.177, South ShanXi Road, Shanghai, China, Shanghai, China, r13381638770@sina.com

1 - Nonanticipative Optimization: From Power to Gas

Ruediger Schultz, Prof. Dr., University of Duisburg-Essen, University of Duisburg-Essen, Faculty of Mathemati, Thea-Leymann-Str. 9, Essen, D-45127, Germany, ruediger.schultz@uni-due.de

Nonanticipativity is a crucial requirement in optimization under uncertainty. Colloquially, it forbids clairvoyance, i.e., says that, in the presence of data uncertainty, decisions over time must coincide as long as the uncertainty of the data they are induced by remains unveiled. Capturing uncertainty by probability measures leads to stochastic programming models. The underlying optimization problems may come from a broad range of models, from linear programs in finite dimension to optimization problems whose constraints involve partial differential equations.

2 - A Grit Theoretical Approach on Potential Driven Networks

Gerrit Slevogt, University Duisburg-Essen, Thea-Leymann-Strasse 9, Essen, D-45127, Germany, gerrit.slevogt@uni-due.de

Potential driven networks are governed by specific (non-linear) constraints such as derivatives of the Euler equations in gas or water and Kirchhoffs circuit laws in power networks. For meshed networks finding a solution for a nomination, i.e. one vector of in- and outputs, that satisfies these equations can be taxing especially if the initial guess is bad. By simplifying those constraints to constraints on graph topology a more general inspection of the given network is possible leading to refined information on all or any specific nomination. This then has the potential to be utilized in regular solution methods, stochastic optimization or make decomposed optimization of the network possible.

3 - Strong Convexity for Mean-risk Models with Complete Linear Recourse

Matthias Claus, University of Duisburg-Essen, Thea-Leymann-Str 9, Essen, D-45127, Germany, matthias.claus@uni-due.de, Rüdiger Schultz, Kai Spürkel

Optimal solutions to strongly convex stochastic programs enjoy privileged stability properties under perturbations, for instance, of the underlying probability measure. This justifies approximation of a given probability distribution by possibly simpler ones. Amongst others, this fact motivates the search for verifiable conditions for strong convexity in terms of model data. In this talk we shall present such conditions for two-stage mean-risk models with complete linear recourse, extending results for risk-neutral models. Our analysis features well-known deviation measures such as expected excess and semideviation.

4 - Chance Constrained Programs with Mixture Distributions

Wenjie Sun, Tongji University, Shanghai, China, r13381638770@sina.com, Zhaolin Hu

Chance constrained programs (CCP) are important models in stochastic optimization. In conventional literature on CCPs, the underlying distribution modeling the randomness of the problem is usually assumed to be given in advance. However, in practice, such a distribution needs to be specified by the modelers based on the information available, which is called input modeling. In this paper we consider input modeling in CCPs. We propose to use mixture distributions to the data available and to model the randomness. By considering several scenarios and conducting numerical experiments, we demonstrate the merits of using mixture distributions and show how to handle the CCPs with mixture distributions.

■ WA17

203B, 2nd Floor

Operation Research in Maritime Transportation

Invited: Maritime Operations

Invited Session

Chair: Mingzhu Yu, Hong Kong University of Science and Technology-HKUST, Hong Kong University of Science and Technology-HKU, Kowloon, Hong Kong, mzyu@szu.edu.cn

1 - Detention Decisions for Empty Containers in the Hinterland Transportation System

Mingzhu Yu, Shenzhen University, mzyu@szu.edu.cn, Jan C. Fransoo, Chung-Yee Lee

In this paper, we study a hinterland empty container transportation system which consists of a sea container terminal and an inland container terminal. There are a hinterland container operator who is in charge of the hinterland container transportation and an ocean carrier who has an empty container depot at the sea container terminal. We utilize a two-stage game model to describe the ocean carrier's decision about the container's free detention time and the hinterland container operator's decision about the time when should an arrived empty container at the inland terminal be dispatched to the sea terminal. Optimal delivery policy of the empty container and the ocean carrier's optimal free detention time are derived. It is shown that the decentralized system does not guarantee system coordination all the time. The ocean carrier has incentive to integrate the hinterland transportation operation only if the hinterland area is not very short of empty containers.

2 - A Multi-objective Optimization Approach for Container Terminal Operation Problem Adopting Time-space Workload Balancing Strategy

Yi Tao, Guangdong University of Technology, 161 Yinglong Road, Guangzhou, 510520, China, oryitao@foxmail.com, Chung-Yee Lee

In this work, a joint planning problem for berth and yard allocation in transshipment terminals is addressed. Multi-cluster stacking strategy is proposed to split each transshipment flow into a number of container clusters and then stack each cluster in different yard blocks. A multi-objective optimization model is formulated to minimize the total distance of exchanging containers between mother vessels and feeders, and the workload imbalance among yard blocks. A novel three-stage heuristic solution approach is developed and extensive numerical experiments are conducted to show the effectiveness of the proposed approach and the benefit of the multi-cluster strategy.

3 - Do Customer Characteristics Affect Innovation Adoption? – Case studies on China Container Terminals

Ranxuan Ke, Jimei University, Haitong 502, No.1 Jiagen Road, Jimei District, Xiamen, 361021, China, keranxuan@126.com

Focusing on container terminal in the shipping industry, this research concerns container terminal companies' decisions on adoption of technological innovation by applying multiple-case study with mixed-research methods. This research involves technology innovation adoption in shipping field and is expected to expand technology innovation diffusion theory. The results of this research indicate that corporate customers have little effect on container terminals decision on adoption of technological innovation, which is different from individual customer. This paper provides example of one aspect of innovation diffusion of organization level, where customers have little impact on innovation adoption of container terminal company, though it needs verify further when expanded to other industries as well as different nations. This paper expands existing theory with the scenarios, where customers have little effect on technology adoption. The findings also address the dynamic and complexity of technology innovation diffusion.

4 - Rail Shuttle Service Pricing and Scheduling in Dry Port System

Xuan Qiu, HKUST, xuanqiu@ust.hk, Gangyan Xu

Dry ports are playing an increasingly significant role in freight transport industry. This paper studies the rail shuttle service pricing and scheduling problem in a dry port system with one dry port and multiple shippers. Bilevel models are developed to address the interaction between the dry port and shippers, with the dry port as the leader and the shippers as followers. The optimal properties of the proposed bilevel model are analyzed and a solution procedure is proposed to solve the model. Numerical studies are carried out to investigate the sensitivity of optimal decisions and performance of both parties with respect to various system parameters. The study shows that offering a higher storage price could not always bring higher profit for the dry port. A significantly high storage price will reduce shippers' total costs especially for shippers with high production rates. It is also found that low setup costs at shippers will bring not only cost savings for shippers but also profit improvement for the dry port.

■ WA18

North Lounge, 3rd Floor

Stochastic Modeling in Healthcare Management

Invited: Healthcare Management

Invited Session

Chair: Jie Song, Peking University, China, 1206182221@pku.edu.cn

1 - Dynamic Recommendation of Physician Assortment with Patient Preference Learning

Fan Zhang, Peking University, Haidian District, No.5 Yiheyuan Road, Beijing, 100871, China, 382016129@qq.com, Xin Pan, Jie Song

Web-based appointment systems are emerging in healthcare industry by providing patients with convenient services. In this work, a preference learning algorithm is proposed that optimizes the delivered recommendations and learns the patient preferences as well. We also provide numerical experiments to show the algorithm performance under random reward scenarios and comparison with that under fixed reward scenarios. We concluded the effect of the frequency to update preference estimate on algorithm performances and analysed the way the preference bound helps the algorithm to make explorations. Finally, we present a utilization-balancing approach that is effective.

2 - Appointment Scheduling with a Waiting Time Target

Xing Liu, City University of Hong Kong, Hong Kong, xliu63-c@my.cityu.edu.hk, Frank Y Chen, Jin Qi, Han Zhu

This work is motivated by the appointment booking of a care center, which accepts only advanced booking and patients should receive consultation within a stipulated target waiting time. We propose a heuristic for this advance booking problem through the policies of an allocation counterpart of the problem, which is optimal when the waiting time target is two periods.

3 - Appointment Capacity Planning with Overbooking for Specialty Clinics with Patient No-shows

Xiaolei Xie, Tsinghua University, 614 Shunde Building, Beijing, 100084, China, xiexiaolei0209@gmail.com, Xiang Zhong, Zhenghao Fan, Reynerio Sanchez

Specialty clinics typically have a critical issue with patient adherence to their clinic appointments, and suffer a huge backlog of patients. To improve patient access, we introduce a novel discrete-time bulk service queue to model the backlog dynamics, and consider different overbooking strategies to reduce backlog at a minimum risk of working overtime. The modeling framework provides a tool for scheduling template design. We also discuss managerial insights.

4 - Comparison of Gatekeeping Schemes: The Impact of Two Level Services' Capacity

Jie Song, Peking University, No 5 Yiheyuan Road, Haidian District, Beijing, 100871, China, songjie@coe.pku.edu.cn, Jianpei Wen, Xiaoquan Gao

The implicit gatekeeping scheme and the explicit gatekeeping scheme have been introduced in different countries' healthcare delivery system. To compare two schemes in terms of the congestion alleviation and operational cost reduction, we develop a unified model framework for two schemes. We firstly design optimal incentives for the implicit gatekeeping system to encourage patients to visit gatekeeper prior to consulting a specialist based on two kinds of measures: the green channel and pricing for two level services. Patients in the implicit gatekeeping system make their choice decision based on three types of cost: out-of-pocket payment, congestion externality, and the concern about the poor care delivered from the gatekeeper. We then compare the optimal implicit gatekeeping system and explicit gatekeeping system, and identify conditions that would lead the central planner to choose one scheme over the other.

■ WA19

South Lounge, 3rd Floor

Health Care

Contributed Session

Chair: Ting Peng, USTC, Jinzhai Road No.96, Hefei, China, pengt11@mail.ustc.edu.cn

1 - An Exploratory Study on the Choosing Process of Young High-educated People Engage in Care Service

Ching-Fang Wu, Nation Cheng Kung University, No.424, Bade Rd., Tainan, 830, Taiwan, r48021037@mail.ncku.edu.tw, Fang Shih-Chieh, Ching Ying Huang

In Taiwan, the nurse aide' job content is considered as a low-level technical job. As a whole, the demographic characteristics of workers engaged in long-term care services are: women over 40 years of age, returning to work, and graduate from middle or high school. The qualitative research method is used for this study in order to understand the interpretation of the job choosing, the difficulty faced at work and the motivation of continuous work from the perspectives of nurse aides. The study found that continuing to learn professional knowledge and promising career planning are the key factors for young high-educated people entering and continuing to engage in long-term care services.

2 - Modeling Approach to Estimate the Necessary Immune Response Rate for Treating Chronic Hepatitis B Virus Infection

Jeng-Huei Chen, National Chengchi University, Department of Mathematical Sciences, Taipei, Taiwan, jhchen@nccu.edu.tw

Chronic hepatitis B virus (HBV) infection and human immunodeficiency virus (HIV) infection share many similar features and both are traditionally modeled by a basic model of virus dynamics. However, this model does not present a self-sustained low-viral-load state in both infections. In our prior research, an extend model describing this state is analyzed for HIV infection. In this talk, we present our parallel results in HBV infection. In particular, we focus on our recent results on estimating necessary response rate to achieve this state, which is critical in immune therapy.

3 - Medical Consultation Simulation for Clinical Documentation using Card Gaming Methods

Ryoma Seto, Associate Professor, Tokyo Healthcare University, 3-11-3 Setagaya, Setagaya, Tokyo, Japan, rseto-ind@umin.ac.jp, Kazuya Imaizumi, Akemi Nishio, Gen Ouchi

The purpose of this work is to develop medical consultation and clinical documentation simulations for Health Information Managers (HIM) students using card gaming methods. Our faculty team selected the work breakdown structure to model medical consultations, and designed our game to train HIM students on processes for obtaining fundamental information and hypothesis development. The physicians' role team made 11.3 question cards on an average. Among all the question cards, 63.5% had closed questions. As a result, HIM students learned the importance of the information obtaining process. This work is a pilot study and more cases are needed to validate our results.

4 - Simulation and Robotic Process Automation for Hospitals in Singapore

Mark Goh, Professor, NUS, 15 Kent Ridge Drive, Singapore, 119245, Singapore, mark_goh@nus.edu.sg, Duy S Dao, Bapi Dutta, Weibo Liu, Sunil Tiwari, Zhengyong Wu, Lifan Zhang, Wei Zhang, Ming Zhao, Robert de Souza

This study seeks to apply robotics process automation to complement the workforce of a hospital's support services, enhance labour productivity, and reduce bottlenecks in the processes related to the different in-house supply chains of several hospitals in Singapore. This study is part of the National Robotics Program designed to develop robotic technologies to address national challenges such as an ageing workforce and lagging productivity, and to build

capabilities to support firms in their business model transformations by leveraging on smart technologies.

5 - A Game Model for Opening Medical Service to Foreigners: Gain and Loss Analysis

Ting Peng, USTC, Jinzhai Road No.96, Hefei, China, pengt11@mail.ustc.edu.cn

Motivated by recent trend in developing countries to open medical tourism to foreigners, we use a queueing game model to capture the interactions among customers, hospitals and policy makers, our main result shows that government's attention on economic benefit will harm local patients' welfare by increasing the crowding in public hospital, operational cost as well. But patients' time tolerance will promote the development of medical tourism.

■ WA20

401, 4th Floor

Data Envelopment Analysis

Contributed Session

Chair: Jilei Lin, Kean, 88 Daxue Rd. Ouhai, Wenzhou, 325060, China, linjil@kean.edu

1 - A Hybrid Bayesian and Data-Envelopment-analysis-based Approach to Measure the Short-term Risk of Initial Public Offerings

Joseph C. Paradi, Professor Emeritus, University of Toronto, Centre for Mgmt. of Tech. & Entrepreneurship, 200 College Street, Toronto, ON, M5S 3E5, Canada, paradi@mie.utoronto.ca

A methodology to model the uncertainty associated with the stock price of an initial public offering (IPO) through developing a frame-work where for each IPO, a unique unconditional probability density function (PDF) of price is predicted. We addressed this problem by developing a recursive and iterative process within a hybrid framework of Bayesian inference and Data Envelopment Analysis (DEA). Essentially, in most IPO cases, there exist limited hard data, yet, strong 'prior' belief (soft data). DEA, is used to develop a multi-dimensional similarity metric that serves to quantify the prior belief, required by the Bayesian phase.

2 - Assessment of the Relative Efficiency of Banks' Operating Environments Using a DEA Framework

Skarleth Carrales, Doctoral Researcher, University of Edinburgh, 29 Buccleuch Pl, Edinburgh, EH8 9TT, United Kingdom, skarleth.carrales@ed.ac.uk, Jamal Ouenniche

To the best of our knowledge, no attempt has been made to investigate the relative efficiency of the banking operating environment. This paper aims at filling this gap by analysing the efficiency of HSBC in different operating environments or countries over time using a dynamic-network DEA framework. The choice of a single bank is motivated by isolating the operating environment effect on efficiency. Our findings suggest that some banking operating environments should be improved to incentivize more bankers to consider investing in the corresponding countries, which would improve the economy as a whole, on one hand, and competition and financial services/loan offerings, on the other hand.

3 - Interval Dual-role Factors in Data Envelopment Analysis

Mehdi Toloo, Technical University of Ostrava, Czech Republic, VŠB-TU Ostrava, Faculty of Economics, Sokolská tr. 33., Ostrava, 702 00, Czech Republic, m_toloo@yahoo.com, Esmaeil Keshavarz, Adel Hatami-Marbini

Data envelopment analysis (DEA) is a data-driven method and hence the data plays an important role in this method. The role of each factor regularly is fixed as either input or output, however, dual-role factors play simultaneously input and output roles. It is most often assumed that the data is precise although, there are some situations that the data is ambiguous. This paper considers two optimistic and pessimistic viewpoints to deal with DEA models in the presence of interval dual-role factors. Theoretically, we prove some theorems to validate the proposed mixed binary integer programming models. Practically, we provide a case study to illustrate the applicability and efficacy of our approach.

4 - Predicting Takeover in China

Jilei Lin, Student, Wenzhou-Kean University, 88 Daxue Rd. Ouhai, Wenzhou, 325060, China, linjil@kean.edu, Mohammad M. Mousavi, Hanyue Zhang

This study develops a new dynamic hostile takeover prediction model and compares its performance with the existing takeover prediction models in the literature. In the first stage, we developed a dynamic measure of corporate governance (CG) efficiency using a multi-period Data Envelopment Analysis (DEA). The estimated CG is then used in the second stage, as a new feature, in combination of accounting and market information, to develop a dynamic hostile takeover prediction model. The contributions of this research are two-fold: first, to the best of our knowledge, this is the primary study to apply a dynamic model to predict hostile takeover. Second, this research proposes a new CG efficiency measure.

■ **WA21**

Joy, 4th Floor

Technology & Applications

Invited: Circular Economy

Invited Session

Chair: Tsai-Chi Kuo, Chung Yuan Christian University, Taoyuan, Taiwan, tckuo@cycu.edu.tw

Co-Chair: Earl-juei Wang, National Pingtung University of Science and Technology, Pingtung, Taiwan, second@mail.npust.edu.tw

1 - Case Study of Commercial Use of Emissions from Carbon Capture and Storage Technology

Shao-Chi Lo, National Tsing Hua University, Hsinchu, Taiwan, fir88987@gmail.com

Carbon Capture and Storage (CCS) is a critical component in reducing emissions and mitigating climate change. In industrial-scale, the geological storage of anthropogenic carbon dioxide (CO₂) has been successfully demonstrated in deep saline formations. However, we are still looking for a pathway that can transform these tons of emissions into commercial use, such as enhanced oil recovery (EOR). In this article, we will summarize the current storage status of the U.S., the U.K. and Japan-China EOR project as case study. We focus on the analysis of supply and demand in CCS and EOR industry. Finally, we will make our suggestion to the nations of different regions to meet the target of Paris Agreement.

2 - Cases study of Circular Economy Benefits by Utilizing Environmental Indicators Management

Wun-Hui Huang, Industrial Technology Research Institute, Zhudong, Taiwan, VincentHuang@itri.org.tw, An-Chi Chen, Fu-Hui Shen

The research about the case of introducing MFCA and MCI into Taiwan electronics factories has helped many factories enhance their products' resource conservation. By using MFCA conservation hot spots analysis, those factories obtains the purpose of improving the resource efficiency, saving the cost and reducing the amount of waste. By using MCI, those factories make their redesigned products not only enhance their resource circularity but also extend the usage of recyclable material and their product's life span. Moreover, carbon footprint (CFP) could be a complementary impact indicator that monitors the enhancement of product's circularity without increasing the CFP.

3 - Conceptual Design of a Circular Economy Framework for Pond-based Culture Systems

Earl-juei Wang, National Pingtung University of Science and Technology, Pingtung, Taiwan, second@mail.npust.edu.tw, Yu-Hsiang Chang, Dian-xuan Weng

Taiwan has leading aquaculture technology in the world but currently facing sustainable difficulty resulting from traditional culture methodology. Inadequate culture systems and breeding methods are two major problems in terms of vicious cycling which have affected not only on the aspect of human and aquaculture health subjects but also at the consequence of environmental pollution and sustainable cultivation circumstance. Concept of circular economy to transform the vicious cycling to a virtuous cycle is critical for cultivation industry. This work proposes a circular economy framework for pond-based culture system in which an integrated breeding circle with culture environment is designed into traceability and water monitoring systems. The proposed circular economy framework accommodates components of culture procedures and how and where aquaculture technology is implemented. The proposed framework can help culture industry to systematically plan the aquaculture circular economy.

4 - Recycling Aseptic Paper Packaging Waste in Indonesia

Kuan Jui Chen, Chung Yuan Christian University, Taoyuan, Taiwan, b2226165@gmail.com, Tsai-Chi Kuo, Reza Wattimena, I-Hsuan Hong, Ir. Sukoyo MT

There are some studies that provide EPR as curtailing the consumption of new products and encouraging recycling and disposal of end-of-life (EOL) products, and some provide approaches to the implementation of Extended Producer Responsibility, while some studies using system dynamics model to promote material efficiency in products through increased recycling rates. This study provides a dynamic system simulation to show the relationship between the entities involved in waste management system and is expected to address the problems occurring in the implementation of EPR in Indonesia. The management of aseptic paper packaging waste for dairy products in West Java, was used as a case study due to the number of these products circulating in the region.

■ **WA22**

Elegance, 4th Floor

Decision Support Systems

Contributed Session

Chair: Amando Ayllon Radomes, Metro Retail Stores Group, Inc., Viscal Building, CD Seno Street corner WO Seno Street, Mandaue City, Cebu, 6014, Philippines, amando.radomes@gmail.com

1 - Predicting the Priority of Elective Patient Admission using Machine Learning Techniques

Jialing Li, Sichuan University, Sichuan Province, Chengdu, China, 596145246@qq.com, Li Luo, Fengyi Zhang

The purpose of this study is to develop a machine-learning approach for assisting healthcare professionals evaluating the priority of the elective admission. our data were collected from the nephrology specialty care unit of West China Hospital. To classify and predict whether elective patients in the waiting list are admitted, we used five machine learning classifiers: LR, RF, GBDT, XGBoost, and an ensemble model of the four classifiers. The results indicate that all of the five models showed a good classification performance with high predictive value.

2 - In Pursuit of Estimating Crowdfunding Projects Success Chance using Regularized Correlational Topic Modeling Algorithm

Ramin Khatami, The University of Tokyo, 7 Chome-3-1 Hongo, Bunkyo, Tokyo, 113-8654, Japan, ramin@khatami.me, Mohsen Jafari Songhori

Existing works in estimating crowdfunding campaigns success are mainly based on basic numerical features such as projects' goal, duration, etc. In this work we investigate impact of textual similarities between projects on their success chance. In doing that, we have proposed a novel "regularized correlational topic modeling" method that takes into account success effects. The results show that our proposed method with a predictive algorithm like "feed-forward neural network with a single hidden layer" can achieve as much as 10% improvement in term of F1-score. Our findings enable project owners to better assess the associated risks with their crowdfunding projects.

3 - Resource Planning for Airport Management

Nang Laik Ma, Dr, Singapore University of Social Sciences, 461 Clementi Road, Singapore, 599491, Singapore, nlma@suss.edu.sg

To improve the airport's operation in one of the busiest airport, we use simulation to determine the optimal number of check-in counters required subjected to satisfy the Service Level Agreement (SLA) at the check-in queue. In additional, we further extend our analysis to cater for different passenger loads from 50 to 500 and determine the linear relationship between the number of counters required and passenger load. Finally, we use the daily flight schedule, to determine the check-in counters requirement for daily operations.

4 - Research on Educational Resources Integrated Management System Based on BP Neural Network

Qin Xu, PhD, Chengdu University of Technology, Cheng Du, China, qin-x99@163.com, Huiqin Zhang, Shuaijiao Bai

The sharing problem of design and application of educational resource management system in our country has not been well solved, which has affected the development of educational information in our country. Through in-depth study of the theory of the subject and summarize the knowledge of data storage theory and BP neural network, especially in the field of BP neural network. In the course of my research, I found that with the development of computer multimedia technology, multimedia-based interactive tools can not only support text and images, but also support synchronous or asynchronous network transmission in various media formats.

5 - Understanding the Structural Complexity of Wicked Problem in Social Planning: A Simulation of the Sustainability of the Call Center City in Cebu, The Philippines

Amando A. Radomes, Instructor, University of San Carlos, Nasipit, Talamban, Cebu, 6000, Philippines, amando.radomes@gmail.com, Reinart Justin E. Bacalso, Andrew Clarence T. Go, Celine G. Lanoy

Cebu City is planning to establish a Call Center City (CCC) to boost its global competitiveness in the BPO industry. The preponderance of physical, economic, and social factors that govern the CCC system result to analytical complexity, giving rise to a wicked problem. This study aims to analyze the CCC's sustainability from a macro-perspective through the development of a dynamic simulation model. Its contribution on the development of social infrastructure archetype can be used as springboard for future researches on social planning.

Wednesday, 10:00AM - 11:30AM

■ WB01

101A, 1st Floor

Sustainable Supply Chain II

Contributed Session

Chair: Daniel Sanchez-Loor, National Cheng Kung University, No. 1 University Rd., Tainan, 701, Taiwan, daniel.sanchez.loor@hotmail.com

- 1 - A Decision Support System for Managing Vendor Managed Supply of Liquid Nitrogen at an Animal Husbandry Department**
Saurabh Chandra, Associate Professor, Indian Institute of Management Indore, 207, Block-A, Main Academic Building, Rau-Pithampur Road, Indore, 453556, India, saurabh@iimdr.ac.in, Sanjay Choudhari

A decision support system framework is presented for managing vendor managed supply of liquid Nitrogen to livestock locations in a district in India. A mixed integer programming model is presented for the problem and two heuristics are suggested for solving real size problems.

- 2 - The Effect of Curse of Knowledge on Information Sharing in Supply Chain**

Daniel A. Sanchez-Loor, National Cheng Kung University, No. 1 University Rd., Tainan, Taiwan, daniel.sanchez.loor@hotmail.com, Wei-Shiun Chang

Supply chain literature assumes that a leader with better information anticipates a follower's response only using the information available to the follower. However, the curse of knowledge suggests that the leader cannot exclude her additional information and overestimates the follower's information. We conduct a pilot experiment in which manufacturers have precise information about demand and set a wholesale price, whereas retailers observe an uncertain demand and order a quantity. Manufacturers show a tendency to move away from their optimal pricing influenced by their additional information.

■ WB07

105, 1st Floor

Scheduling II

Contributed Session

Chair: Hung-Kai Wang, Kuang-Fu Road, 101, Section 2, Kuang-Fu Road, Hsinchu, none, Taiwan, endywang0@gmail.com

- 1 - Integrated Optimization of Product Mix and Scheduling in a Two-machine Flowshop**

Xiang-Yang Du, Northwestern Polytechnical University, Xi'an, China, pacpos.xydu@gmail.com, Jun-Qiang Wang

We study the integrated optimization of product mix and scheduling in a two-machine flowshop and propose an approximate algorithm based on the theory of constraints (TOC) to fully exploit the machine capacity. Furthermore, considering lot streaming on the basis of the integrated optimization problem, we discuss different models such as equal-size sublots and consistent-size sublots, and give efficient TOC-based approximate algorithms to obtain the product mix, lot sizes and sequence of the products. The related method and results will help product managers better understand the integrated operation mode of planning and scheduling in make-to-order environments.

- 2 - Single Machine Scheduling under Cumulative and Positional Effects**

Strusevich Vitaly, Professor, University of Greenwich, Old Royal Naval College, Park Row, Greenwich, London, SE10 9LS, United Kingdom, sv02@gre.ac.uk, Alan J Soper

We consider single machine scheduling problems to minimize the total completion time. The actual processing time of a job is subject to a deterioration effect, which can be positional, cumulative of a combination of both. We clarify the status of several problems of this range regarding a possible structure of an optimal permutation of jobs, which can be either a V-shaped sequence or an SPT sequence. The presented results can be seen as updates of the relevant parts of the recent monograph "Scheduling with Times-Changing Effects and Rate-Modifying Activities" (Springer, 2017) by V.A. Strusevich and K. Rustogi.

- 3 - Mobile Mechanic Scheduling with Time Windows and Time-dependent Travel Speeds**

Xue Han, YourMechanic, Inc., 2525 E Charleston Rd, Suite 100, Mountain View, CA, 94043, United States, lulu@yourmechanic.com, Rajat Agarwal

At YourMechanic, we work with mobile mechanics to provide car repair services at car-owner specified locations. In this paper, we formulate a novel mixed integer program that maximizes mechanic utilization and prescribes the optimal route for each mechanic, subject to time-dependent travel speeds and car-owner-specified time windows. This problem is challenging because mechanics are not identical in their service areas, skill sets and availability that could be intermittent. We perform sensitivity analyses of time-window widths using real-life data in our top 10 markets and provide business insights. We also propose a modification on our model if minimizing travel time is to be pursued.

- 4 - Multi Depot Vehicle Routing Problem with Different Depot Replenishment Costs**

Wenli Li, Huazhong University of Science and Technology, Luoyu Road, Number 1037, Wuhan, 430074, China, 614548702@qq.com, Kunpeng Li

In this paper, we investigate the multiple-depot vehicle routing problem where the replenishment cost for each depot is different. We formulate the problem into a concise mathematical model, which is further improved utilizing the problem characteristics. We then propose an effective and efficient tabu search algorithm to tackle the problem with practical sizes. Tight lower bounds to the problem are also obtained by Lagrangian relaxation technique. Numerical tests indicate that the proposed tabu search algorithm can solve large instances and provide satisfactory results for this challenging problem.

- 5 - A Hybrid Genetic Algorithm for Photolithography Process of TFT-LCD Array Manufacturing Scheduling Problem**

Hung-Kai Wang, National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu, Taiwan, g9734501@oz.nthu.edu.tw, Tzu-Yen Hong, Chen-Fu Chien

The TFT-LCD manufacturing is a highly capital-intensive industry. Among all the processes, photolithography of the array process is the bottleneck due to the complex constraints, such as the photo masks, machines availability and limited waiting time. An effective scheduling system can simultaneously increase the throughput and the product quality. This study proposes a mixed integer nonlinear linear programming model to explain the practical problem. Meanwhile, a hybrid genetic algorithm is proposed and compared with the MINLP model and other metaheuristics. The small size and large size scenarios will be validated to show the effectiveness and efficiency of the proposed HGA.

■ WB08

201A, 2nd Floor

Domain Specific Analytics on Innovative Commerce Applications

Invited: Fusions of Big Data, AI, Blockchain and FinTech Applications

Invited Session

Chair: Wen-Tsung Chang, Institute for Information Industry, Taipei, Taiwan, wtchang@iii.org.tw

- 1 - An Internet Celebrity Persona Analysis via Deep Learning Techniques**

Yu-Hui Yeh, Institute for Information Industry, Taipei City, Taiwan, florayeh@iii.org.tw, Chieh-Yu Liao, Yi-Chun Chen, I-Ying Lu, Yueh-Hsin Hsu

Internet celebrity, as known as opinion leader on social media, has reshaped consumers fundamental purchasing behaviors. Companies are realizing the power and the effectiveness of social media marketing. These internet celebrities enacted as a new advertised strategy. Yet, defining the right candidate is challenging. When effectively constructing personas for target customers, it is important to identify their demographics, characteristics, willingness and emotional reasoning when purchasing a product. Therefore, we propose an effective and easy-to-use system, Key Opinion Leader Recommender (KOLR), that helps a company to select the most suitable candidate for advertisement. In this system, we analyze public information deemed from social media demographic information, posts, location, and comments, and cluster them into corresponding interest groups to construct internet celebrities and their audiences personas. Techniques such as LDA, RNN and LSTM are applied in KOLR to match the brand with internet celebrities and possible target audiences for precision marketing. The system not only recommends the most qualified internet celebrity, but also provides a clear perspective of profitable audience and marketing strategies.

2 - Sales Forecasting from Heterogeneous Data Sources

Hong-Han Shuai, National Chiao Tung University, Hsinchu, Taiwan, hhshuai@nctu.edu.tw, Jui-Yi Tsai, Yi-Chun Chen

Due to the convenience and low cost for both retailers and customers, E-commerce platforms have been indispensable for our modern lives. One of the key technologies for e-commerce platforms is to predict the next sales of commodities. An accurate prediction helps retailers not only reserve commodities in a smart way but also price the commodities for maximizing the total revenue. In this paper, we propose a fast and effective tensor decomposition model for sales forecasting via learning from heterogeneous data, including the information from omni-channel retailing, cross-channel user behavior series and social media. Abundant information with tensor decomposition facilitates the learning framework to avoid the cold-start problem as well as handles the missing data problem. We show the effectiveness of the proposed method on a real dataset including two e-commerce platforms (Yahoo and Ruten) and an online cosmetics review platform (UrCosme).

3 - 'Shippin' Platform and Warehouse Logistics Management

Rong-Sheng Wang, Institute for Information Industry, Taipei City, Taiwan, cylin@iii.org.tw, Min-Hua Hsiao, Shao-Huan Chen

iShippin' is a platform that collect shipping information by means of APIs concatenation between e-commerce platform and logistics companies. As companies attempting to sell goods overseas, they often face the obstacle of searching various logistics companies since these companies serve different countries. iShippin' provides a one stop logistics service with lower price that will reduce retailers search time in looking for the best logistic solution, which implies the lowest price as well as the fastest delivery. In addition, another crucial point to note is that iShippin' also provide pragmatic statistical analysis including the status of domestic/overseas warehouse, cross-border popular items, distribution statistics, as well as the average delivery days in each country. In summary, iShippin' is aiming to become the preferred cross-border export service channel for domestic e-commerce and support retailers to export goods throughout the Southeast Asian market (Singapore/Malaysia/Indonesia).

4 - The Prediction of College Graduates' Employment

Chun-Ting Lee, Yi-Jia Chung, Ting-Ying Yan, Asia University, Taichung, Taiwan. ctlee0503@asia.edu.tw

This paper considers the relationship between college graduates' school performance and the state of employment. Data are collected from the Institutional Research database and the results of college graduates' graduate destination from Asia University. The purpose of this study is to explore the relationship among college graduates' background, school curriculum, school performance, extracurricular experience, internship experience, and the state of employment.

5 - Smart Technologies: An Investigation for Business Research Avenues

Michael Chuang, Kuan-Tsae Huang, Houston Baptist University, Houston, TX, mikeychuang@gmail.com

With rapid developments of smart technologies building IoT device connections and enabling wisdom generation from data analytics and artificial intelligence, smart technologies also establish an arena for abundant research potentials embracing various business applications, scenarios, and issues across organizations and industries. This research incorporates smart technology's interdisciplinary nature, and reviews relevant research domains such as organization, innovation, and entrepreneurship, in anticipation of highlighting future avenues of business research.

WB09

201B, 2nd Floor

Supply Chain Management IV

Contributed Session

Chair: Tianxiao Chen, The Chinese University of Hong Kong, ERB615, Shatin, Hong Kong, ERB615, Hong Kong, chentx@se.cuhk.edu.hk

1 - Optimization of FMCG Brand Supplier's Pricing Strategy with Limited Inventory Resources

Cheng-Chieh Chen, Associate Professor, National Dong Hwa University, No. 1, Sec. 2, Da-Hsueh Rd., Hualien, 974, Taiwan, frank542@mail.ndhu.edu.tw, Yin-Jui Chang, Chih-Peng Chu

This paper seeks to identify some factors critical for managing brand marketers' channel resource, especially during the promotion periods. The study starts from managing products of less-sensitive shelf life with three kinds of channel partners' behaviors (i.e. price-takers, price-negotiators, and leave-without-procurement). This study aims to determine the wholesale prices of products while considering negotiation behavior during the procurement among a brand marketer and several channel partners. We also analyze the brand marketer's total expected revenue and channel partners' potential revenue, under different channel resource allocation strategies.

2 - A Simulation-based Model for Optimizing Resource Allocations in Cold Chain Channels

Tzu-Yin Lin, Research Assistant, National Dong Hwa University, Hualien, Taiwan, 610637001@gms.ndhu.edu.tw, Cheng-Chieh Chen

This study aims to assist brand marketers determining the optimal prices and corresponding quantity allocated for channel operators before annual sales. This study will focus on cold-chain product suppliers and distributors in managing channel resource allocation problems, from general sale periods to specific promotion dates. We first start from modeling behaviors between one brand marketer versus one channel partner. For those one-to-many bargaining conditions, we further incorporate the optimization logic into the simulation program to analyze different channel resource allocation strategies.

3 - Multi Season Production Planning under Export Quotas

Tianxiao Chen, The Chinese University of Hong Kong, ERB615, CUHK, Shatin, Hong Kong, chentx@se.cuhk.edu.hk, Xiting Gong, Qing Li, He Xu

This paper studies a periodic-review multi-season production planning problem facing by an exporting firm where the total sales quantity in each season is restricted by an export quota. The problem is motivated by "export quota" in international trading. We formulate the problem as a MDP and study the structural properties of the value functions and the impact of export quota on the optimal policy.

WB10

201C, 2nd Floor

Global Logistics II

Contributed Session

Chair: Kuan-Chih Shu, Asia University, 500, Lioufeng Rd., Wufeng,, Taichung, 41354, Taiwan, vickyteacher@yahoo.com.tw

1 - The Effect of Personal Moral Philosophy on Ethical Decision-making Process: Within Environmental Ethics in Hotel Context

Chia-Ju Lu, Asia University, Taichung, Taiwan, jareelu@gmail.com, Chiung-Chi Pen, Yun-Ju Liu

In tourism, natural resources and the physical environment are regarded as important assess. In environmental ethics consideration, hotel should reduce not only to their environment impacts but also to improving the quality of the environment. The research framework in this study is developed based on the model for individual ethical decision making and behavior. Two environmental ethic scenarios of leisure hotels are developed. On the basis of 253 valid questionnaires, we arrive at three conclusions.

2 - Exploring the Effectiveness of Relationship Marketing and Experiential Marketing

Yan-Ting Lin, Asia University, 500, Lioufeng Rd., Wufeng, Taichung, 41354, Taiwan, a01051999@gmail.com, Cheng-Feng Cheng

This study aims to explore the effectiveness of relationship marketing and experiential marketing. As well as, exploring the relationships among perceived value, perceived risk, and purchase intention are the other purposes. The statistical techniques we adopt contain descriptive statistics, factor analysis, reliability analysis, SEM, and fsQCA. The results of SEM indicate that both relationship and experiential marketing have significant effects on perceived value and risk. Furthermore, perceived value and risk also have significant effects on purchase intention. fsQCA display that there are four causal configurations found to be sufficient for high purchase intention.

3 - A Case Study on the Business Model Innovation of Quartz Firms

Sie-Yo Lin, Asia University, 500 Lioufeng Road Wufeng, Wufeng, Taichung, 41354, Taiwan, lin20000913@yahoo.com.tw, Shieh-Liang Chen, Wen-Hong Chiu

Quartz products are made in small quantities but have great variety. The operating procedures are complex and it is very difficult to optimize process management. This study adopts the business model innovation framework proposed by Mark Johnson (2010) with four aspects: customer value proposition, key resources, key processes, and profit formula, and examines a case study for a quartz company in Taiwan. Results of this case study can provide a managerial implications for business innovation at quartz industries.

4 - The Service Technology Selection Model of Biological Printing Applied on Medical Treatment Assistant Device Selection

Kuan-Chih Shu, PhD Student, Asia University, 500, Lioufeng Rd., Wufeng,, Taichung, 41354, Taiwan, vickyteacher@yahoo.com.tw, James K. C. Chen

Purpose: How to select biological printing device aids for medical treatment that it is a very important issues. Design/methodology/approach: This research establishes one selection model for how selection the biological print medical assistant device. Findings: The results show the best criteria. Research limitations: It is no included the others biological printing institutes of foreign country. Practical implications: This study proposed a methods of service technology selection model of biological printing medical treatment assistant device. Originality/value: It is can extraction out the optima medical treatment device for doctor/manager to do decision making.

■ WB12

201E, 2nd Floor

Urban Transport

Sponsored: Transportation Science & Logistics

Sponsored Session

Chair: Baicheng Li, The University of Hong Kong, Central and Western, Hong Kong, 999077, Hong Kong, bclee@connect.hku.hk

1 - Human Behaviors in O2O On-demand Delivery: Order Assignment and Routing with Crowd-sourced Drivers

Hongyan Dai, Central University of Finance and Economics, Beijing, China, daihy@cufe.edu.cn, Jiawei Tao, Hai Jiang, Weiwei Chen

This paper explores the human behaviors in the O2O on-demand delivery system for both the drivers and the customers. We employ an integer programming model to maximize the total operation cost in order to decide the order assignment and routing. We also apply a real data set from one of the largest online restaurant chain in China, to validate our model and generate managerial insights. The analytical and numerical results are expected to guide the practitioners to better manage this new business and logistics modes.

2 - Patrol Routing Desing to Minimize Overall Risk Network

Ruben Yie, Universidad el Norte, Km 5 Antigua via Puerto Colombia, Barranquilla, Colombia, ryie@uninorte.edu.co, Andrea Margarita Ditta

It is well-known that police patrolling is one of the best preventive practices for public safety against urban crimes. This work, deals with the problem of planning police patrol routes to minimize the overall risk at minimum cost. A specific mathematical formulation, models the problem under critical time constraints and resources. Algorithms of ant colony and evolutionary techniques, offers effective solutions for this model. A case study in Barranquilla (Colombia), allows validate the performance of our approach in real scenarios.

3 - A Dispatching and Routing Planning Operating System for Rehabilitation Bus Service

Che-Ming Chen, National Dong Hwa University, Hualien, Taiwan, 810332005@gms.ndhu.edu.tw, Chih-Peng Chu, Ching-Yu Tai, Chung-Yi Peng

With the real rehabilitation bus data collected, 9533 data from 2016 June-September from Hualien Mennonite Foundations, a system that utilizes Geographic Information System and Open Source Routing Machines is presented. The simulation results show that the number of vehicles service for same group of patients can be reduced by 40.17% than that of current system. This system allows patients having the reservation result immediately when they call and could also optimize the system efficiency.

4 - Taxi Service Area Design: Formulation and Analysis

Baicheng LI, PhD Candidate, The University of Hong Kong, Central and Western, Hong Kong, China, Hong Kong, 999077, Hong Kong, bclee@connect.hku.hk, Wai Yuen Szeto

Taxis serve as an important transportation mode with speed and comfort. In some cities (e.g., New York and Hong Kong) with multiple taxi types, the government may restrict the service areas of some types of taxis. However, there is no methodology to design the best service area of restricted area taxis. In this paper, an optimization model is developed to provide insights to the taxi service area design. The model contains two sub-problems, in which the first one is a combined network equilibrium problem and the second one is a regulatory problem. Numerical results reveal that the best service area of restricted area taxis is affected by travel demand distribution as well as taxi fleet sizes and fare levels.

■ WB13

201F, 2nd Floor

Operations and Economics Interface VIII

Invited: Operations and Economics Interface

Invited Session

Chair: Xin Wang, Hong Kong University of Science and Technology, Kowloon, Hong Kong, xinwang@ust.hk

1 - Crowdfunding for Green Energy Investment

Ying Xu, Singapore University of Technology and Design, 8 Somapah Road, Engineering System & Design, Singapore, 487372, Singapore, xu_ying@sutd.edu.sg, Ronghuo Zheng, Katia P. Sycara

This paper studies a new green energy investment model through crowdfunding, in which a large green energy project is financed by small contributions of a large group of individuals who are also energy consumers. We find that crowd-funders' coupling decisions on investment and consumption can increase green energy investment.

2 - Balancing Efficiency and Equality in Vehicle Licenses Allocation

Qi Qi, Hong Kong University of Science & Technology, Hong Kong University of, Science and Technology, Kowloon, Hong Kong, kaylaqi@ust.hk

Due to traffic and air quality concerns in urban cities, many big cities have begun to adopt the vehicle licenses quantitative control policies. The current allocation mechanisms differ from city to city. In this work, we propose to target the dual objectives of efficiency and equality and present a unified framework that either includes or outperforms all the existing mechanisms. Besides, the unified framework also leads to easy implementation due to its truthfulness and simple structure. Under this framework, we develop the first truthful, equality-guaranteed, socially efficient mechanism and prove this mechanism is also distribution-free under some mild condition.

3 - Mergers and Product Repositioning

Xin Wang, Hong Kong University of Science and Technology, IELM, Kowloon, Hong Kong, xinwang@ust.hk, Soo-Haeng Cho

Mergers often induce firms to modify both product quality and variety. To date, the impact of such change has received scant attention in merger literature. We focus on how quality and variety alterations in a merger affect consumers by analyzing a merger in a vertically differentiated market. In contrast to existing literature that uses price as the main determinant of consumer welfare, we find that a merger may decrease customer welfare even if it induces the post-merger firm to reduce prices, because quality could be affected. Furthermore, although conventional wisdom dictates that cost reduction from a merger usually reduces prices and benefits consumers, we find this is not always either accurate or precise. Cost reduction can increase price by inducing a post-merger firm to raise quality and charge a higher price. Cost reduction can also result in a reduction in the number of products and adversely affect consumers.

■ WB15

202B, 2nd Floor

E-Business/Commerce

Contributed Session

Chair: Peng Wang, 266 Xilong Section Xifeng Road, 266 Xilong Section Xifeng Road, Xian, 710126, China, 15891795977@163.com

1 - Blockchain Based Electronic Contract Management System

Yijiang Guan, Guangdong University of Technology, No. 100 Waihuan Xi Road, Guangzhou, 510006, China, 411605315@qq.com

Nowadays Supply Chain Network become more and more complicated, and the paper contract can't meet the needs of business. Electronic contracts have the advantages of security and efficiency. However, it also has some shortcomings, like inflexibility, less execution, insufficient feedback. In this paper, we propose a blockchain-based electronic contract management system (BECMS), which can enhance the flexibility about emergency and the ability of execution by using smart contracts. We also illustrate the system's framework and how it works.

2 - How Online Media Synergy Influences Consumers' Purchase Intention

Xuebing Dong, Shanghai University, 99 Shangda Road, Baoshan District, Shanghai, 200444, China, dongxuebing116@sina.com

This study examined the synergistic effects of online multimedia by categorizing it into online broadcast media and online interactive media. We used an online experiment method to manipulate the online message stimuli level. The results revealed that participants exposed to message stimuli of online media synergy reported greater source credibility, cognitive responses, attitude toward the brand, and purchase intention. In online multimedia, source credibility influences attitude toward the brand through brand credibility and positive thoughts about the brand; in online single media repetition, source credibility influences attitude toward the brand through only brand credibility.

3 - Revenue Management for Fashion Apparel Products: A Practice at JD.com

Deng Ge, Research Scientist, JD.com American Technologies Research Center, Mountain View, CA, 94043, United States, deng.ge@jd.com, Di Wu

JD.com is the largest retailer in China and is building up an intelligent revenue management system, especially for fashion apparel categories. In this presentation, focusing on JD's fashion apparel products. We analyzed the product features such as categories, style, early demand signal, price range, and potential demand and user profiles, and then proposed a machine learning based predictive modeling framework that could achieve higher revenue and avoid liquidation in the late life cycle of products.

4 - Agency Versus Wholesale Model for Asymmetric Competing Platforms

Peng Wang, PhD Candidate, Xidian University, China, 15891795977@163.com, Rong Du

Agency model (allowing firms directly sell to consumers by taking a per-determined commission fee) and wholesale model (buying products from manufacturers and reselling to consumers) are widely adopted by online platforms. Considering the asymmetric between-platform competition, we specifically investigate how the chosen revenue model affects the profit of the upstream firm, platforms' revenues, consumers' utilities and social welfare.

■ WB18

North Lounge, 3rd Floor

Quality Management & Reliability

Contributed Session

Chair: Yeneneh Tamirat Negash, Asia University, 500, Lioufeng Rd., Taichung, 41354, Taiwan, yeneneh@asia.edu.tw

Co-Chair: Kannan Ramanathan, University of Texas- Dallas, Richardson, TX 75080, kannan.ramanathan@utdallas.edu

1 - Optimum Life Test Plans in Presence of Type-i Hybrid Censoring for Products Sold under General Rebate Warranty

Jimut Bahan Chakrabarty, Indian Institute of Management Kozhikode, Kunnammangalam, Kozhikode, 673570, India, jimutb08fpm@iimk.ac.in

One of the most frequently employed techniques in determining an acceptance sampling plan is minimizing the expectation of the sum of relevant costs involved. In this approach however, the expected warranty cost of the product to be incurred due to acceptance of a sample is seldom considered. This study determines optimum reliability acceptance sampling plan in presence of Type-I hybrid censoring using a cost function approach for products sold under general rebate warranty scheme having Weibull product lifetimes. A constrained optimization approach is followed considering both producer's and consumer's risk. Suitable numerical analysis techniques are employed in obtaining optimal solution.

2 - Sampling Plans for Autocorrelation Between Nonlinear Profiles

Yeneneh Tamirat Negash, Assistant Professor, Asia University, 500, Lioufeng Rd., Taichung, 41354, Taiwan, yeneneh@asia.edu.tw

A new sampling plan based on the exponentially weighted moving average (EWMA) yield index for lot sentencing for autocorrelation between nonlinear profiles is proposed. The advantage of the EWMA statistic is the accumulation of quality history from previous lots. In addition, the number of profiles required for lot sentencing is more economical than in the traditional single sampling plan. Considering the acceptable quality level (AQL) at the producer's risk and the lot tolerance percent defective (LTPD) at the consumer's risk, we proposed a new search algorithm to determine the optimal plan parameters. A numerical example is provided to show the applicability of the proposed sampling plan.

3 - Reliability Estimation of Circular K-out-of-N: G Balanced Systems

Alfonso Julanto Endharta, Pohang University of Science and Technology, 77 Cheongam-ro, Nam-gu, Pohang, Gyeongbuk, 37673, Korea, Republic of, aj.endharta@gmail.com, Young Myoung Ko

This paper studies a circular k-out-of-n: G balanced systems with identical and independent spatially distributed units. The system consists of an even number of units n with random failure time distribution. The system is operating if at least k units are operating and it is balanced. A new balance definition is proposed and the system reliability is estimated when the existing and the proposed system balance conditions are considered. The difference between the system reliability estimates reinforces the need to carefully select the system balance definition, depending on the system.

4 - Multi-Stage DNN Model Compression for IoT Enabled Edge Devices

Ching-Hu Hu, National Taiwan University of Science and Technology, Taipei, Taiwan, jhluh@ieee.org, Jen-Wei Wang

With the advances in edge computing for the Internet of Things (IoT) applications, increasing researchers have tried to reduce the parameters and size of a deep neural network (DNN) model through mostly single-stage model compression. This enables a resource-constrained edge device to accommodate a compressed DNN model and to mitigate the computing burden of its back-end servers. However, existing researches often faced the problem of poorer accuracy due to model compression. To address the issue, our study proposed multi-stage model compression, which compresses a DNN meanwhile maintaining as much accuracy. The experiment results have shown that the accuracy of the resultant compressed model through the multi-stage model compression is better than those only used the one-stage compression, given the same model size.

■ WB22

Elegance, 4th Floor

Multiple Attribute Decision Making (MADM)

Sponsored: Multicriteria Decision Making

Sponsored Session

Chair: Chi-Yo Huang, National Taiwan Normal University, Taipei, Taiwan, cyhuang66@ntnu.edu.tw

1 - A Novel Hybrid MCDM Approach for Improving the Performance of Enterprise Voluntary Participation in the Flood Information Management System

Chia-Lee Yang, National Center for High-Performance Computing, No. 7, R&D 6th Rd., Hsinchu Science Park, Hsinchu, 30076, Taiwan, georgeh168@gmail.com, Chi-Yo Huang

Flood hazards, which is the most pressing natural disaster in the world, is particularly bad in Taiwan. In order to better prepare residents to reduce flood hazards, the model of volunteer-based crowdsourcing is proposed to monitor, manage and reduce flood disaster. This research aims to find the enablers, barriers and the improving strategies of enterprise voluntary participation into the public flood management system. A novel hybrid multi-criteria decision-making (MCDM) model includes DEMATEL, ANP and VIKOR methods. An empirical study in Taiwanese public flood information systems will be used to verify the effectiveness of the proposed methodology.

2 - Airline Performance Analysis using AHP and TOPSIS

Aman Gupta, Associate Professor, Embry-Riddle Aeronautical University, 10733 Copper Ridge Dr, Louisville, KY, 40241, United States, aman.gupta@erau.edu

The research presents a multi attribute decision making approach to assess airlines' performance in the United States. We considered number of financial ratios under five different categories including, financial structure, liquidity, turnover, profitability, and airline specific ratios. AHP and TOPSIS are applied to solve the multi attribute decision making model. Comparison of results from the methods used is presented.

3 - Explore the Key Influential Factors of Corporate Governance in Taiwan Listed Companies

Jim-Yuh Huang, Professor of Specialist, National Taiwan University of Science and Technology, No.43, Keelung Rd., Sec.4, Da'an Dist., Taipei, 10607, Taiwan, D10216009@mail.ntust.edu.tw, Kao-Yi Shen, Gwo-Hshiung Tzeng, Yucheng Kao, Joseph C.P. Shieh

The purpose of this study is to explore the key factors that influence the corporate governance of listed companies in Taiwan and the correlation between their key influencers. It is hoped that this study will assist financial supervisory authorities, stock exchanges, listed companies, financial institution customers, investors, etc. to understand the effectiveness of corporate governance implementation of listed companies, guide healthy competition among enterprises, and strengthen the corporate governance standards to shape corporate initiatives. Improve corporate governance culture and further improve the performance of listed companies.

4 - A Hybrid MCDM Model for Supporting Personnel Selection and Improvement

Shu-Kung Hu, Kainan University, Taoyuan, Taiwan,
syokou@mail.knu.edu.tw, Yen-Ching Chuang,
Gwo-Hshiung Tzeng

A personnel evaluation not only selects the suitable staff for a company, but also improves their performance. Thus, the personnel evaluation is a significant decision-making problem in human resource management (HRM), which belongs to multiple criteria decision-making (MCDM) problem. In this study, we use a hybrid MCDM model to evaluate personnel selection and improvement problems. The results showed that this model could enable managers to make effective decisions for supporting personnel selection and improvement.

5 - The DANP II Algorithm: the Problem of Too Many Items in the Original DANP Technology was Modified

Shan-Lin Huang, Sanming University, Sanming city, China,
samlin0668@gmail.com

Original DANP (DEMATEL-base ANP) technology is a hybrid MADM (Multiple Attribute Decision Making) method. This technology provides decision makers with an improving strategy in a systematic way to avoid the problem of “treat the head when the head aches, treat the foot when the foot hurts”. Although this technology has many advantages. However, “excessive items in the questionnaire” make expert investigation difficult. This series of technologies has always been a problem. Thus, this paper presents the DANP II technique to modify the original.

A

Abhishek, Vibhanshu SA19
 Abouee-MehrziHossein TA02
 Adan, Ivo SC02
 Agarwal, Rajat WB07
 Agca, Senay SB04
 Ahmadi, Taher SC02
 Ahmed, Maqsood TA12
 Ahn, SeHwan
 MONDAY POSTER SESSION
 Akansel, Mehmet TB09
 Al Shishany, Amer MB22
 Alcívar Espín, Roberto Andres
 MONDAY POSTER SESSION
 Ali, Mohd WA09
 Alibrahim, Abdullah TA18
 Alwan, Layth WA03
 Andreyeva, Elena TC18
 Ang, Marcus TA19
 Angelus, Alexandar SC13
 Ardiansyah, Muhammad Nashir
 MC12
 Argon, Nilay SC18
 Arnosti, Nicholas TD02
 Aros-Vera, Felipe TB14
 Arunachalam, S. TC05
 Asadabadi, Mehdi Rajabi
 MONDAY POSTER SESSION,
 TD01
 Asai, Jun MC18
 Asfora, Eduarda MD22
 Ashouri, Mahsa TA03,
 TC03, TD03
 Askin, Ronald MA10
 Atan, Zumbal SC02
 Avgerinos, Emmanouil TD17
 Azar, Macarena SB19

B

Babich, Volodymyr SB04
 Bacalso, Reinart Justin WA22
 Bagchi, Uttaran WA07
 Bai, Shuaijiao WA22
 Baik, Seung Min
 MONDAY POSTER SESSION
 Banerjee, Somnath MD04
 Barak, Sasan TB09
 Baron, Opher SB08, MC19,
 TA02, TB18
 Batra, Rajeev TC05
 Batta, Rajan TB14
 Bauleke, Robert TA08
 Bayliss, Christopher TC05
 Bebitoglu, Basak MC01
 Bendersky, Michael SA09
 Benjaafar, Saif SA06, SB13
 Berk, Emre TC02
 Berman, Oded TA02
 Bermudez Sarmiento, Nestor
 MB04
 Bertazzi, Luca WA12
 Betrie, Getnet MB14
 Bhaisare, Sandesh SA19
 Bharadwaj, Anandhi TB13
 Bhattacharya, Shantanu SC11
 Bhimasta, Raden Agoeng MC15

Bi, Sheng SB13
 Bian, Shelly MC18
 Bichescu, Bogdan TB16
 Birge, John Sunday Keynote,
 SB04, SC08
 Bley, Andreas SC02
 Blondon, Katheine TC19
 Bolandifar, Ehsan SC04
 Bookbinder, James MA12, MD12
 Boonyanusith, Wijai MB19
 Borovkova, Svetlana MA11
 Boyabatli, Onur SC13
 Bressan, Stephane MD07
 Bu, Jinzhi SA02
 Burgess, David MA08
 Butler, C. Allen TB05
 Buzacott, John Tuesday Plenary

C

Cai, Jinling MD02
 Cai, Ning MA01, MA11
 Cai, Rongrong MD10, TD14
 Cai, Xueyuan TD05
 Candelieri, Antonio MD07
 Cano Bejar, Arturo TD03
 Cao, Bin MC13
 Cao, Chenyuan TD01
 Cao, Mei MD05
 Cao, Qingning MD13
 Cao, Wenhua MC18
 Cao, Xianfeng MD12
 Capela, Frenanda TA09
 Carrales, Skarleth WA20
 Carrasco, Rodrigo SB19, MA16
 Carter, Michael TB18
 Catlin, Jesse MB20
 Chakrabarty, Jimut Bahan WB18
 Chakrabarty, Subrata WA03
 Chan, Eugene MA20, MB20
 Chan, Han-Chao
 MONDAY POSTER SESSION
 Chan, Pak Wai MD09
 Chan, Tian SC11, TB13
 Chan, Ya-Hui MD08
 Chan, Ya-Hui
 MONDAY POSTER SESSION
 Chan, Ya-Lan TC02
 Chandra Bayu, Yudhistira MC14
 Chandra, Saurabh WB01
 Chang, Arthur TB15
 Chang, Chao-Ming TD19
 Chang, Chia-Hao TC21
 Chang, Chih-Chuan TC20
 Chang, Cuixian MD09
 Chang, Dong-shang TD15
 Chang, Elizabeth TD01,
 MONDAY POSTER SESSION
 Chang, Fa-Yu TD19
 Chang, Li-Heng WA12
 Chang, San-Cheng (Simon)
 Tuesday Keynote
 Chang, Shao Hsin TB03
 Chang, Ting-Kai SA13
 Chang, Tsung-Sheng MC12
 Chang, W.M. Tina TB03
 Chang, Wei-Shiun WB01
 Chang, Yaw MD09

Chang, Ya-Yuan MA22
 Chang, Yin-Jui WB09
 Chang, Yu-Hsiang WA21
 Chang, Yung-Chia MB19
 Chang, Yung-Chun MC08
 Chang-Shi, Aichih SB02
 Che Leon, Bruno MA16
 Che, Gelegen SC10
 Chen, An-Chi WA21
 Chen, Bo-Cheng MB22
 Chen, Cathy MA11
 Chen, Che-Ming MA21, WB12
 Chen, Chen MA02
 Chen, Cheng-Chieh SB12,
 MD12, TB09, WB09
 Chen, Cheng-Ta MA22
 Chen, Chih-Yu MA07
 Chen, Ching-Yen SA01
 Chen, Chi-Yu MC12
 Chen, Chun-Hung MB04, TD07
 Chen, David TA02
 Chen, Evin MA09
 Chen, Feng MD12
 Chen, Frank TC02, TD13, WA18
 Chen, Fu Hsiang TD22
 Chen, Guangliang TB10
 Chen, Hao-Wei WA13
 Chen, Hsiu-I TD19
 Chen, Huayi TC07
 Chen, Huifen SC07
 Chen, James TA09, TA21, TD10,
 WA10, WB10
 Chen, Jeifuu SB10
 Chen, Jeng-Huei WA19
 Chen, Jia-Siang TC03
 Chen, Jiasong TD20
 Chen, Jie TA20
 Chen, Jingnan TB11
 Chen, K.H.
 MONDAY POSTER SESSION
 Chen, Kuan Jui WA21
 Chen, Kun-Huang MD08
 Chen, Li-Ming MD15
 Chen, Lucy MB02
 Chen, Ming-Der MD08
 Chen, M.T.
 MONDAY POSTER SESSION
 Chen, Nan MA11, TA20
 Chen, Ningyuan TA01
 Chen, Peng-Chun TC13
 Chen, Pingping SB04
 Chen, Qiong MB13
 Chen, Shao-Huan WB08
 Chen, Sheng-I SC03
 Chen, Sheng-Wei SB05
 Chen, Shieh-Liang WA10, WB10
 Chen, Shien-Tsung TC03
 Chen, Shimiao TD05
 Chen, Ta-Cheng MB09
 Chen, Tai Lung TB03
 Chen, Tianxiao WB09
 Chen, Tsung-Hsing MB03
 Chen, Tsung-Hui MD01
 Chen, TzuLi SB07
 Chen, Wei TB02
 Chen, Wei-Ting TA08
 Chen, Weiwei MD10, WB12
 Chen, Wei-Zhu TC03

Chen, Wen-Chih SB09
 Chen, Xiaole SB08
 Chen, Xin SB08, MA02, MB02,
 MC13, MD09
 Chen, Yi-Chun WB08
 Chen, Yihsu MB14
 Chen, Ying-Ju MB21,
 TA17, TC01
 Chen, Yi-Su WA13
 Chen, Yi-Ting TB09, TB19
 Chen, Yu-Chen MB19
 Chen, Yuh Wen TC22
 Chen, Yu-Hung TA13
 Chen, Zhenzhen SB11
 Chen, Zhi SB11
 Chen, Zhong SC04
 Chen, Zongjian TD10
 Cheng, Cheng-Feng WA10,
 WB10
 Cheng, Ching-Chan MA22
 Cheng, Chun Hung SC19
 Cheng, Edwin SC12, TC01
 Cheng, Fei-Fei MA15
 Cheng, Hsing TA10
 Cheng, Shih-Fen SB09
 Cheng, Yi-Ju WA10
 Cheon, Hyungjun
 MONDAY POSTER SESSION
 Cheung, Henry SB12
 Chew, Ek Peng MA17, MC17
 Chi, Hui-Ru MD05, WA15
 Chiang, Yen-Ju MB20
 Chiang, Yi-Lin MA07
 Chien, Chen-Fu MB21, WB07
 Chien, Shih-Yi MA15
 Chien, Yu-Hsuan TC03
 Chih-Hsuan, Ku TC07
 Ching, Feng TD22
 Chiu, Chih-Chou TC05
 Chiu, Hong-Jen MD05
 Chiu, Ming-Chuan MB21
 Chiu, Weh-Hao TC21
 Chiu, Wen-Hong MD05, WA10,
 WA15, WB10
 Chiu, Wen-Hong WA10
 Chiu, Wen-Hong WB10
 Chiu, Yi-Bin
 MONDAY POSTER SESSION
 Cho, Soo-Haeng WB13
 Cho, Tsung-Lin TB09
 Cho, Yong-Ju
 MONDAY POSTER SESSION
 Choi, Dong Gu MC14,
 MONDAY POSTER SESSION
 Choi, Jaehyuk TC10
 Chou, Bai-Jian MA07
 Chou, Chun-An MC03, TC03
 Chou, Hsin-Hui MC09, TD08
 Chou, Mabel SA13, SC08,
 TA19, TC18
 Chou, Shuo-Yan MC14
 Chou, Yon-Chou
 MONDAY POSTER SESSION
 Chou, Yun-Hsin MD15
 Choudhari, Sanjay WB01
 Chow, Andy SB12
 Chow, Sheung Chi MC09
 Christensen, Jonas TA17

Christopher S., Tang TB01
 Chu, Amanda Man-Ying SC19
 Chu, Chih-Peng SB12, MA21, TA12, TB09, WB09, WB12
 Chu, Yu-Hsiu TD19
 Chua, Geoffrey WA12
 Chuang, Hao-Chun TC13
 Chuang, Michael WB08
 Chuang, Shuang-Shii MB20
 Chuang, Ya-Tang SB09
 Chuang, Yen-Ching WB22
 Chung, Jen-Yao SB05
 Chung, Tuck Siong MB15
 Chung, Wei-Ho WA11
 Chung, Yi-Jia WB08
 Chung, YiJia
 MONDAY POSTER SESSION
 Chung-Shou, Liao TC07
 Claus, Matthias WA16
 Cohn, Amy MD18
 Crama, Pascale SB11
 Crivelli, Silvia TC08
 Crook, Jonathan SC01
 Cui, Zheng TA13
 Currie, Christine TC05

D

Dai, Bin MC04, TD05
 Dai, Gengling TB11
 Dai, Hongyan WB12
 Dai, Tinglong TA10
 Dai, Wanyang MA10
 Dai, Yue MD21
 Danielson, Mats MD22
 Danks, Nicholas TA03
 Danni, Wang WA07
 Dao, Duy TA19, WA19
 Darkow, Inga-Lena TD16
 Das, Sidhartha MD05
 David, Guy TC18
 Davis, Robert MA08
 Dawande, Milind SB01, TB02
 Day, Min-Yuh MC08
 De Almeida, Adiel MD22
 de Kok, Ton SC02
 de Oliveira Capela, Fernanda TC07
 De Reyck, Bert TD17
 de Souza, Robert TA19, WA19
 de Vries, Harwin SB19
 Dekker, Rommert MD19, TC17
 Delage, Erick TB16
 Deng, Chi-Tse TB15
 Deng, Shiming SB04
 Deo, Sarang SC18
 Deoghare, Smruti TC19
 Dewabharata, Anindhita MC14
 Dimas, Itzhel TC08
 Ding, Xiaoning
 MONDAY POSTER SESSION
 Ding, Yi
 MONDAY POSTER SESSION
 Ditta, Andrea WB12
 Dong, Chang MB17
 Dong, Ciwei TC01, WA01
 Dong, Ming TC18
 Dong, Xuebing WB15
 Dong, Yun SA10, MB10, TD17
 Dong, Zhanyu TB13

Down, Douglas TC20
 Downs, Julie SA19
 Du, Rong WB15
 Du, Xiang-Yang WB07
 Duan, Housheng WA09
 Duan, Lian SB10
 Dufresne, Daniel SB07
 Duijzer, Lotty MD19
 Duru, Okan TC17
 Dutta, Bapi TA19, WA19

E

Ehrgott, Matthias TC22
 Ekenberg, Love MD22
 Eksan, Siti Hawa WA09
 Endharti, Alfonsus Julanto WB18
 Erdogan, Ayca TB10
 Eridani Budi D, Vertic TC22

F

Fan, Liaoyuan TA20
 Fan, Rui-Na TB20
 Fan, Zhenghao WA18
 Fang, Fang SC04
 Feldman, Sue TB19, TC19
 Feng, Ben MC11
 Feng, Bo TD13
 Feng, Guilin SC10
 Feng, Ling SC03
 Feng, Youyi MD21
 Feng, Yuan MD21
 Fengler, Matthias MA11
 Ferguson, Mark MC01
 Ferreira, Kris MA03
 Folmar, Eric MC03
 Fontin, Jean-Raymond TA22
 Fourer, Robert MB06
 Fragkos, Ioannis TD17
 Fransoo, Jan TA17, WA17
 Fruchter, Gila MA04
 Fry, Michael MB18
 Fu, Hui MA12
 Fu, Ke SA03, MC04, TB02
 Fu, Michael MC11, TD07
 Fu, Qi TD01
 Fu, Qiang SC13
 Fu, Wayne WA13
 Fu, Yufang MD10
 Fuh, Jong-Ling TC03

G

G. Srinivasan SB01
 Gai, Ling MD22
 Gallego, Guillermo
 Monday Keynote, MB12, TA01
 Gandajaya, Lukas MD21
 Gansukh, Zolboo TA08
 Gao, Jianjun MB11
 Gao, Xiangyu SB08, MB02
 Gao, Xiaoquan WA18
 Gao, Xuefeng TA20
 Gao, Yini SB13, TA10
 Garzon Rozo, Betty Johanna SC01
 Gau, Churn-Shiouh TD19
 Gaurav, Kunal SB01

Gavirneni, Srinagesh MB02
 Ge, Deng WB15
 Geng, Na MB18, TD18
 Geng, Xianjun MD13
 Gentili, Monica MC19
 Go, Andrew Clarence WA22
 Goh, Joel SB18, MA03
 Goh, Mark TA19, WA19
 Gomaa, Ahmed WA08
 Gong, Jie SC13
 Gong, Xiting SA02, SA03, MC02, TC02, WB09
 Gorenstein Dedecca, Joao
 MONDAY POSTER SESSION
 Goto, Makoto MB14
 Goyal, Shashank MD18
 Graham, Colin MA18
 Gratton, Austin MD09
 Graue, Ryan SB18
 Greene, Travis TA03
 Griddin, Jordan MA15
 Griffin, Joshua TA16
 Grob, Christopher SC02
 Groger, Andre SA09
 Grossmann, Christopher MB15
 Grossmann, Ignacio MC10
 Gu, Weijia MB02
 Guan, Yijiang WB15
 Gung, Roger MA21
 Guo, Chaoran TA18
 Guo, Hainan MD10
 Guo, Hong MC01
 Guo, Shu WA01
 Guo, Xiaomeng MA13, MD02
 Guo, Yongjiang TB20
 Gupta, Aman WB22
 Gupta, Diwakar MD18, TD18
 Gupta, Garima
 MONDAY POSTER SESSION
 Gupta, Manu TB18
 Gupta, Sross SB10
 Guran, Xu TB01
 Gurvich, Itai SC18
 Gusikhin, Oleg
 Sunday Keynote

H

Ha, Albert MB07
 Haghani, Ali SB12
 Hakvoort, Rudi
 MONDAY POSTER SESSION
 Hall, Nicholas MA06, MA14
 Hamid, Mona MC12
 Han, Chuan-Hsiang WA11
 Han, Qianqian TD16
 Han, Shasha SB18
 Han, Shuang MA12
 Han, Shui Hua MD10, TD14, TD16, WA08
 Han, Xue WB07
 Han, Yunghsiang MD20
 Handa, Hikari SC03
 Hao, Zhongyuan WA09
 Hardle, Wolfgang MA11
 Hasija, Sameer SC11
 Haskell, William TC20
 Hatamimarbini, Adel TC09, WA20
 Hatano, Ryo SC03

Hattori, Akihiro TB14
 Hayes, Leslie TC19
 He, Anqi TC10
 He, Jing SA19
 He, Junkai MB17
 He, Long SB13, SC13
 He, Qiao-Chu SB13
 He, Xuedong TA20
 Heidergott, Bernd MA11, MC11
 Henkel, Sven TC01
 Herder, Paulien
 MONDAY POSTER SESSION
 Hernke, Michael TC11
 Hersh, Jonathan SA09
 Hipel, Keith MC22
 Hiroyuki, Morikawa SA11
 Hirozawa, Tatsuki SC03
 Ho, Cheng-Yuan TD21
 Ho, Chia-Che SC09
 Ho, Sin C. TB12
 Ho, TingYu MD19
 Hoberg, Kai SB03, SC02, TA06
 Hong, Chi-Hao SB07
 Hong, I-Hsuan MD21, WA21
 Hong, Jeff SC18
 Hong, Juntaek TC16
 Hong, Tzu-Yen WB07
 Honma, Yudai TA14, TC14
 Hou, Hanxu MD20
 Hou, I-Hong MD20
 Hsiao, Lu TC01
 Hsiao, Min-Hua WB08
 Hsiao, Po-Wen TC05
 Hsieh, Cho-Jui MD16
 Hsieh, Min-Wei SC03
 Hsieh, Pei-shan TB15
 Hsu, Chung-Chian TB15
 Hsu, Hsin-Wei MB21, MD21
 Hsu, Hwai-Jung WA15
 Hsu, Pei-Fang MC15
 Hsu, Te-Cheng TC03
 Hsu, To-Liang WA12
 Hsu, Yueh-Hsin WB08
 Hsueh, Pei-Yun Sabrina TB05
 Hu, Chen TC05
 Hu, Ching-Hu WB18
 Hu, Hongtao MD17
 Hu, Jianyuan MD17
 Hu, Kun
 MONDAY POSTER SESSION
 Hu, Lingyu TA07
 Hu, Lu
 MONDAY POSTER SESSION
 Hu, Ming-Che TC03
 Hu, Peng SA02, MB02, TD05
 Hu, Shu-Kung WB22
 Hu, Wen-Cheng MA22
 Hu, Xiangling TD01
 Hu, Yihong MB01, TC09, TC15
 Hu, Zhaolin SC07, MD11, WA16
 Hu, Zhenyu SB08
 Huang, Baobin MB10
 Huang, Boray TD02
 Huang, Chin Hsiu MD15
 Huang, Ching Ying MA19, WA10, WA19
 Huang, Chi-Yo TC22, WB22
 Huang, George TB07, TD10
 Huang, Hao SB07, MD19
 Huang, He SB02, MC04

Huang, Hsini SA11
 Huang, Hu WA08
 Huang, Jefferson TC20
 Huang, Jih-Jeng MB22
 Huang, Jim-Yuh TA22, WB22
 Huang, Jingyan MD09
 Huang, Jinjia SA13
 Huang, Junfei MA10
 Huang, Junting MC10
 Huang, Kuancheng MC12
 Huang, Kuan-Tsae WB08
 Huang, Kwei-Long SA13
 Huang, Li Ying TD19
 Huang, Min TB17
 Huang, Pei-Ju MC15
 Huang, Pin-Hao SB18
 Huang, Shan-Lin WB22
 Huang, Shiuli TB15
 Huang, Song TB01
 Huang, Taichih SA01, TC09
 Huang, Tim T. C. SC12
 Huang, Tingliang TB13
 Huang, Ting-Syun MA07
 Huang, Tseng-Chang TA12
 Huang, Weixiang TD13
 Huang, Wen-Yi TA22
 Huang, Wun-Hui WA21
 Huang, Zeyu TD01
 Hwang, Juhwen TC09
 Hwang, Sagheum MONDAY
 POSTER SESSION
 Hwang, Shyh-Huei MA15
 Hwang, Youngdeok TB03

I
 Ilk, Noyan TA13
 Imaizumi, Kazuya WA19
 Imdahl, Christina SC02
 Inkaya, Tulin TB09
 Ito, Kazuya MD14
 Ito, Mari MD14

J
 Jaarsveld, Willem TC17
 Jacob, Emil MB12
 Jacobson, Sheldon MB04
 Jafari Songhon, Mohsen
 MONDAY POSTER SESSION
 Jafari Songhori, Mohsen SA11,
 TD20, WA22
 Jain, Rahul TC20
 Jain, Sanjay MB15
 Jampani Hanumantha, Girish
 MA10
 Janakiraman, Ganesh SB01,
 TB02
 Jang, Bo-Kai MA07
 Jen Son, Cheng WA03
 Jeong, Dongyeon TD16
 Jeong, Dongyeon
 MONDAY POSTER SESSION
 Jeong, In-Jae TC22
 Jeong, Youngseon
 MONDAY POSTER SESSION
 Jha, Shashi Shekhar SB09
 Ji, Jiahui MA11
 Jia, Qing-Shan TD07
 Jiang, Baojun SC04

Jiang, Guangxin SC07
 Jiang, Hai WB12
 Jiang, Hao TD13
 Jiang, Juncal SA04
 Jiang, Li WA09
 Jiang, Rujun MB11
 Jiang, Shun-Ran SA13
 Jiang, Xiaojuan TC16
 Jiang, Xin Jia TA17
 Jiang, Yangsheng
 MONDAY POSTER SESSION
 Jiang, Zhaoli TA20
 Jiao, TJ TA05
 Jin, Haomiao TA18
 Jin, Judy SB03
 Jin, Xiao TD07
 Jin, Xiaoning TC10
 Jin, Yong MC01
 Jin, Zhenhu TC11
 Jin, Zhongyi TB03
 Jittamai, Phongchai MB19
 Jo, Eunji
 MONDAY POSTER SESSION
 Johnson, Nicholas MD15
 Jong, Simcha SA11, TD20
 Jordan, Jeremy SC01
 Joshi, Maheshkumar MD05

K
 Kadiyala, Bharadwaj SA03
 Kahng, Hyungu TC08
 Kalayci, Betül WA11
 Kalkanci, Basak WA13
 Kamaleswaran, Rishikesan MA08
 Kaminsky, Philip MC01
 Kancharla, Surendra Reddy MB12
 Kang, Hsin-Hong TD14
 Kannan, Pallassana MB15
 Kao, Cathy Kai-Ling TD19
 Kao, Ling-Jing TC05
 Kao, Ta-Wei WA13
 Kao, Yucheng TA22, WB22
 Kao, Yu-Tzu SB12
 Kaplan, Edward Tuesday Keynote
 Karami, Fatemeh MC19
 Karijadi, Irene MC14
 Karimov, Azer WA11
 Katehakis, Michael SB02
 Kato-Lin, Yi-Chin SA19, SB10
 Kaur, Inderpal SB01
 Kawahara, Yoshinobu MC03
 Ke, Ginger MA12
 Ke, Jiannan MC13
 Ke, Ranxuan WA17
 Ke, T. Tony SB13
 Keller, Robin MA20
 Keppo, Jussi TD11
 Kersten, Gregory MC22
 Keshavarz, Esmail WA20
 Khatami, Ramin SA11, WA22
 Khatami, Ramin
 MONDAY POSTER SESSION
 Khojandi, Anahita MA08
 Khoshnevis, Pegah WA15
 Kilgour, Marc MC22
 Kim, Daeho MC14
 Kim, Dohyun
 MONDAY POSTER SESSION

Kim, Dong Gu
 MONDAY POSTER SESSION
 Kim, Hansung MC14
 Kim, Hwang MD04
 Kim, Jeenyoungh TD16
 Kim, Sang Won TA08
 Kim, Seoung TC08
 Kim, Seoung Bum WA15
 Kim, Younghoon TC08
 Kinaev, Dmitriy WA08
 King, Douglas MB04
 Kitayama, Daisuke MC18, WA09
 Ko, Young Myoung TD12,
 TD16, WB18
 Ko, Young Myoung
 MONDAY POSTER SESSION
 Kocaga, Yasar Levent SB04
 Koffijberg, Erik SC11
 Koizumi, Naoru MC19, MD18
 Komendantova, Nadejda MD22
 Kong, Qingxia TB18, TD18
 Koshman, Scott TA04, TB04
 Kovvali, Vijay TA12
 Krass, Dmitry MC19
 Kreutzer, Karin MB12
 Krishnan, Ramayya SA08
 Ku, Chien-Chun MB21
 Ku, Lun-Wei
 MONDAY POSTER SESSION
 Kuan, Chi-Yi MA05,
 MC06, MD06
 Kuan, Yuan-Hung TC03
 Kuang, Hanbin TB17
 Kuang, Yunjuan TC01
 Kulkarni, Radhika
 Monday Keynote
 Kumar, Ashwani MB12
 Kumar, Avinash TA18
 Kumari, Shreya SB01
 Kundu, Tanmoy TB14
 Kung, Ling-Chieh MC01, TA13
 Kuo, Chia-Wei SA13
 Kuo, Hsintz TD09
 Kuo, Kevin MD08
 Kuo, Tonny Meng-lun MC15,
 TD03
 Kuo, Tsai-Chi WA21
 Kuo, Tsung-Yuan TB03
 Kuo, Way SA08
 Kuo, Yong-Hong SB12,
 SC19, MA18
 Kurata, Hisashi MD04
 Kwak, Ming TC08
 Kwon, Dharma MA13

L
 Lagana, Demetrio WA12
 Lai, David SB12
 Lai, Ing-Chou TB03
 Lai, Mei-Chi TD19
 Lai, Xiaofan MC17
 Lai, Yu-i MB22
 Lam, Henry MC11
 Lam, Hugo MA14
 Lam, Shao Wei MB18
 Lan, Chen-Yang MA07
 Lan, Yongquan MA04
 Lang, Jin SC10
 Lange, Jean-Charles TD08

Lanoy, Celine WA22
 Larson, Richard
 Sunday Keynote
 Lee, Carmen Kar-Hang SC19
 Lee, Chia-Yen MA07
 Lee, Chieh SA01, MB03, TC09
 Lee, Chihoon SB04
 Lee, Chung-Yee TA17, WA17
 Lee, Chun-Ting WB08
 Lee, CT
 MONDAY POSTER SESSION
 Lee, Eva MB08
 Lee, Garry MD08
 Lee, Hankyu WA15
 Lee, Hsiao-Hui SA13, SC13, TB13
 Lee, Hyun-Rok MC18
 Lee, JongHwa TC17
 Lee, Kangbok TC16, WA07
 Lee, Lee
 MONDAY POSTER SESSION
 Lee, Loo Hay MA17, MC17,
 TA17, TD07
 Lee, Meng-Ying MB21
 Lee, Michael TC05
 Lee, Myungho WA07
 Lee, Pey-jiuan TA18
 Lee, Pual SB07
 Lee, SangYong
 MONDAY POSTER SESSION
 lee, Seungyeon
 MONDAY POSTER SESSION
 Lee, Taesik MA18, MC18
 Lee, Yonghoon SC11
 Lee, Young MB05, TB03
 Lee, Yu-Chi SC09
 Lee, Yu-Ching MB21, MD21
 Lee, Yung-Shiang TD19
 Lee, Yun-Ju TD19
 Lei, Lei MC11, MD10
 Lei, Yong TA10
 Leon, Jorge MC17
 Leung, Eman SC19
 Leung, Janny SB12, MA18
 Levy, Haim MC09
 Lewis, Mark TC20
 Lewis, Tracy SA02
 Li, Anran MB13
 Li, Baicheng WB12
 Li, Chen SC12
 Li, Chongshou TD05
 Li, Chung-Lun MA14
 Li, Dongni SB03
 Li, Haobin MA17, MD17, TD07
 Li, Hong Shuang (Alice) MB15
 Li, Hongbo WA07
 Li, Jialing WA22
 Li, Jianbin TC05, TD05
 Li, Jiliu SA12, TD13
 Li, Jing TC18
 Li, Jonathan TB16
 Li, Jr-Shin MC03
 Li, Juan MD02, TB01
 Li, Kevin MA04
 Li, Kunpeng SA10, TD08, WB07
 Li, Kuo-Pin WA10
 Li, Lihong MD16
 Li, Linfeng SA13
 Li, Lingfei TA20
 Li, Lishuai MB03
 Li, Lu WA08

Li, Michael TA01
 Li, Ming TB07
 Li, Qing SA03, WA08, WB09
 Li, Qingying MA13
 Li, Quanlin MA10, TB20
 Li, Shao Chun TB03
 Li, Tian MB07
 Li, Weiqi TC16
 Li, Wenhao SC18
 Li, Wenli WB07
 Li, Xiaolong MC13
 Li, Xilin MA20
 Li, Xinyu MC04
 Li, Xuanjing MB18
 Li, Yafei TB17
 Li, Yang SB08
 Li, Yanzhi SB04, MA04, TA15, TD13
 Li, Yifu TA10
 Li, Yinxing TA09
 Li, Yongquan TD01
 Li, Youlin TD17
 Li, Zhi TA09
 Li, Zhipeng SB02
 Liang, Chia-Ching MA21
 Liang, Chih-Chin TD02
 Liang, Guitian SA03
 Liang, Liang TA07
 Liang, Wan-Ju MA22
 Liang, Yong MA02
 Liang, Zhe SA09, TC03, TD08, WA07
 Liao, Chieh-Yu WB08
 Liao, Mary WA15
 Liao, Shu-Chuan TD21
 Liao, Xuehua TD15
 Liao, Xuehua M
 ONDAY POSTER SESSION
 Lie, Wei
 MONDAY POSTER SESSION
 Lien, Yao-Nan TD21
 Liew, Shirlene TD18
 Lim, Yun Fong MD13
 Lin, Bertrand SC12
 Lin, Cathy TB15
 Lin, Che TC03
 Lin, Chen-ju MB03
 Lin, Chia Li TA22
 Lin, Ching-Chieh TA13
 Lin, Chuan-Jie MC08
 Lin, Dai-Jie MD08
 Lin, Fu-ren SB10, TB15
 Lin, Grace MD08
 Lin, Grace
 MONDAY POSTER SESSION
 Lin, Han MA20
 Lin, Jen-Yen SA01
 Lin, Jie TB20
 Lin, Jilei WA20
 Lin, Ka Yuk Carrie SB19
 Lin, Li-Bing TB19
 Lin, Mei-Hsing MC09
 Lin, Meiyen TA02
 Lin, Peng TB07, TD10
 Lin, Po-Hung MA15
 Lin, Royce TB10
 Lin, Shao Chieh WA03
 Lin, Shi-Woei MA21
 Lin, Shun-Chieh MA07

Lin, Shu-Ping MA22
 Lin, Sie-Yo WB10
 Lin, Tim TA05
 Lin, Tzu-Yin WB09
 Lin, Yan-Ting WB10
 Lin, Yen-Ting (Daniel) MD13
 Lin, Yi-Bing TB09
 Lin, Yi-Cheng TD19
 Lin, Yu-Fan TC05
 Lin, Yu-Jyun MD12
 Lin, Yupo MB14
 Lin, Yvette
 MONDAY POSTER SESSION
 Ling, Haoran TD01
 Linz, David SB07
 Liou, James J.H. MB22
 Liou, Shawn
 MONDAY POSTER SESSION
 Lipscomb, Nikolai MD09
 Liu, Chenru TC10
 Liu, Chien-Chih MA19, MB19
 Liu, Dacheng MB18
 Liu, De SB02
 Liu, Fan TA07
 Liu, Fang SA02, MA03, MB02, MD13
 Liu, Guangwu MB04, MC11
 Liu, Hanqing MB02
 Liu, Hongrui TB10
 Liu, Jau Yang TD22
 Liu, Ji MD16
 Liu, Jiayi SB19
 Liu, Jing MC04
 Liu, Junming MD10
 Liu, Lindong SC12
 Liu, Meng-Kun MA07
 Liu, Ming MB17
 Liu, Qian TA10
 Liu, Ran MB18
 Liu, Shan MD19
 Liu, Shengwang TD17
 Liu, Shiyong
 MONDAY POSTER SESSION
 Liu, Tianxiang MC16
 Liu, W. TA19
 Liu, Weibo WA19
 Liu, Xiao-Mei TD22
 Liu, Xin MB17
 Liu, Xing WA18
 Liu, Yan TA01
 Liu, Yanchu MA11
 Liu, Yifang TC08
 Liu, Yunan TB20
 Liu, Yun-Ju WB10
 Liu, Zhixue MD12
 Lo, Huai-Wei MB22
 Lo, Mei-Chen TA22
 Lo, Mei-Chen TD14
 Lo, Shao-Chi WA21
 Loke, Gar Goei MB18
 Long, Daniel Zhuoyu TA13
 Lu, Chia-Ju WB10
 Lu, Hsuan-Yu TA12
 Lu, Hui MB22
 Lu, I-Ying WB08
 Lu, Kuan TA16
 Lu, Lauren TA19, TC18
 Lu, Ming-Tsang MB22
 Lu, Richard MC09

Lu, Susan TA19, TC18
 Lu, Tao TA17
 Lu, Tianshu MC19, TB18
 Lu, Wen Cheng TB21, WA10
 Lu, Ye MD02, TB01, TD05
 Lu, Yi-Chih TD09
 Lu, Yingdong MC20
 Ludden, Ian MB04
 Luh, Hsing TD19
 Luh, Peter MD07
 Lumbreras, Sara
 MONDAY POSTER SESSION
 Luo, Haidong SB19
 Luo, Huajiang MB07
 Luo, Li MD21, WA22
 Luo, Rongrong SB11
 Luo, Xiaomeng TD05
 Luo, ZhiXing TD13
 Luong, Chi-Quyen WA15
 Lyu, Guodong MA03, TA10

M

Ma, Chiahao TD14
 Ma, Guangrui SC13
 Ma, Jie TB03
 Ma, Jing-Yu MA10
 Ma, Kang-Ting MB21
 Ma, Lijun TA02
 Ma, Nang Laik WA22
 Ma, Shiqian MC16
 Ma, Xiang TA20
 Ma, Yujie TB16
 Mahmud, Dyantika Putry MA21
 Mak, Ho-Yin TA08
 Man, Xiaoyi MB17
 Manohar, Manju MB12
 Manuel, Rommel MB20
 Mao, Huiqiang MC04, TA15
 Mao, Jianfeng TD08
 Mao, Ke TB02
 Mao, Wenzheng (Wendy) TB13
 Marathe, Rahul SB01
 Marín, Magdalena MA16
 Martin, J. Lemuel MA03
 Martinez, Denisse TA09
 Masuda, Yasushi MA10
 Matranga, Andrea SA09
 Meena, Purushottam SB01
 Mefford, Robert TD11
 Melamed, Benjamin SB02
 Meng, Fanwen SB18, TA15
 Meng, Ying SA10, MC10
 Merfeld, Katrin MB12, TC01
 Miao, Hongru MA18
 Miao, Zhaowei MC04
 Mihm, Jorgen SB11
 Min, Daiki MA14, MC14, TD16
 Min, Guo
 MONDAY POSTER SESSION
 Minner, Stefan SC01
 Mirzaei, Shokoufeh TC08
 Miura, Hidetoshi TC14
 Mizuno, Shinji TA16
 Modi, Shikha TB19
 Mohamed Ismail, Mohamed
 Wahab MD12
 Mohr, Esther TD16
 Mookerjee, Vijay SB01
 Moon, Hana MA14
 Moon, Seung Ki TC22
 Moradi, Siamak TC22
 Moravick, Sarah SB18
 Moreira, Fernando SC01
 Mori, Shunsuke MD14
 Motwani, Jaideep TD01
 Mousavi, Mohammad M TD11, WA20
 Mrigank, Prasoon SB01
 MT, Ir. Sukoyo WA21
 Mu, Jinping MD13
 Muangkote, Areerats MA22
 Mulder, Judith TC17
 Muller, Hannes SA09
 Murugesan, Sugumar TB03

N

Nadimi, Reza MB21
 Naguleswaran, Sanjeev MA19, WA08
 Narang, Palak SB10
 Narayanaswami, Sundaravalli MB12
 Narita, Reika
 MONDAY POSTER SESSION
 Nasiry, Javad TA01
 Nayak, Sagar SB01
 Nayebpour, Mehdi MC19, MD18
 Negash, Yeneneh TB21, WB18
 Negoescu, Diana SB18
 Nelissen, Franz TB16
 Ng, Chi To SC12, TC01
 Ng, Jeff MA14
 Ng, Michael Kwok-Po MD09
 Nguyen, Thi anh Tuyet MC14
 Nguyen, Tuan Thanh TD03
 Nie, Tiantian SB13
 Nishio, Akemi WA19
 Nishiyama, Hiroyuki SC03
 Niu, Baozhuang TA10
 Niu, Shuiye WA01
 Norton, Matthew TA15
 Nuggehalli, Ranganath MB05, TD06

O

Ogiya, Mitsuharu MC18, WA09
 Oh, Chang Hyup TD12
 Ohwada, Hayato SC03, MB19
 Okamoto, Masayuki SC03
 Okpoti, Evans Sowah TC22
 Olivares, Marcelo TA08
 Ong, Soon Tat TC07
 Ooi, Chee Kheong TA15
 Ooi, Oon Cheong SB19
 Oren, Shmuel Monday Keynote
 Oron, Daniel WA07
 Ouchi, Gen WA19
 Ouenniche, Jamal MC12, TD11, WA12, WA20
 Ouyang, Huiyin SC18
 Ouyang, Ruilin TC03
 Ozaydin, Bunyamin TB19
 Ozkan-Seely, Gulru MB13
 Ozmen, Ayse WA11

P

Pacino, Dario TA17
 Padman, Rema SA19, SB06, SB10, SC06
 Pan, Shin Hung TD21
 Pan, Xin WA18
 Pan, Xingwei TD18
 Pang, Zhan MB02, MC20
 Paradi, Joseph WA20
 Paradiso, Rosario WA12
 Park, Eric SC18
 Park, Hyungjun MC14
 Park, Youngchoon TB03
 Parker, Geoffrey MC04
 Parlier, Greg TB04, TC04, TD04
 Patel, Swati TA15
 Pei, Renhui TB20
 Pekgun, Pelin MC01
 Pen, Chiung-Chi WB10
 Peng, Chung-Yi WB12
 Peng, Ting WA19
 Peng, Yijie MB04, MC11, TD07
 Pengqian, Yu TC20
 Perera, Sandun SB01
 Petruzzini, Nicholas MD18
 Png, Ivan SC13
 Poelmans, Eline WA15
 Pokutta, Sebastian MD07
 Polak, George TB16
 Pong, Ting Kei MC16
 Pourghaderi, Ahmad TD02
 Prasad, Ashutosh MA04
 Prasad, Dayal SB01
 Prattipati, Satya WA08
 Priese, Benjamin TD16
 Proske, Frederik TB04
 Puspita, Pratiwi TB09

Q

Qang, Mei-Chuan SA01
 Qi, Jin TA13, WA18
 Qi, Qi WB13
 Qi, Wei SC13
 Qi, Xiangtong SC12, TA10
 Qian, Shaodi MC03
 Qin, Hu SA12
 Qin, Yiyan SB02
 Qiu, Xuan WA17
 Qiu, Yunzhe MB04
 Qiu, Zhipeng MC17
 Qu, Shengnan MB01, TC09, TC15
 Quesada, Jose TD08
 Quyen, Luong TC21

R

Radomes, Amando WA22
 Raghavan, Sriram
 Tuesday Keynote
 Raghunathan, Srinivasan WA03
 Raith, Andrea TC22
 Rajendram, Rishikeshan SB09
 Ramadurai, Gitakrishnan MB12
 Ramirez-Marquez, Jose TA09, TD09
 Ramos, Andres
 MONDAY POSTER SESSION

Ramyar, Sepehr MB14
 Rao, Vithala MD04
 Ravichandran, Narasimhan WA06
 Ray, Pritee SB01
 Ray, Soumya TA03
 Rêgo, Leandro MC22
 Riegger, Anne-Sophie TC01
 Rivard, Andrew MC19
 Rong, Ying TA08
 Roselli, Lucia MD22
 Roszkowska, Ewa MC22
 Roth, Aleda MB13
 Roy, A MD07
 Roy, Ram Babu SA19
 Rubin, Donald SB18
 Ryu, Jong-hyun MC14

S

S. Shen, Meng-Chun TB21
 Saberi, Morteza TD01
 Saberi, Morteza
 MONDAY POSTER SESSION
 Sadhwani, Apaar TC19
 Sajadi, Seyed Mojtaba SA11, TC09, TD20
 Sakai, Hideo
 MONDAY POSTER SESSION
 Sakakibara, Akira MC05
 Salcedo, Jonathan MC18
 San, Ling SA08
 Sanchez, Reynerio WA18
 Sanchez-Loor, Daniel WB01
 Sarkar, Ashutosh SB01, SC01
 Sasaki, Mihiro TB14
 Sato, Kimitoshi TB11
 Sawada, Kiyoshi TA16
 Sawaki, Katsushige TB11
 Schlapp, Jochen SB11
 Schmeiser, Bruce SC07
 Schroff, Gautam
 MONDAY POSTER SESSION
 Schultz, Rüdiger WA16
 Schultz, Ruediger WA16
 Schuster, Kelsey TB03
 Scurlock, Corey MB18
 Sehgal, Gunjan
 MONDAY POSTER SESSION
 Seif, Javad WA03
 Sen, Alper MC01
 Sethi, Suresh SC04
 Seto, Ryoma WA19
 Shafahi, Ali SB12
 Shan, Xi SC04
 Shan, Zhe TC19
 Shang, Guangzhi MC01, TA13
 Shang, Kevin TC20
 Shang, Weixin MB07
 Shanguan, Lili MC04
 Shanthikumar, George TC06
 Shanthikumar, J SC08
 Shao, Ling-Feng TD15
 Shao, Lusheng SC13
 Shao, Saijun TB07
 Shao, Zhen TB02
 Sharma, Geetika
 MONDAY POSTER SESSION
 Sharma, Hiteshi TC20

Sharma, Shrutivandana TB18, TD18
 Sheikh, Shaya SB01
 Shen, Bin SA04
 Shen, Chia-Ya
 MONDAY POSTER SESSION
 Shen, Chi-Ya MD08
 Shen, Fu-Hui WA21
 Shen, Hao MA02
 Shen, Huaxiao SB04
 Shen, Kao-Yi MB22, TA22, WB22
 Shen, Xiaobei MC02
 Shen, Zuo-Jun SB13, TD18
 Shen, Zuo-Jun Max MA02
 Sheu, Jiu-Hsiung TB14, TD09
 Shi, Chao TB11
 Shi, Fengyuan SA10
 Shi, Jianming TA16
 Shi, Junmin SB02
 Shi, Leyuan SB03, TD07
 Shi, Ling TB01
 Shi, Peng TD02
 Shi, Xiutian TC01, WA01
 Shi, Ye WA03
 Shi, Yuhui MA02
 Shi, Yun MB11
 Shi, Zhongshun TD07
 ShiCui, Xiangyu MB11
 Shie, Ming-You MA09
 Shieh, Joseph C.P. WB22
 Shih, Cheng-Ting MA09
 Shih, Hsu-Shih TC22
 Shih, Yi-Hsuan TC03
 Shih, Yuchih TB03
 Shih-Chieh, Fang WA19
 Shin, Dongwook TA01
 Shin, Kyohong MA18
 Shiue, William TD22
 Shivers, Lauren TC19
 Shmueli, Galit TA03, TC03
 Shou, Biying MA04
 Shu, Kuan-Chih TA21, WA10, WB10
 Shuai, Hong-Han WB08
 Shui, C.S. TB12
 Shui, Chin Sum TB12
 Shum, Stephen MB02, TA10
 Shyu, Jonchi TA22
 Siddiqui, Afzal MB14
 Sie-Yo, Lin TC21
 Silva, Christian TB18
 Sim, Jessica MA20
 Sim, Melvyn MB18
 Sin, CY (Chor-yiu) TA16
 Sinha, Sudhi TB03
 Sirikulvadhana, Surapong MB19
 Slavova, Kremena TD20
 Slevogt, Gerrit WA16
 So, Mee Chi TC05
 Song, Boqian TA01
 Song, Dongping SC12
 Song, Dongying SC10
 Song, Haiqing WA09
 Song, Hummy SB18, TC18
 Song, Jie MB04, WA18
 Song, Jing-Sheng SA02, MC02, TA02
 Song, Lulu SA10
 Song, Miao MD02, TB01, TD05

Song, W.M. Tina SB18
 Song, Wheyming Tina SB07
 Songhori, Mohsen SC11
 Soper, Alan WB07
 Souissi, Omar TC16
 Soumya, Ray TD03
 Souza, Gilvan SA13
 Spürkel, Kai WA16
 Starker, Martin SB09
 Steckel, Kathryn MD13
 Stock, Axel MD04
 Su, Emily MC08
 Su, Hsiu-Ting MA15
 Su, Hung-Chung WA13
 Su, Lijie MC10
 Su, Teng-Sheng MC17
 Su, Ting-Yang TD19
 Su, Yi-Zhu SB07
 Subramanian, Ravi WA13
 Suen, Sze-chuan SB18, MC18
 Sun, Benson TA21
 Sun, Daewon SC01
 Sun, Daxin MA20
 Sun, Defeng MB10
 Sun, Edward TB09, TB19
 Sun, Hongpeng MC16
 Sun, Jiong SA04, SC04
 Sun, Jiong MONDAY POSTER SESSION
 Sun, Libo MA03
 Sun, Shu Sen TA09
 Sun, Wenjie SC07, WA16
 Sun, Yiqi TC02
 Sun, Yongchao MD11
 Sun, Zhankun SC18
 Sun, Zhuo MA17
 Susuki, Yoshihiko MC03
 Suzuki, Atsuo TA14
 Suzuki, Masaaki SC03, MB19, MD14
 Swaminathan, Jayashankar SC08, TB06
 Sycara, Katia WB13
 Szeto, Wai Yuen TB12, WB12

T

Tai, Ching-Yu WB12
 Takano, Masato MC18
 Takano, Masato WA09
 Takashima, Ryuta MB14, MD14
 Takazawa, Yotaro TC16
 Takeda, Akiko MC16
 Tam, Leona MB20
 Tan, Chee Wei MD20
 Tan, Conghui MC16
 Tan, David TA08
 Tan, Hong Ming TD11
 Tan, Roy TC17
 Tan, Yinliang MC04, TA10
 Tan, Yue MC20
 Tan, Zhe MC04
 Tanaka, Makoto MB14, MD14
 Tancrez, Jean-Sebastien TD08
 Taneri, Niyazi SB11, SC11
 Tang, Christopher
 PLENARY SUNDAY, SC08
 Tang, Lianjie MC10
 Tang, Lixin SA10, SC10, MB10, MC10, MD17, TD17

Tao, Jiawei WB12
 Tao, Yi WA17
 Tay, Nicholas TD11
 Tay, Seow Yian TA15
 Teguh, Sandra MA21
 Teirlinck, Peter WA15
 Teixeira de Almeida, Adiel MD22
 Teng, Chien-Chung MA22
 Teng, Mingfei MD10
 Teo, Chung-Piaw SA13, SB13, MA03, TB18
 Teo, Kelvin Wee Sheng TA15
 Teow, Kiok Liang TA15
 Terui, Nobuhiko TA09, TC05
 Thakur, Saurabh SA19
 Thanh, Vo-Van MD01
 Thekdi, Shital TB14
 Thepsithar, Prapisala TC17
 Tian, Lin SA04
 Tian, Qiannan TD08
 Tian, Yuan MA11
 Tian, Zonggui TA09
 Ting, Ching-Jung MD17
 Tiwari, S. TA19
 Tiwari, Sunil WA19
 Tiwari, Vikram TA18
 Tokimatsu, Koji MB21
 Toloo, Mehdi WA20
 Tong, Shilu MB07
 Trianis, Konstantinos
 MONDAY POSTER SESSION
 Tsai, Brick MD08
 Tsai, Brick
 MONDAY POSTER SESSION
 Tsai, Chih-Yang TD16
 Tsai, Hsin-Jung TA13
 Tsai, Jeffrey SA08, MD08
 Tsai, Jui-Yi WB08
 Tsai, Ming-Chun MA22
 Tsai, Yuan-Yu MB09
 Tsai, Yueh-Lin MD08
 Tsai, Yueh-Lin TD21
 Tsai, Yueh-Lin
 MONDAY POSTER SESSION
 Tsao, Hsiao-Shen TB10
 Tsao, Jacob TB10
 Tsao, Yu-Chung MD01
 Tseng, Chin-Yi MA07
 Tsuchiya, Shuto TA14
 Tsui, Kwok-Leung MD10
 Tsuji, Akira MA10
 Tsung, Fuguee SB03
 Tucker, Anita SB18
 Tung, Wei-Feng MA15, MD15
 Tzeng, Gwo-Hshiung MB22, TA22, TB22, WA15, WB22

U

Uekado, Kazuya SC03
 Uryasev, Stan SC01, TA15
 Uvalle, Oscar TD11

V

Valavi, Ehsan MA03
 Van de Klundert, Joris SB19
 Van den Bulte, Christophe MA04
 van Wyk, Franco MA08
 Varadarajan, Deepa TB13

Vazquez-Abad, Felisa SB07
 Vieira, Giannini MC22
 Virine, Lev SC01
 Vitaly, Strusevich WB07
 Vitullo, Steven TB03
 Volk-Makarewicz, Warren MA11
 Vu, Thuy Linh MD01

W

Wachowicz, Tpmasz MC22
 Wagelmans, Albert P M SB19
 Wall, Kylie MA19
 Wan, Guangyu SC11
 Wan, Yat-wah TC09
 Wang, Benyu
 MONDAY POSTER SESSION
 Wang, Chun-Han MD21
 Wang, Di TC10
 Wang, Earl-juei WA21
 Wang, Fan TD17
 Wang, Gongshu MB10
 Wang, Harry TD14
 Wang, Henan TB03
 Wang, Hongfeng TB17
 Wang, Hongwei SA03
 Wang, Huihui TD13
 Wang, Huiming TA15
 Wang, Hung-Kai WB07
 Wang, Jen-Wei WB18
 Wang, Jian TB03
 Wang, Jianan TC20
 Wang, Jianfu TB18
 Wang, JianJun MA18
 Wang, Jiawen TA09
 Wang, Jin MD10
 Wang, Jing-Doo TD21
 Wang, Jingqi TB13
 Wang, Jun-Qiang WB07
 Wang, Junwei SC19
 Wang, Jyun Cheng MC15
 Wang, Ko-Yang MC05, MD08
 Wang, Ko-Yang

MONDAY POSTER SESSION
 Wang, Kung-Jeng TD19
 Wang, Liang WA03
 Wang, Liangyan MA20
 Wang, Mengdi MD16
 Wang, Peng WB15
 Wang, Po-Hung SA01
 Wang, Qin MA20
 Wang, Qiong SB08
 Wang, Rong-Sheng WB08
 Wang, Rouwen TD15
 Wang, Rowan SB13
 Wang, Shiyu MB04, MC11
 Wang, Shouqiang MB13
 Wang, Shuaian TA08, TC12
 Wang, Shukun MD12
 Wang, Tao TB10
 Wang, Tiffany TA09
 Wang, Tong SB08, MC02, TA02
 Wang, Waiming TA09
 Wang, Wei-Chung SC05
 Wang, Wenbin SA13, MD13
 Wang, Wencheng MD17
 Wang, Xiaoxia MA12
 Wang, Xin SC13, TB02, WB13
 Wang, Xuan SC12, MB13
 Wang, Ying MB14

Wang, Yishi MD09
 Wang, Yitong MB20
 Wang, Yu TB16
 Wang, Yu Jen TA13
 Wang, Yuan MC10
 Wang, Yulan TB01
 Wang, Yunjie MB07
 Wang, Zhengwei MD10
 Wang, Zhongxiang SB12
 Wang, Zhuowei TB10
 Wang, Ziteng WA09
 Wang, Zizhuo MB13
 Watanabe, Daisuke TC14
 Watanabe, Hiroko TC14
 Watanabe, Kenji TC17
 Wattimena, Reza WA21
 Weber, Gerhard WA11
 Weber, Thomas MA14
 Wei, Ying TB01
 Wei, Yongchang TB07
 Wein, Lawrence TC19
 Wen, Jianpei WA18
 Wen-Cheng, Lu TB21
 Weng, Chiau-Shin SB09
 Weng, Dian-xuan WA21
 Weng, Jiaying
 MONDAY POSTER SESSION
 Windasari, Nila SB10
 Wissink, Pascal WA12
 Wong, Nancy MB20, TC05
 Wong, Wing-Keung MC09
 Wong, Zoie Shui-Yee MA19
 Wu, Zhou, Yong MC13
 Wu, Cheng-Hung SB09, TC20, WA12
 Wu, Cheng-Lung TA08
 Wu, Cheng-Man MA07
 Wu, Ching-Fang WA19
 Wu, Chin-Shan MA15
 Wu, Chun Ching SB18
 Wu, Danny TC19
 Wu, Di MA02, WB15
 Wu, Jei-Zheng TD22
 Wu, Jianguo TC10
 Wu, Jing SA10, SB04
 Wu, Joseph MC19
 Wu, Jun TD20
 Wu, Junjie TD07
 Wu, Kan TC09
 Wu, Kun-Chih MD17
 Wu, Lan MA01
 Wu, Lingxiao TC12
 Wu, Lixin MA01
 Wu, Min-Ching MB21
 Wu, Owen SA13
 Wu, Qi MC13, TD02
 Wu, Qiujun TD17
 Wu, ShiKui TC07
 Wu, Shining MD02
 Wu, Shinyi TA18
 Wu, Sz Wei TC03
 Wu, Wei-Ying TB09
 Wu, Ya-Han MA15
 Wu, Yao-Cheng MB09
 Wu, Yen-Hui TD19
 Wu, Yifan MD04
 Wu, Yuguang SB11
 Wu, Z. TA19
 Wu, Zhengping TC02
 Wu, Zhengyong WA19

X

Xia, Cathy MC20
 Xia, Jun SA12, MC17
 Xia, Li MA10
 Xiao, Binqing TB01
 Xiao, Fan SA09
 Xiao, Guang MA13, MD02
 Xiao, Jinghua TD15
 Xiao, Jinghua
 MONDAY POSTER SESSION
 Xiao, Li TA02
 Xiao, Wenli MD13
 Xiao, Yangge SA02
 Xiao, Yixuan MC02
 Xiao, Yongbo TC05
 Xie, Jingui SB19, MB18, TA19, TD18
 Xie, Kang TD15
 Xie, Kang
 MONDAY POSTER SESSION
 Xie, Qinghong
 MONDAY POSTER SESSION
 Xie, Xiaolan MB18, TD18
 Xie, Xiaolei MB18, WA18
 Xie, Yongqin TD15
 Xing, Aijing TC05
 Xiong, Hui TC01
 Xiong, Liyang TB01
 Xu, Fasheng MD02
 Xu, Gangyan TB07, WA17
 Xu, H MD07
 Xu, He SA03, WB09
 Xu, Hongyan SB02, MC04
 Xu, Jie MB04
 Xu, Liang MD18, TA14
 Xu, Minghui MC09
 Xu, Qin WA22
 Xu, Sherry MA08
 Xu, Shuting MC04
 Xu, Te SA10
 Xu, Wenxin MA13
 Xu, Xia TC11
 Xu, Xianhao TD09
 Xu, Yan MA05, MA08
 Xu, Yangyang MC16
 Xu, Ying TB18
 Xu, Ying WB13
 Xu, Yuhong TB11
 Xu, Yunzong MB13
 Xu, Zhou SA12, TA14
 Xu, Zuoquan MA01
 Xue, Weili TA02

Y

Y.H., Huang WA03
 Yagi, Kyoko TB11
 Yamada, Takeshi SC03
 Yan, Eugene MB14
 Yan, Hong-Wei MD05
 Yan, Hong-Wei TC21
 Yan, Ting-Ying WB08
 Yan, Xiaoyue TA02
 Yan, Yingchen SA04, SC04
 Yan, Zhenzhen TA19
 Yang, Albert TC03
 Yang, Chaolin TA02
 Yang, Chao-Lung MB09
 Yang, Chia-Lee WB22

Yang, De-Nian
 MONDAY POSTER SESSION
 Yang, Feng TA07
 Yang, Hui TA15
 Yang, Jinah TD16
 Yang, Julius SB18
 Yang, Ming-Fong SA01
 Yang, Muer MB18
 Yang, Pei-Jung MC01
 Yang, Ting Ying
 MONDAY POSTER SESSION
 Yang, Yang SC10
 Yang, Yi MD02, TB01, TC20
 Yang, Yu-Chen MC01
 Yao, Dacheng SA02
 Yao, Dai MB15
 Yao, David Sunday Keynote
 Yao, David TA19
 Yao, David D. MB01
 Yao, Ming-Jong SA01
 Yeh, Li-Ting TD09
 Yeh, Tsung-Kai TD08
 Yeh, Yi-Ren WA11
 Yeh, Yu-Hui WB08
 Yektamaram, Alireza TA16
 Yen, Chen-Ni SA13
 Yen, I-Ling MC09
 Yen, Sheng-Che MC03
 Yeung, Andy MA14
 Yie, Ruben WB12
 Yih, Yuehwern SC05
 Yih, Yuehwern SC18
 Yilmaz, Ovunc MC01
 Yin, Yong TD10
 Ying, Hao MC01
 Yiu, Lik Man Daphne TD01
 Yong, Lam Khin Monday
 Keynote
 Yoshida, Mika
 MONDAY POSTER SESSION
 Yoshikawa, Tohru TC14
 Young, Derek
 MONDAY POSTER SESSION
 Yousuk, Ramidayu TB17
 Yu, Andrew WA03

Yu, Chenglin TB07
 Yu, Hai-Bo TB20
 Yu, Jianli WA08
 Yu, Jinze TD11
 Yu, Jiun-Yu MA18, TA13, TC13
 Yu, Lina TB17
 Yu, Miao TC15
 Yu, Mingchuan MA20
 Yu, Mingzhu WA17
 Yu, Niu TD05
 Yu, Peiwen SA03
 Yu, Yi Peng TB03
 Yu, Yimin MC02, TD13
 Yu, Ying TB07
 Yu, Yugang MA03, WA01
 Yuan, Gao WA12
 Yuan, Quan MC02, TC02
 Yuan, Xue-Ming TB20
 Yue, Xiaohang WA03

Z

Zabinsky, Zelda SB07, MD19
 Zaerpour, Nima TC12
 Zavala, Araceli TD09
 Zeng, Saixing MA20
 Zeng, Yun MC20
 Zengul, Ferhat TB19
 Zhang, Canrong MD10, TB17
 Zhang, Chenglin SC04
 Zhang, Chi WA01
 Zhang, Chuck SA05, SC09
 Zhang, Di TB01
 Zhang, Fan MB04, WA18
 Zhang, Fengyi WA22
 Zhang, Fuqiang SC04,
 MA13, MD02
 Zhang, Hanqin TA02
 Zhang, Hanyue WA20
 Zhang, Hongtao WA09
 Zhang, Huiqin WA22
 Zhang, Huiwen MA12
 Zhang, Jie TA10
 Zhang, Jie TD11
 Zhang, Jun MD13

Zhang, Kun MB04, MC11
 Zhang, L. TA19
 Zhang, Li WA08
 Zhang, Lianmin TA13
 Zhang, Lifan WA19
 Zhang, Ning TB11
 Zhang, Qingpeng SA19,
 MA19, MB03
 Zhang, Qingyu MD05
 Zhang, Qinhong MD01
 Zhang, Renyu MB13
 Zhang, Runhao MC13
 Zhang, Si SC07, MB04
 Zhang, Tong MC16
 Zhang, W. TA19
 Zhang, Wei WA19
 Zhang, Xi TC10
 Zhang, Xiaohui MA02
 Zhang, Xiaoli WA01
 Zhang, Yan WA08
 Zhang, Yanwei TA17
 Zhang, Yanyan SC10
 Zhang, Yu TB16
 Zhang, Yue SA02
 Zhang, Zengbo TD12
 Zhang, Zijun MB03
 Zhao, Bin
 MONDAY POSTER SESSION
 Zhao, Guodong MB10
 Zhao, Hui MD18
 Zhao, Jiahong MA12
 Zhao, M. TA19
 Zhao, Ming TB01, WA19
 Zhao, Qitong MA17
 Zhao, Ren MB10, MD17
 Zhao, Ruiqing SC04
 Zhao, Shucheng MB10
 Zhen, Lu MD12, TA08, TC12
 Zheng, Feifeng MB17
 Zheng, Gang MD05
 Zheng, Jia-Wen SA01,
 MD08, TD21
 Zheng, Kejia TD11
 Zheng, Meimei TB20, TC09
 Zheng, Qingqing MD05

Zheng, Ronghuo WB13
 Zheng, Rui MA04
 Zheng, Weimin TC15
 Zheng, Zhichao SB19, TB18,
 TC18, TD18
 Zhong, Ji MD16
 Zhong, Xiang WA18
 Zhong, Yuanguang MC13
 Zhou, Chao TD11
 Zhou, Chenhao MA17, MD17
 Zhou, Chenxi SA04
 Zhou, Haotian MA20
 Zhou, Jiaqi SA19, MA19, MB03
 Zhou, Ke MB11
 Zhou, Lei TD08
 Zhou, Pin SA03
 Zhou, Sean SB08
 Zhou, Sean X. MB01
 Zhou, Shaorui TD17
 Zhou, Sijie WA01
 Zhou, Wan TA17
 Zhou, Wenwen TA16
 Zhou, Xunyu MB11
 Zhou, Yangfang SC13
 Zhou, Zhi MB14
 ZHU, Han WA18
 Zhu, Jing
 MONDAY POSTER SESSION
 Zhu, Jingrong TC15
 Zhu, Juanxiu
 MONDAY POSTER SESSION
 Zhu, Kaijie SC04, TD01
 Zhu, Peng WA08
 Zhu, Qingyuan SA04
 Zhu, Wanshan SB11, TC02
 Zhu, Ziming MC22
 Zhuang, Weifen MB01
 Zhuge, Dan TA08
 Zipkin, Paul TA02
 Ziya, Serhan SC18
 Zou, Chengye SC19
 Zou, Zongbao SB02
 Zuidwijk, Rob MA17
 Zulvia, Ferani Eva MC14

SESSION INDEX

Sunday, 8-9:30am

- SA01 New Approaches in Supply Chain Risk Management
- SA02 Inventory Problems in Supply Chains
- SA03 Inventory Sharing and Collaboration
- SA04 Operations/Marketing Interface I
- SA05 Tutorial: Applications of Custom 3D Printed Physiological Heart Valve Models for Reducing Heart Surgery
- SA06 Tutorial: Models for the Sharing Economy
- SA08 Panel: Transforming Education through Analytics and Learning Science and Engineering
- SA09 Topics in Military OR: Conflict Analysis and Logistics
- SA10 Application of Operation Analytics and Optimization Methods
- SA11 Crowdsourcing and Crowdfunding Platforms
- SA12 New Optimization Methods for Vehicle Routing Problems
- SA13 Emerging Topics in Operations
- SA19 AI Methods for Healthcare and Medical Informatics

Sunday, 10-11am

Plenary- Christoper Tang

Sunday, 11:15am -12:45pm

- SB01 Supply Chain Coordination under Risk
- SB02 Interface Between Supply Chain and Information Technology
- SB03 Panel: Industry 4.0 Opportunities for Integrative Decisions in Smart Manufacturing
- SB04 Operations/Marketing
- SB05 Practice I
- SB06 Tutorial: Healthcare Informatics and Analytics – I
- SB07 Simulation Optimization
- SB08 Retail Operations
- SB09 Data Analytics and Artificial Intelligence with Manufacturing and Service Applications
- SB10 Data-driven Analysis for Health Service Design
- SB11 R&D Management: Competitors and Contractors
- SB12 Recent Advances in Public Transit Scheduling
- SB13 Innovative Business Operations
- SB18 Data-driven Healthcare Operations
- SB19 Healthcare Operations Management

Sunday, 2-2:50pm

Keynote- John Birge
Keynote- David Yao
Keynote- Oleg Gusikhin
Keynote- Richard Larson

Sunday, 3:45-5:15pm

- SC01 Risk Analysis
- SC02 Modelling Real-life Inventory Systems
- SC03 Data-driven Decisions
- SC04 Operations/Marketing Interface II
- SC05 Practice II
- SC06 Tutorial: Healthcare Informatics and Analytics – II
- SC07 Simulation Optimizations
- SC08 Meet the Editors Panel
- SC09 New Developments in Design, Manufacturing, Health and Productivity
- SC10 Energy Operation Analytics and Optimization
- SC11 Managing Partnerships and Innovation Adoption

- SC12 Scheduling and Logistics
- SC13 MSOM Energy and Sustainability
- SC18 Healthcare Management
- SC19 Data Analytics and Technology in Healthcare for Efficiency, Quality, and Privacy

Monday, 8-9:30am

- MA01 Modeling and Computations in Financial Engineering
- MA02 Frontiers in China's Largest E-commerce Supply Chain
- MA03 Supply Chain Analytics in Developing Markets
- MA04 Optimization Involving Advertising, Promotions and Branding
- MA05 Practice III
- MA06 Tutorial: Research and Teaching Opportunities in Project Management
- MA07 Data Science in Manufacturing
- MA08 Building and Deploying Real World Optimization and Machine Learning Models
- MA09 Applications of Additive Manufacturing for Healthcare and Clinical Applications
- MA10 Intelligent Resource Allocations and Competitions in Networks and Systems with Big Data
- MA11 Financial Engineering I
- MA12 Transportation Safety and Traffic Control
- MA13 Operations and Economics Interface I
- MA14 Climate Change, Corporate Performance and Natural Resources
- MA15 IT Supportive Innovative Service Design
- MA16 Scheduling Applications
- MA17 Advanced Maritime Simulation Technologies
- MA18 Recent Advances in Emergency Medical Service Management
- MA19 Elderly Care Management
- MA20 Behavioral Decision Making
- MA21 Best Practices in Business and Big Data Analytics
- MA22 Fintech and Mobile Service

Monday, 10-10:50am

Plenary- John A. Buzacott

Monday, 11am- 12:30pm

- MB01 Topics in Logistics and Transportation
- MB02 Inventory Management I
- MB03 Big Data Analytics on Healthcare and Transportation Applications
- MB04 Integrated Simulation and Optimization
- MB05 Practice IV
- MB06 Tutorial: Model-Based Optimization for Operations Research: Best Practices and Current Trends
- MB07 Information Management in Supply Chains
- MB08 Tutorial: Machine Learning and Big Data Analytics
- MB09 Cyber-physical Systems and Industry 4.0 for Manufacturing and Service Industries
- MB10 Logistics Operation Analytics and Optimization
- MB11 Optimization and Risk Management in Financial Applications
- MB12 Intelligent Transportation Systems I
- MB13 Operations and Economics Interface II
- MB14 OR Applications in Sustainable Energy
- MB15 Managing Services Online
- MB17 Advances and Applications of Scheduling Theory
- MB18 Stochastic Modeling and Optimization in Healthcare Operations
- MB19 Data Driven Approach in Healthcare

MB20 Consumer Decision Analysis
 MB21 Energy Management
 MB22 Multidisciplinary Applications of MCDM I

Monday 12:30-1:30pm

Posters

Monday 1:30-2:20pm

Keynote- Shmuel S. Oren
 Keynote- Radhika Kulkarni
 Keynote- Guillermo Gallego
 Keynote- Lam Khin Yong

Monday, 3-4:30pm

MC01 Revenue Management and Pricing in OM&IS
 MC02 Inventory Management II
 MC03 Data-Driven Methods for Dynamical Systems
 MC04 Competition and Contracting in Supply Chains
 MC05 Practice V
 MC06 Tutorial: How to Leverage Big Data Analytics to Grow Business – I
 MC08 Information Extraction and Utilization
 MC09 Operations Management I
 MC10 Manufacturing Operation Analytics and Optimization
 MC11 Simulation and Finance
 MC12 Last Mile Logistics
 MC13 Operations and Economics Interface II
 MC14 Harnessing Renewable Energy and Efficiency
 MC15 Service Design & Service Systems
 MC16 First-order and Stochastic Algorithms for Large-scale Optimization Problems
 MC17 Automated Traffic System in Container Terminals
 MC18 Decision Analysis in Healthcare Systems
 MC19 Scheduling Optimization and Management in Healthcare
 MC20 Computation and Control in Stochastic Systems
 MC22 Negotiation Analysis and Support

Monday, 4:35-6:05pm

MD01 Smart Pricing and Inventory Control
 MD02 New Topics in Operations with Pricing and Inventory Considerations
 MD04 Operations & Marketing Interface
 MD05 Innovation/Entrepreneurship
 MD06 Tutorial: How to Leverage Big Data Analytics to Grow Business – II
 MD07 Modeling and Algorithmic Approaches for Critical Intelligent Systems
 MD08 SCM Finance & Big Data Institutional Research
 MD09 Data Mining and Computation with Emerging Applications
 MD10 Optimal Design and Operations in Supply Chains
 MD11 Simulation and Optimization
 MD12 Logistics
 MD13 Operations and Economics Interface IV
 MD14 Sustainable Energy and Environmental Policy
 MD15 Service Science I
 MD16 Reinforcement Learning and Optimal Sequential Decision Making
 MD17 Future of Yard Operation in Maritime Logistics I
 MD18 Healthcare Policy and Applications
 MD19 Dynamic Decision Making for Health Care Policy
 MD20 Performance Analysis of Computer Systems and Networks
 MD21 Measurement & Evaluation
 MD22 Preference Elicitation, Communication, and Use

Tuesday, 8-9:30am

TA01 Pricing and Behavioral Issues
 TA02 Supply Chain Inventory
 TA03 Data Privacy, Path Models and Predictive Analytics
 TA04 Special Session: Condition Based Maintenance and Hazards Modeling
 TA05 Practice VI
 TA06 Tutorial: Analytics for the Supply Chain 4.0
 TA08 Transportation Operations
 TA09 Data Mining, Graphs, and Networks
 TA10 Supply Chain and Logistics Management
 TA12 Intelligent Transportation Systems II
 TA13 Operations and Economics Interface V
 TA14 Location Model
 TA15 Machine Learning and Big Data Analytics
 TA16 Optimization I
 TA17 Future of Yard Operation in Maritime Logistics II
 TA18 Innovative Applications in Health Care and Health Policy Research
 TA19 Healthcare System Resource Allocation: Insight, Analysis, and Optimization
 TA20 Stochastic Models in Quantitative Finance
 TA21 New Technology and Service Innovation
 TA22 Multidisciplinary Applications of MCDM II

Tuesday, 10-10:50am

Keynote- Edward Kaplan
 Keynote- Sriram Raghavan
 Keynote- San-Cheng Chang

Tuesday, 11:00-12:30pm

TB01 Pricing and Revenue Optimization
 TB02 Topics in Inventory Management and Pricing Management
 TB03 Industrial IoT and ML Applications
 TB04 Topics in Military OR: Health Monitoring and Scheduling Systems
 TB05 Practice VII
 TB06 Tutorial: Responsible Operations: Models, Relevance and Impact
 TB07 Smart Transportation in Industrial Parks
 TB09 Data Mining and Statistics with Emerging Applications
 TB10 Optimization Modeling and Analytics
 TB11 Financial Engineering II
 TB12 Metaheuristics in Transportation
 TB13 Operations and Economics Interface VI
 TB14 Strategic Location Analysis for Safety and Logistics
 TB15 Technology-enabled and Knowledge Intensive Service
 TB16 Optimization II
 TB17 Land Logistics and Warehousing
 TB18 Managing Patient Inflow at Hospitals
 TB19 Data and Literature: A Quality and Informatics Perspective
 TB20 Queueing Models and their Applications
 TB21 Quality Control and Reliability
 TB22 MCDM Tutorial

Tuesday, 1:30-3:00pm

TC01	Retail Management
TC02	Inventory Management III
TC03	Optimization and Machine Learning for Big Data-driven Problems
TC04	Special Session: Military Operations Research: Past, Present, Future
TC05	Marketing
TC06	Tutorial: Data Integrated Stochastics: Models and Methods
TC07	Smart City Applications
TC08	Artificial Intelligence
TC09	Supply Chain Management I
TC10	Data Analytics for Engineering System Improvement
TC11	Finance - Theory & Empirics
TC12	New Trends in Maritime Transportation Operations Management
TC13	Operations and Economics Interface VII
TC14	Urban Operations Research
TC15	Service Science II
TC16	Combinatorial Optimization
TC17	Future Shipping Solutions
TC18	Healthcare Systems
TC19	Quality and Safety Tools put into Practice
TC20	Stochastic Dynamic Optimization
TC21	Service Quality and Customer Satisfaction
TC22	Multiple Objective Decision Making (MODM)

Tuesday, 3:30-5:00pm

TD01	Operations Management II
TD02	Queueing Models
TD03	Predictive Analytics in Service and Education
TD04	Transforming US Army Supply Chains: A Project Update
TD05	Retail Operations Management
TD06	Tutorial: Tales from the Crypt: Lessons Learned in Implementing Optimization Systems
TD07	Simulation and Optimization for Design and Control of Complex Systems
TD08	Next Generation Air Transportation
TD09	Supply Chain Management II
TD10	Manufacturing & Supply Chains
TD11	Finance - Risk Management
TD12	Disaster Logistics
TD13	Sharing Economy
TD14	Behavioral Operations
TD15	Customer Relationship Management (CRM)
TD16	Forecasting
TD17	Future of Yard Operation in Maritime Logistics III
TD18	Healthcare Analytics and Operations Management
TD19	OR and Healthcare
TD20	Product Development
TD21	Smart Traffic
TD22	Multidisciplinary Applications of MCDM III

Wednesday, 8:00-9:30am

WA01	Sustainable Supply Chain I
WA03	Operations Management III
WA06	Tutorial: The Evolution of Supply Chain Function in the Context of India
WA07	Scheduling I
WA08	Big Data & Business Applications
WA09	Supply Chain Management III
WA10	Global Logistics I
WA11	Financial Analytics
WA12	VRP
WA13	Operations in Supply Chains
WA15	Business Applications
WA16	Stochastic Optimization
WA17	Operation Research in Maritime Transportation
WA18	Stochastic Modeling in Healthcare Management
WA19	Health Care
WA20	Data Envelopment Analysis
WA21	Technology & Applications
WA22	Decision Support Systems

Wednesday, 10-12:pm

WB01	Sustainable Supply Chain II
WB07	Scheduling II
WB08	Domain Specific Analytics on Innovative Commerce Applications
WB09	Supply Chain Management IV
WB10	Global Logistics II
WB12	Urban Transport
WB13	Operations and Economics Interface VIII
WB15	E-Business/Commerce
WB18	Quality Management & Reliability
WB22	Multiple Attribute Decision Making (MADM)

