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 Session Codes

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

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

The day of the week

Time Blocks

Sunday

A — 8:00am - 9:30am
B — 11:00am - 12:30pm
C — 1:30pm - 3:00pm
D — 2:00pm - 3:30pm
E — 4:00pm - 5:30pm

Monday

A — 8:00am - 9:30am
B — 11:00am - 12:30pm
C — 2:00pm - 3:30pm
D — 4:00pm - 5:30pm

Tuesday

A — 9:00am - 10:30am
B — 1:30am - 3:00pm
C — 3:30pm - 5:00pm

Wednesday

A — 9:00am - 10:30am
B — 11:00am - 12:30pm

Sunday, 8:00am - 9:30am

■ SA01

King's 1

Foundations and Applications of Satiation Preferences

Sponsored: Decision Analysis

Sponsored Session

Chair: Manel Baucells, University of Virginia, Darden Faculty Office Building, Charlottesville, VA, 22906, United States, mbaucells@gmail.com

1 - Effort Provision with Fatigue

Lin Zhao, Chinese Academy of Sciences, zhaolin@iss.ac.cn

We propose a model of fatigue that is economically sound, and that formalizes the robust empirical findings of Baumeister, Muraven and colleges regarding self-regulation. The model will define precisely notions such as "fatigue", "replenishment", "cost of self-control", "willpower capacity", and "increase in willpower capacity." The model has strong prescriptive value, as it will help us understand how an individual should act in order to minimize fatigue and achieve a set of goals requiring self-regulation. Policy implications are also explored.

2 - Dynamic Pricing under Satiation and Habit formation

Ying He, University of Southern Denmark, Odense, Denmark, yinghe@sam.sdu.dk, Wen Chen

A representative consumer's utility maximization problem is solved to obtain the demand function under habit formation and satiation. We then show that the optimal pricing policy for the monopolist is either penetration pricing or skimming pricing. We discuss the sensitivity of the optimal policy and profit with respect to the behavioral parameters in our model.

3 - Where Does Satiation Comes From?

Manel Baucells, Darden School of Business, baucellsm@darden.virginia.edu

We introduce a natural extension of the occupancy problem in probability theory. Our first result derives the response function of such system. Next, we show that the response function is approximately equal to the satiation utility function. Third, we show that the optimal temporal distribution of inputs follows a high-low-high pattern. The proposed system is a toy model of neurobiological signal transmission, and offers a new frame to connect utility and biology.

■ SA02

King's 2

Energy Security

Invited: Homeland Security and Disaster Management

Invited Session

Chair: Dean Hartley, Principal, Hartley Consulting, 106 Windsong Ln, Oak Ridge, TN, 37830, United States, Dshartley3@comcast.net

1 - Managing Threat Risk Assessment Issues in Homeland Security

William P Fox, Naval Postgraduate School, wpfox@nps.edu

In this paper we examine a threat risk assessment process and mathematical modeling methodologies that could be used by local law enforcement, homeland security, or military units to prioritize terrorist threats. We provide examples from risk assessment that include energy sources. In our example, we apply a multi-attribute decision making methods to the threat assessment process. We apply sensitivity analysis to our methods.

2 - Essentials of Energy Storage

Dean S. Hartley, Principal, Hartley Consulting, 106 Windsong Ln, Oak Ridge, TN, 37830, United States, DSHartley3@comcast.net

We discuss the alternative forms of energy storage, with pros and cons. We then introduce the science and engineering behind superconducting magnetic levitation and how it supports a better form of energy storage.

3 - Local Energy Storage As Part of Homeland Security
Dean S. Hartley, Hartley Consulting, DSHartley3@comcast.net

We discuss the security benefits of breaking the national energy grid into a thousand pieces. We show how local energy storage supports this and how the Sisyphus system enables local energy storage.

■ SA03

King's 3

Behavioral Operations and Cars

Sponsored: Behavioral Operations Management

Sponsored Session

Chair: Natalia Sowik, EBS University of Business and Law, Gustav-Stresemann-Ring 3, Wiesbaden, 65189, Germany, natalia.sowik@ebs.edu

1 - Design of Pedestrians Running Red Lights Warning System
Changan Gao, Huazhong University of Science and Technology, Hongshan District, 1037 Luo Yu Road, Wuhan, 430074, China, bestchangan@126.com

In China, many pedestrians may run a red light when crossing the road. In order to solve this problem, we conducted a field survey, and collected a large number of data. Then we analyzed the reason of the pedestrian red light, and designed an alarm device based on the knowledge of electromagnetism, optics, acoustics and so on. This device and the traffic light system can be combined into an intelligent alarm system, whose application in the intersection can effectively improve the phenomenon of pedestrians running red lights, and help to improve the traffic efficiency.

2 - Psychological Ownership in Access Based Consumption on the Example of Carsharing
Natalia Sowik, EBS University of Business and Law, Gustav-Stresemann-Ring 3, Wiesbaden, 65189, Germany, natalia.sowik@ebs.edu

Humans express themselves through ownership (OS) by building consumer-object relationships. Nevertheless, access-based consumption (ABC), formed on the avoidance of OS, but acquisition of temporary access to objects, is gaining momentum. Based on the shift from OS to access, we assume that it is not essential to own an object to develop feelings of OS, referring to the theory of psychological ownership (PO). To examine PO in ABC, we conducted a quantitative study among 1,526 carsharing users. The results show evidence for PO with no significant difference between respondents, who additionally own a car, and those, who do not. Impacts of PO on satisfaction, loyalty, and word-of-mouth were found.

3 - Identifying Range Anxiety of Electric Vehicle Drivers using Psychophysiological Measures
Dongwoo Jin, KAIST, yuseong-gu Daehak-ro 291, W1-2 4203, Daejeon, Korea, Republic of, jindowo@kaist.ac.kr

Electric vehicles were developed as the alternative eco-friendly transportation to reduce dependency on fossil fuel. However, technical and psychological difficulties from short driving range, slow recharging speed and fewer recharge stations still limit the broad acceptance of electric vehicles to the public. This study focused on the phenomenon of range anxiety which is drivers' anxiety about the limited range of their electric vehicles and underdeveloped infrastructure of charging opportunities. EEG, ECG and pupillary size were utilized for this study and they first processed to extract anxiety-related indexes for representing drivers' mental status while driving electric vehicles.

4 - Comparative Analysis of Various Population Groups in Car Collision Based on Collision Risk Factors using Data Mining Technique
Yeonghwa Woo, KAIST, Daejeon, Korea, Republic of, beeltebum@kaist.ac.kr

Road safety is one of main health issues related to transportation system. Risk factor analysis is performed to identify major variables that determine severity of collisions, and to measure their influence to the injury severity. In this study, we identify major risk factors that determine collision severity for various subgroups involved in accidents, and compare different subgroups quantitatively and qualitatively based on risk factor importance. Subgroups are generated by five criteria of driver's gender, population of collision area, at-fault party indicator, race of driver, and vehicle maker. Risk factor importance is measured using data mining technique of regularized random forest.

■ SA04

Queen's 4

Marketing and Commerce

Contributed Session

Chair: Osman Oguz, Bilkent University, Dept of Industrial Engineering, Ankara, 06800, Turkey, ooguz@bilkent.edu.tr

1 - The Impact of Business Response to Negative Online Reviews
Shuojia Guo, Assistant Professor, CUNY-CSI, 2800 Victory Boulevard, Staten Island, NY, 10314, United States, nancy.guo@csi.cuny.edu

Online feedback mechanisms have become increasingly important to companies' bottom lines as more and more consumers rely on online reviews to evaluate product or service quality before making purchase decisions. However, it is almost certain that at some point some consumers will write negative reviews for a company. While most of the extant literature on online reviews is focused on how the valence of online reviews affects consumers' purchase intentions, there has been virtually no attention paid to the topic of online business responses. This current study aims to investigate how managers' responses to customer reviews and in particular to negative reviews affect subsequent ratings and reviews.

2 - Exploring the Biasing Effects of a Two-Sided Format on Product Reviews
Haksin Chan, Hang Seng Management College, Shatin, Hong Kong, hschan@hsmc.edu.hk

Online product reviews are among the most frequently used information sources today. Interestingly, online review forums vary widely in how they solicit information. Some forums give reviewers a free hand in the review process, whereas others request reviewers to highlight both positive and negative product attributes. Intuitively, the two-sided format (TSF) is conducive to unbiased reviews. This research, however, explores the potentially biasing effects of the TSF. Results from three experiments indicate that the TSF can have a centralizing or a polarizing effect on product ratings. These results have strong implications for understanding, comparing, and driving user-generated content.

3 - Mobile Shopping More Impulse Purchases in a Higher Friction Market
Yubo Chen, Associate Dean and Professor, Tsinghua University, School of Economics and Management, Beijing, 100084, China, chenyubo@sem.tsinghua.edu.cn

The rapid development of the mobile Internet is changing the landscape of the E-commerce. It becomes very important to understand whether and how the mobile channel affects consumer purchase behavior. This paper studies this issue by modeling the data from one of the largest online retailers in China. We find that customers' mobile channel adoption can significantly increase their overall purchase frequency and spending in both the short and long term. Interestingly, the mobile channel can have both substitutive and complementary effects on the traditional PC channel. We further examine the mechanism behind the impacts of mobile channel on customer purchase behaviors.

4 - A Heuristic for Traveling Salesperson Problem
Osman Oguz, Assoc. Professor, Bilkent University, Dept of Industrial Engineering, Ankara, 06800, Turkey, ooguz@bilkent.edu.tr

A Dynamic Programming based heuristic algorithm is presented to solve the TSP. The complexity of the algorithm is polynomial. The performance of the algorithm will be evaluated on a set of numerical experiments.

■ SA05

Queen's 5

Healthcare Management 1

Invited: Global Health

Invited Session

Chair: Eman Leung, City University of Hong Kong, emaleung@cityu.edu.hk

Co-Chair: Zachary N. Leung, City University of Hong Kong, znhleung@cityu.edu.hk

1 - Multi-modality Magnetic Resonance Imaging Neuroinformatics in Alzheimer's Disease

Xiaoying Tang, Sun Yat-sen University-Carnegie Mellon University, Joint Institute of Engineering, Sun Yat-sen University, China, txiaoyin@andrew.cmu.edu

We examine the morphometrics and photometrics of the hippocampus and amygdala obtained from multi-modality magnetic resonance images and their discriminative capabilities in diagnosing Alzheimer's disease (AD). For morphometrics, both the global volume and the local shape will be investigated. Photometrics will be extracted from diffusion tensor images quantifying microstructural brain integrity. Following the careful collection of the aforementioned neuroinformatics, we will extend the reach of this work by making use of emerging and current machine learning techniques involving big data and large scale learning methodologies to differentiate between AD and normal aging populations.

2 - Signaling by (not) Testing

Tinglong Dai, Assistant Professor, Johns Hopkins University, Baltimore, MD, 21202, United States, dai@jhu.edu

Diagnostic experts, such as medical specialists, often only imperfectly observe customers' conditions, and may resort to advanced testing procedures. We model a diagnostic expert's diagnostic decision tree problem when the expert's level of competence is unknown to customers. We characterize perfect Bayesian equilibria, and establish the existence and uniqueness of a separating equilibrium. Our results offer insights into diagnostic experts' testing behavior driven by their signaling efforts.

3 - Admission Control of Pregnant Women in Obstetrics Units

Na Geng, Shanghai Jiao Tong Univ., gengna@sjtu.edu.cn, Xiaolan Xie

Obstetrics unit provides the long-term consistent cares for women starting from the antenatal care to perinatal stage. Due to the uncertainties of patient arrival, the time and duration of using the critical resources, it is difficult for the scheduler to make the admission decision to make sure the availability of resources when the patient needs it. This paper proposes a simulation model to determine the optimal threshold for admitting the patients. The objective is to minimize the criteria value, including the idle bed cost, overload penalty, and referral penalty. Numerical experiments find show that the optimal proposed threshold performs much better than that in from practices.

■ SA06

Queen's 6

Trading Networks and Applications

Invited: Sharing Economy, Matching Markets, and Networks

Invited Session

Chair: Thanh Nguyen, Purdue University, Purdue University, West Lafayette, IN, 47907, United States, nguye161@purdue.edu

1 - Delay in Trade Networks

Thanh Nguyen, Purdue University, nguye161@purdue.edu

We analyze a bargaining model in supply chain networks, and characterize how the network structure leads to delay and failure in negotiation.

2 - Network Flows and Trading Networks

Ozan Candogan, University of Chicago, Ozan.Candogan@chicagobooth.edu, Markos Epitropou, Rakesh Vinay Vohra

In trading networks where agents exchange indivisible goods (or indivisible contracts), recent literature has established that under a full substitutability condition on agents' preferences, a competitive equilibrium exists. Moreover, competitive equilibria of trading networks are also stable outcomes, which is equivalent to the seemingly weaker chain stability condition. This paper's contribution is to show that under the full substitutability assumption, all these results can be obtained simply and directly from the optimality conditions of a generalized submodular flow problem in an appropriately defined network. This is joint work with Markos Epitropou and Rakesh Vohra.

3 - Fast Approximate Policies for Large Networks

Ankur Mani, MIT, amani@mit.edu

Optimal policies for networks may be computationally hard and still may lead to suboptimal outcomes if the network information is noisy. We present simple heuristics with comparable performance. These policies are easy to compute and we provide guarantees for their performance. As an example we study price discrimination in networks and show that our heuristics give approximately optimal expected profits for large random networks.

■ SA07

Kohala 1

Operations/Finance Interface

Invited: Operations/Finance Interface

Invited Session

Chair: Weiming Zhu, Smith School of Business, 7621 Mowatt Lane, College Park, MD, 20740, United States, zhuwm923@gmail.com

1 - Delayed Payments in Supply Chains: the Role of Moral Hazard vs. Bankruptcy

Sripad Devalkar, Indian School of Business, sripad_devalkar@isb.edu

We consider a buyer who uses delayed payments as a mechanism to mitigate supplier moral hazard. Moral hazard in the supply chain arises because the buyer prefers shorter lead times that require the supplier to exert costly effort that is unobservable. We show that suppliers with high cost of effort are able to use the threat of bankruptcy to extract better payment terms from the buyer. We show that bonus payments for timely delivery along with delayed payment can restore supply chain efficiency.

2 - An Application of Cardinality-constrained Multiple Benchmarks Tracking Error Model on Crop Variety Selection

Quizhuo Ma, South China Agricultural University, College of Economics and Management, Guangzhuo, 510642, China, maqzh@scau.edu.cn

Similar to the connection between the stock return and listed enterprise performance, the return from different crop varieties are correlated with the natural conditions and market environment within a certain geographic range. As we treat an economic area, such as a country, a province, a city or even an agricultural production base as a production unit, its decision-maker, like the government, business owner or even an individual farmer may face the choice between pure- and diversified-variety cropping strategies when considering different risk aversion levels.

■ SA08

Kohala 2

Marketing Models

Invited: Operations/Marketing Interface

Invited Session

Chair: Ashutosh Prasad, University of Texa-Dallas, Richardson, TX, United States, aprasad@utdallas.edu

1 - Advertising under Model Uncertainty

Olivier Rubel, University of California, Davis, orubel@ucdavis.edu

Marketing managers and researchers traditionally postulate particular sales response models, estimate model parameters and derive advertising strategies assuming that there is no uncertainty with respect to the process governing sales. When a doubt exists with respect to this process, we apply minimax control theory to obtain dynamic advertising policies that are robust to model uncertainty. We discuss the costs and benefits of being robust and empirically illustrate our approach with data from a large public health agency.

2 - When Showrooming Increases Retailer Profit

Dmitri Kuksov, The University of Texas at Dallas, Richardson, TX, 75080, United States, Dmitri.Kuksov@utdallas.edu, Chenxi Liao

Showrooming, - the consumer practice of visiting a brick-and-mortar store but then buying online, - is attracting an increasing attention in business practice and the academic literature. It is commonly considered a major threat faced by the brick-and-mortar retailers. However, the usual arguments ignore the strategic role of the manufacturer in the distribution channel. This paper analytically shows that given the optimal profit-maximizing behavior of the manufacturers, showrooming may lead to increased profits of brick-and-mortar retailers. This result holds even if the manufacturer is restricted to wholesale-only contracts and is not allowed to price discriminate between channels.

3 - Selling Opaque Goods with Bundles

Ashutosh Prasad, The University of Texas at Dallas, aprasad@utdallas.edu

Moving beyond pure components selling, a multi-product seller has pertinent and innovative selling strategies available for consideration. Two possibilities that received separate academic attention are to create bundles of products and to create opaque goods for populating the product line. We construct and examine an extended product line of original product components, derived bundles and opaque goods to assess profitability. We find that customer heterogeneity distribution, consumer risk profiles and marginal costs play important roles in establishing the profitability of this complex set of offerings.

■ SA09

Kohala 3

Innovation, Collaboration and Policy in Emerging Economics

Invited: Entrepreneurship and Innovation

Invited Session

Chair: Jizhen Li, Tsinghua University, Room 541, Weilun Building, Beijing, 100084, China, lijzh@sem.tsinghua.edu.cn

1 - Assistant Professor, School of Economics and Management

Si Zhang, University of Chinese Academy of Sciences, zhangsi@ucas.ac.cn, Na Li, Jizhen Li

Drawing on a sample of 402 inter-firm R&D alliances ,the paper will first construct a Comprehensive Index Evaluation System for relational rent. This will allow quantitative estimations to be made on relational rent. Although extant researches attempt to grasp potential elements that affect the generation of mutual benefits in technological collaborations and alliances, it seems to have overlooked the role of a very essential factor —- the nature of relationship per se between the firms. Therefore, the paper secondly adopts a semi-parametric model to quantitatively examine how the nature of relationship dominantly affect the alliance outcome.

2 - How Contraints Trigger Firms' Innovation. Evidence From China

Jianghua Zhou, Beijing Normal University, zhoujh@bnu.edu.cn, Yinan Xia, Yimei Hu, Si Zhang

This paper focuses on how market and skill contraints trigger firms' innovation . Based on the analysis of a sample of over 1400 firms in mnufacturing sector in China, We find that, through stimulating firms enhancing internal knowledge recombination and external knowledge sourcing, constraints can trigger firms' product and process innovation. Specifically, external knowledge sourcing partially mediates the relationship between skill constraint and process innovation. Internal knowledge recombination and external knowledge sourcing fully mediate the relationship between skill constraint and product innovation and the relationship between market constraint and product innovation.

3 - Government Support and Firm Growth: Evaluation of Innofund

Yueheng Wang, Tsinghua University, wangyh.08@sem.tsinghua.edu.cn

While an increasing number of government support programs towards technology-based SMEs have been carried out to address their resource constraints and promote their growth, rigorous evaluations of such programs are largely missing and their effectiveness remain uncertain. This paper examines government support program's influence on the development of technology-based SMEs, and empirically tests the effect of the InnoFund program in China. To avoid the endogeneity issue and single out the effect of government support while controlling for other factors influencing venture growth, this study adopts both the regression discontinuity approach and the randomized controlled trial method.

■ SA10

Kohala 4

New Directions in Optimization Over Polytopes

Sponsored: Optimization

Sponsored Session

Chair: Amir Ali Ahmadi, 329 Sherrerd Hall, Princeton University, Princeton, NJ, 08540, United States, a_a_a@princeton.edu

1 - Maximizing a Class of Utility Functions over the Vertices of a Polytope

Alper Atamturk, University of California-Berkeley, atamturk@berkeley.edu, Andres Gomez

Given a polytope X, a monotone concave univariate function g, and two vectors c and d, we consider the discrete optimization problem of finding a vertex of X that maximizes the utility function c'x + g(d'x). This problem has numerous applications in combinatorial optimization with a probabilistic objective. We show that the problem is NP-hard for any strictly concave function g even for simple polytopes, such as the uniform matroid, assignment and path polytopes; and propose a 1/2-approximation algorithm for it. We discuss improvements for special cases. In particular, for the square root function, the approximation ratio is 4/5.

2 - Two New Efficient Algorithms for Compressed Sensing (tentative)

Robert J Vanderbei, Princeton University, Princeton, NJ, United States, rvdb@princeton.edu

We present two new approaches for solving large-scale compressed sensing problems. The first approach uses the parametric simplex method to recover very sparse signals by taking a small number of simplex pivots while the second approach reformulates the problem using Kronecker products to achieve faster computation via a sparser problem formulation. Numerical studies show that each of these two algorithms are about 10 times faster than current state-of-the-art methods.

3 - Robust-to-dynamics Linear Programming

Amir Ali Ahmadi, Princeton University, a_a_a@princeton.edu, Oktay Gunluk

We introduce a new type of robust optimization problems that we call "robust to dynamics optimization" (RDO). The input to an RDO problem is twofold: (i) a mathematical program (e.g., an LP, SDP, IP), and (ii) a dynamical system (e.g., a linear, nonlinear, discrete, or continuous dynamics). The objective is to maximize over the set of initial conditions that forever remain feasible under the dynamics. We initiate an algorithmic study of RDO and demonstrate tractability of the LP case.

4 - Iterative LP and SOCP-based Approximations to Semidefinite and Sum of Squares Programs

Georgina Hall, Princeton University, Princeton, NJ, 08540, United States, gh4@princeton.edu, Amir Ali Ahmadi, Sanjeeb Dash

We develop techniques for approximating SDPs with LPs and SOCPs. Our algorithms iteratively grow an inner approximation to the PSD cone using a column generation scheme and/or a change of basis scheme involving Cholesky decompositions.

5 - First-order Methods for Robust Convex Optimization

Nam Ho-Nguyen, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States, hnh@andrew.cmu.edu

Robust optimization is a framework to model parameter uncertainty in optimization problems. Inspired by recent developments, we present several efficient first-order methods to approximately solve robust convex optimization problems. We also introduce the notion of weighted regret online learning and the online saddle-point problem, which form key building blocks for our methods. Finally, we discuss some proximal-type algorithms for these problems.

■ SA11

Kona 1

Mechanism Design in Healthcare

Invited: Mechanism Design and Game Theory

Invited Session

Chair: Hamsa Bastani, Stanford University, 650 Knight Way, Stanford, CA, 94305, United States, hsridhar@stanford.edu

1 - Mechanism Design for Allocation Problems

Rediet Abebe, Cornell University, rta36@cornell.edu

There are various randomized mechanisms for allocating indivisible goods to agents when monetary transfer isn't allowed. The main desirable properties here are fairness, truthfulness and efficiency. The three most prominent mechanisms in the literature—Randomized Serial Dictatorship, Probabilistic Serial, and the Hylland-Zechkauser mechanisms—have complementary properties. In this work, we introduce a novel truthful mechanism for the allocation problem. We discuss its fairness and efficiency properties as well as its comparative advantages over existing standard randomized mechanisms in some healthcare settings. Joint work with Richard Cole, Vasilis Gkatzelis and Jason Hartline

2 - Optimal Provision-after-wait in Healthcare

Jing Chen, Stony Brook University, Stony Brook, NY, United States, jingchen@cs.stonybrook.edu, Mark Braverman, Sampath Kannan

We investigate computational and mechanism design aspects of allocating medical treatments of different costs to patients who each value them differently. The payer wants to ensure that the total cost is at most the budget, B. Over-demanded hospitals are rationed through waiting times. We show that optimizing social welfare in equilibrium is NP-hard; and if the number of hospitals is small and the budget can be slightly relaxed, the optimum can be achieved efficiently. Next, we show waiting times emerge endogenously from the dynamics between hospitals and patients. Finally, we show that under natural conditions, optimal welfare is actually attained by a randomized assignment without waiting times.

3 - Incentive Programs for Reducing Readmissions when Patient Care Is Co-produced

Dmitrios Andritsos, HEC Paris, andritsos@hec.fr, Christopher S Tang

To compare the effectiveness of three different hospital reimbursement schemes (i.e., Fee-for-Service, Pay-for-Performance and Bundled Payment) in reducing readmissions, we develop a "health co-production" model in which the patient's readmission is "jointly controlled" by the efforts exerted by both the hospital and the patient.

4 - Analysis of Medicare's Hybrid Pay-for-performance Contracts

Hamsa Sridhar Bastani, Stanford University, Stanford, CA, United States, hsridhar@stanford.edu, Mohsen Bayati, Mark Braverman, Ramki Gummadi, Ramesh Johari

Medicare has sought to improve patient care through hybrid pay-for-performance (P4P) policies that better align hospitals' financial incentives with quality of service. However, the design of these policies has been ad-hoc and deviate from optimal designs advocated by economic theory. A key practical constraint is the use of a "small P4P incentive." We analyze the efficiency of mechanisms in this regime under a principal-agent model. Our results can be used to inform various design choices and yield insights for current Medicare policies. We further characterize an optimal hybrid mechanism and the conditions under which it can substantially increase efficiency.

■ SA12

Kona 2

Scheduling and Project Management 1

Invited: Scheduling and Project Management

Invited Session

Chair: Yumei Huo, City University of New York, Staten Island, NY, United States, yumei.huo@csi.cuny.edu

1 - Polynomial Time Algorithms for Two Machines Bicriteria Scheduling Subject to Arbitrary Machine Availability Constraints

Hairong Zhao, Purdue University Calumet, hairong@purduecal.edu

We study the bi-criteria scheduling problem on two machines subject to the machine availability constraint. We want to minimize the makespan subject to the total completion time is minimum or vice versa. Each machine may have one or more unavailable periods. The jobs can be resumed after interrupted by the unavailable intervals. Preemption is allowed. We show that the problems can be solved in polynomial time.

2 - Coordination Mechanisms for Scheduling Game on Parallel-batching Machines with Non-identical Job Sizes

Quanneng Wang, Performance Analysis Center of Production and Operations Systems(PacPos),Northwestern Polytechnical University, Xi'an, China, pacpos.qnwang@gmail.com, Guoqiang Fan, Junqiang Wang

We consider a non-cooperative scheduling game problem with m identical parallel-batching machines and n independent selfish jobs. Each machine has a capacity C and job j has size sj, and the total size of jobs in the same batch cannot exceed the machine's capacity. Job's strategy is to minimize its own cost and global objective is to minimize makespan. We define the cost of job j as the sum of time cost Cj and batching cost bj and design a LPT-FF mechanism for this game. Finally we prove the existence of pure Nash Equilibrium, and show that the price of anarchy is no greater than 5/2-1/2m.

3 - Parallel Machine Scheduling under Time of Use Electricity Prices

Jian-Ya Ding, Tsinghua University, ding-jy12@mails.tsinghua.edu.cn

We have studied the unrelated parallel machine scheduling problem under time-of-use (TOU) pricing scheme. The objective is to minimize total electricity cost by appropriately scheduling the jobs such that the overall completion time does not exceed a pre-determined production deadline. To solve this problem, two solution approaches are presented. The first approach models the problem with a new time-interval based mixed integer linear programming formulation. In the second approach, we reformulate the problem using Dantzig-Wolfe decomposition and propose a column generation (CG) heuristic to solve it. Computational experiments results confirm the effectiveness of the proposed methods.

4 - Parallel Ant Colony Optimization for Flow Shop Scheduling Subject to Limited Machine Availability

Yumei Huo, City University of New York, College of Staten Island, yumei.huo@csi.cuny.edu

In this research, parallel ant colony algorithm (PAC) and parallel ant colony with local search algorithm (PACwLS) are presented and applied to Permutation Flowshop Scheduling Problem subject to limited machine availability. The objective is to minimize total flowtime criterion. PAC and PACwLS are based on the classical ant colony algorithm, but are implemented and adapted on parallel computer systems with Message Passing Interface. Computational experiments show that by comparing with monte carlo algorithm, both PAC and PACwLS ourperform monte carlo algorithm, and PACwLS consistently outperforms PAC and converges faster than both PAC and monte carlo algorithm.

5 - Efficient Algorithms to Find Makespan under Scheduling Perturbation

Golshan Madraki, PhD Candidate, Ohio University, 15 Station St apt F, Athens, OH, 45701, United States, g.madraki@gmail.com

Perturbations over processing times, sequence of operations or schedule of jobs in a manufacturing system are likely. A desirable system can immediately recalculate the performance measures of the system such as the Makespan. Any manufacturing system can be represented by a directed acyclic graph. Graphical wise, perturbation may occur over node weights or structure of the graph. The goal of current research is to find the efficient algorithms to calculate changes to the performance measures of a perturbed system. we will show that there will be savings in computational complexity. Finally, the efficiency of algorithms will be discussed. As an example, a buffered job shop system is discussed.

■ SA13

Kona 3

Learning Probabilistic Models

Sponsored: Applied Probability

Sponsored Session

Chair: Jinwoo Shin, KIAST, Korea, Korea, 00000, Korea, Democratic People's Republic of, jinwoos@kaist.ac.kr

1 - Tensor Methods: A New Paradigm for Training Probabilistic Models and Neural Networks

Anima Anandkumar, University of California, Irvine, a.anandkumar@uci.edu

Tensors are rich structures for modeling complex higher orderrelationships in data rich domains such as social networks, computervision, internet of things, and so on. Tensor decomposition methodsare embarrassingly parallel and scalable to enormous datasets. Theyare guaranteed to converge to the global optimum and yield consistentestimates for many probabilistic models such as topic models,community models, hidden Markov models, and so on. I will alsodemonstrate how tensor methods provide a guaranteed method for trainingneural networks.

2 - Efficient Structure and Parameter Learning for Ising Models: A New Approach
Marc Vuffray, Los Alamos National Laboratory, Los Alamos, NM, United States, vuffray@lanl.gov, Andrey Lokhov, Sidhant Misra, Chertkov Misha

Ising models are a class of graphical model representing probability distributions over binary variables. We consider a machine learning problem where we receive a collection of i.i.d. samples generated by an Ising model and our task is to reconstruct the underlying graph and factors. We suggest a new method that is efficient computationally and scales well with the number of samples. Our genuine statistical estimator is inspired by considerations borrowed from statistical physics. The estimator is consistent and it implements a convex optimization. We show that with a proper regularization our estimator reconstruct couplings of arbitrary Ising models with a quasi-optimal number of samples.

3 - Optimal Learning Via Belief Propagation for Crowdsourcing
Jinwoo Shin, Korea Advanced Institute of Science and Technology, jinwoos@kaist.ac.kr

Crowdsourcing systems are popular for solving large-scale labelling tasks with low-paid (or even non-paid) workers. We study the performance of the Belief Propagation (BP) algorithm for the problem of recovering the true labels from the possibly erroneous crowdsourced labels under the popular Dawid-Skene model. We prove that it is information-theoretically impossible for any other algorithm to correctly label a larger fraction of the tasks than BP. Experimental results also suggest that BP is optimal for all regimes considered, while all other known algorithms show suboptimal performances in certain regimes.

■ SA14

Kona 4

Behavior and Decision Support in Health Care

Sponsored: Health Applications

Sponsored Session

Chair: Steven J. Landry, Purdue University, ba, West Lafayette, IN, 47907, United States, slandry@purdue.edu

1 - Research on Interaction of Mobile Health Service Platforms
Jingwen Huang, Master, Huazhong University of Science and Technology, LuoYu Road No.1037, Hongshan District, School of Management, Room 316, WuHan, 430074, China, glenywxk@163.com

The key for mobile health services to success is to make sure that the interaction between users and medical institutions are honest, and to let users talk more about themselves on a mobile health service platform. In fact, few users are willing to talk too much about themselves and tell the truth about themselves on these platforms. In allusion to this phenomenon, we collected a large amount of data by sending and receiving a lot of questionnaires online and offline. Through analyzing these data, we find that there are mainly two aspects of reasons that affect the interactivity of mobile health service platforms. Finally, aiming at these factors, we put forward some reasonable suggestions.

2 - Data Analytics for Telehealth
Kylie Wall, Principal Health Consultant, QSPectral Systems, 2/125 Bulimba Street, Brisbane, 4171, Australia, kylie.wall@qspectral.com.au

Health systems face an increasing demand on resources, as the world's population ages. Technology in the form of sensor-based remote monitoring systems has emerged as a viable option to mitigate this asymmetry between supply and demand enabling vulnerable individuals to live at home safely and independently. We will present novel data analytics that becomes a decision support system for sensor based human activity recognition in a home setting. The advance of analytics methods provides a means to contextualise and aggregate data from disparate sensors in a meaningful manner. We present a scalable and robust algorithm that can accept a number of inputs as various data sources are added to a system.

■ SA15

Kona 5

Personalized E-Commerce

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Van-Anh Truong, Columbia University, 338 S.W. Mudd Building 500 W. 120th Street, New York, NY, 10027, United States, vt2196@columbia.edu

1 - Bayesian Dynamic Learning and Pricing with Strategic Customers
Zizhuo Wang, University of Minnesota, zwang@umn.edu

We consider a seller who repeatedly sells a product to a customer. The seller does not know the valuation distribution of the customer, but can learn from the customer's purchase history, and wishes to maximize her long run revenue. This problem is important in the era of personalized pricing. We study such a problem when the customer knows the seller's policy, and thus may behave strategically. Using a Bayesian setting with a binary prior, we show that a naive policy by the seller may lead to incomplete learning and the regret can grow linearly. Then we propose a randomized Bayesian policy (RBP), under which the seller can learn the customer type exponentially fast and the regret is bounded by a constant.

2 - Personalized Assortment Optimization and Pricing with Framing Effects
Aran Li, Columbia University, al2942@columbia.edu

We propose one of the first models of "framing effects" for pricing and assortment optimization. Framing refers to the way in which customer choice from among available alternatives can be influenced by how the alternatives are framed. We introduce a model in which a set of products must be organized sequentially into a set of virtual pages and priced appropriately. Each customers will only consider a random number of pages, and will select a product, if any, from these pages following a general choice model. We show that the above product-placement problem is NP-hard. We derive algorithms with guaranteed relative performance. We also show new structural results for pricing problem.

3 - Dynamic Optimization of Mobile ``Push Ads" at Alibaba Group
Xinshang Wang, Columbia University, New York, NY, United States, xw2230@columbia.edu, Van-Anh Truong, Shenghuo Zhu, Qiong Zhang

In recent years, e-commerce companies are seeing an increasing amount of transactions completed via mobile platforms, such as apps in iOS and Android systems. In China, the e-commerce market share of a mobile app developed by Alibaba Group, which has been installed on several hundred million devices, is rapidly replacing that of traditional e-commerce markets hosted on webpages. We study the problem of managing the allocation of push notifications sent to users by this app which recommends products tailored to every user. The model deviates from canonical revenue management models as the app can dynamically sequence the users to receive messages.

4 - Online Personalized Resource Allocation with Customer Choice
Van Anh Truong, Columbia University, vt2196@columbia.edu

We introduce a general model of resource allocation with customer choice. This model has a number of applications, including personalized assortment optimization, revenue management of parallel flights, and web- and mobile-based appointment scheduling. We derive online algorithms that are asymptotically optimal and achieve the best constant relative performance guarantees for this class of problems.

■ SA16

Waikoloa 1

Urban and Public Sector Applications of Location Models

Sponsored: Facility Location

Sponsored Session

Chair: Mihiro Sasaki, Nanzan University, 18 Yamazato, Showa, Nagoya, 466-8673, Japan, mihiro@nanzan-u.ac.jp

1 - Optimal Ambulance Location and Relocation Problem for Nagoya City
Keisuke Inakawa, Akita Prefectural University, inakawa@akita-pu.ac.jp

Recently, the number of calls for ambulances tends to increase in Japan, and the mean response time is also increasing. In these contexts, Nagoya City is considering a plan for adding two more ambulances. In this research, we decide the optimal locations of additional two ambulances, and we evaluate the effect of additional two ambulances by the mean response time which is computed by a Markov chains simulation model. In addition, the relocation plan is also solved by the simple Median problem, and we compare these ambulance locations by the mean response time.

2 - Optimal Layout of City Blocks with Respect to Sky View Factor
Hiroko Watanabe, University of Tokyo, ukonano@icloud.com, Yudai Honma

In Japan, the heights of buildings are limited almost uniformly by a restriction law of the oblique line. To alleviate this restriction, a sky view factor was introduced to the amended Building Standards Law from January 2003. This implementation makes it possible to design buildings more flexibly, and to use the floor area ratio more effectively. The purpose of this study is to show the optimal layout of city blocks which incorporate a sky view factor. Respecting actual building regulations, the building volumes are maximized under the condition of street width and block area. Visual benefits by the alleviation of Building Standards Law are also demonstrated.

3 - Airline Network Design Model Based on Point-to-point Services
Mihiro Sasaki, Professor, Nanzan University, 18 Yamazato, Showa, Nagoya, 466-8673, Japan, mihiro@nanzan-u.ac.jp, Taiki Oba

In this presentation, we consider an airline network design model based on point-to-point services in which hubs are not necessarily required. In the proposed model, we try to construct an airline network by opening/closing flight legs. More precisely, we open a most profitable leg one by one, which contribute to the increase of the number of customers, and close a leg that has become less profitable at some point after its establishment. We are interested in whether hub-like facilities appear in the resultant network or not, and how different network is established compared with optimal networks of traditional hub-based models. We also analyze the results from the customer's perspective.

■ SA17

Waikoloa 2

Recent Development in Pricing and Revenue Management

Sponsored: Revenue Management and Pricing Section
Sponsored Session

Chair: Hongmin Li, Arizona State University, Tempe, AZ, United States, hongmin.li@asu.edu

1 - Incorporating Display Effect in Recommender Systems
Hai Jiang, Tsinghua University, haijiang@tsinghua.edu.cn

It has been recognized by online retailers that how products are displayed can significantly affect consumer behavior. We quantify the display effect and propose to incorporate such information into recommendation. We develop an optimization model and demonstrate its effectiveness through numerical experiments.

2 - Pricing and Inventory Management for an Online Retailer
Rui Yin, Associate Professor, Arizona State University, Tempe, AZ, 85287, United States, rui.yin@asu.edu, Christopher S Tang, Elliot Rabinovich

We consider two selling mechanisms for an online retailer: price markdown and inventory disclosure, and examine the impacts of these mechanisms on the retailer's sales and profits.

3 - Probabilistic Selling for Vertically Differentiated Products: The Role of Salience
Xiajun Amy Pan, University of Florida, amy.pan@warrington.ufl.edu

Probabilistic selling has been extensively studied for horizontally differentiated products where this unique strategy leads to a higher profit. In this work, we examine the probabilistic selling strategy for vertically differentiated products. In contrast to the existing literature, we find that probabilistic selling for vertically differentiated products with a well behaved continuous valuation distribution is never optimal for any level of supply. However, when consumers are salient thinkers, we show that the probabilistic selling strategy increases the seller's profit provided that the cost differential between the high and low quality products is not small.

4 - Pricing Correlated Product Options
Hongmin Li, Arizona State University, hongmin.li@asu.edu, Scott Webster

We study price optimization with price-demand relationships captured by the paired combinatorial logit (PCL) model, which overcomes the restrictions of MNL and NL models by allowing choice-correlation between any two choice alternatives. Due to cross-nesting of choice alternatives, the pricing problem under the PCL model poses a greater challenge than the MNL and NL models. However, using the concept of P-matrix, we are able to identify conditions for a unique optimal price solution and develop an efficient approach for finding the optimal prices. The analysis and solution approach are generalizable to other GEV family models with cross-nested alternatives.

■ SA18

Waikoloa 3

Healthcare Analytics

Invited: Big Data Analytics
Invited Session

Chair: Hui Zhi, University of Hong Kong, Pokfulam, Hong Kong, 00000, Hong Kong, hzhi@hku.hk

1 - Subgroup Identification for Differential Care-intervention Effects
Sijian Wang, University of Wisconsin, Madison, Madison, WI, 53705, United States, sijian.wang@wisc.edu, Xinmei Liu

This work in motivated by a Mammography Screening Study,which included female subjects who were non-adherent to mammography screening guidelines at baseline. One primary interest of the study was to compare the intervention effects of phone counseling, DVD-based tutorial and usual care at 21 months post-baseline and identify the subpopulation for which each of three interventions works best. We propose a general method to facilitate comparative care-intervention selection when there is substantial heterogeneity of intervention effectiveness and identify subgroups that exhibit differential intervention effects.

2 - Precision Care for Stroke Patients
Hui Zhi, University of Hong Kong, hzhi@hku.hk

Stroke is one of the major causes of death across the world, especially in developing countries such as China. This talk summarizes data-driven precision care for stroke patients based on multiple healthcare databases in stroke patient registries and clinical trials.

3 - Tales of Five Chinese Cities: Pm2.5 Data Reliability and Compatibility in Air-quality Assessment
Xuan Liang, Peking University, Beijing, China, liangxuan@pku.edu.cn, Shuo Li, Shuyi Zhang, Hui Huang, Song Xi Chen

We investigate PM2.5 data reliability in five Chinese cities: Beijing, Shanghai, Guangzhou, Chengdu and Shenyang by cross-validating data from US diplomatic posts and the nearby Ministry of Environmental Protection sites based on data from January 2013. The investigation focuses on the compatibility in air-quality assessment derived from the two data sources. It consists of studying on (i) the duration statistics in different states of PM2.5; (ii) the air-quality assessment for each city and (iii) the winter-heating effects in Beijing and Shenyang. We also provide much needed air-quality assessments on the severity and trends of the fine particulate matter pollution in the five cities.

4 - On Scalar-on-matrix Bilinear Regression with Applications in Healthcare Analytics
Dong Wang, Rutgers University, Piscataway, NJ, United States, dongwangunc@gmail.com, Dan Yang, Haipeng Shen, Hongtu Zhu

Covariates sampled in the form of two-dimensional matrices are becoming increasingly common in healthcare analytics. For instance, many researches aim at establishing the relationship between a scalar clinical trait and a two-dimensional medical image. In this talk, we consider the scalar-on-matrix bilinear regression model. We propose a bilinear plain estimator and a bilinear ridge estimator, which are generalizations of the linear estimator and the linear ridge estimator respectively. The numerical performances of the estimators are demonstrated through both simulations and a real data application building the bilinear connection between behavioral score and hippocampus imaging.

Sunday, 10:00am - 11:00am

■ Plenary

Monarchy Ballroom

Qing Wu- Opening Plenary

Invited Session

Chair: Catalina Stefanescu-Cuntze, European School of Management and Technology, Schlossplatz 1, Berlin, 10178, Germany, catalina.stefanescu-cuntze@esmt.org

1 - Data Analytics Frontier in Google/Alphabet
Qing Wu, Google, San Francisco, CA, 1, United States, qingwu@google.org

In this talk I will give a brief summary of the data analytics practice in Google/Alphabet and how it evolved to the current scale. I will give a tour of the data and analytic tools that are available to the public and showcase how we use them for various applications within the company. In the end I will point out the challenges and emerging data analytics trends.

Sunday, 11:00am - 12:30pm

■ SB01

King's 1

Revisiting the Foundations of Decision Analysis

Sponsored: Decision Analysis

Sponsored Session

Chair: Salvatore Greco, University of Catania, Corso Italia 55, Catania, 95129, Italy, salgreco@unict.it

Co-Chair: Fabio Maccheroni, Bocconi University, Via Roentgen 1, Milano, 20136, Italy, fabio.maccheroni@unibocconi.it

1 - Decision Analysis and Bounded Rationality

Rakesh Sarin, UCLA, Los Angeles, CA, United States, rakesh.sarin@anderson.ucla.edu

Decision Analysis requires information on beliefs and preferences and uses subjective expected utility to optimally choose a decision alternative. Because of the cost of processing information, limits on reasoning, or an aversion to thinking, people behave in boundedly rational manner. This presentation will examine models of bounded rationality that simplify decision making process and yet capture the spirit of decision analysis. Examples from investment and marketing will be given to illustrate the approach.

2 - Multiple Sources of Uncertainty and Varying Risk Confidence

Veronica Cappelli, HEC Paris, Jouy en Josas, France, veronica.cappelli@hec.edu, Simone Cerreia-Vioglio, Fabio Maccheroni, Massimo Marinacci

There is by now solid empirical evidence on the dependence of risk attitudes of decision makers on the risk source they are facing. For example, human casualties generated by different catastrophic events may be evaluated in very different ways by policy makers taking prevention measures. Analogously, consumption at future dates is obviously discounted in different ways, but an investor may also take into account the fact that in different future dates he will be more on less affected by outcomes' variability. In this paper, we provide a framework to describe source dependent prospects and we obtain a general axiomatic foundation for the representation of preferences between these prospects.

3 - Robust Multicriteria Decision Analysis

Salvatore Greco, University of Catania, Catania, Italy, salgreco@unict.it, Veronica Cappelli, Salvatore Corrente, Fabio Maccheroni

Multiple Criteria Decision Analysis (MCDA) supplies the basic concepts and tools to support complex decisions in which a plurality of points of view, technically criteria, have to be considered. Traditionally, MCDA proceeds by defining a decision model representing the preferences of the Decision Maker (DM). Since in general there is more than one decision model of a given class (for example, multi attribute utility functions) compatible with the preference expressed by the DM, robustness concerns suggest to take into account the whole set of these compatible decision models.

4 - Rational Preference and Rationalizable Choice

Fabio Maccheroni, Università Bocconi, Milano, Italy, fabio.maccheroni@unibocconi.it, Simone Cerreia-Vioglio, Alfio Giarlotta, Salvatore Greco, Massimo Marinacci

We study an agent characterized by two relations. The first reflects his judgments, his *mental preferences*. The second describes his choice behavior, his *behavioral preferences*. We propose axioms that allow a joint representation of these preferences by a set of probabilities and a utility function. It is mentally rational to prefer f over g if the expected utility of f is at least as high as that of g for all probabilities in the set. It is behaviorally rationalizable to choose f over g if the expected utility of f is at least as high as that of g for some probability in the set. This also gives a foundation for a decision analysis procedure called robust ordinal regression and proposed by Greco et al. (2008).

■ SB02

King's 2

Network Restoration and Resiliency

Invited: Homeland Security and Disaster Management

Invited Session

Chair: Thomas Sharkey, RPI, 110 8th St., Troy, NY, 12180, United States, sharkt@rpi.edu

1 - An Integrated Network Design and Scheduling Problem for Network Restoration and Emergency Response

Laura Albert Mclay, University of Wisconsin-Madison, 1513 University Ave, Madison, WI, 53706, United States, laura@engr.wisc.edu, Suzan Afacan

We study how to cost-effectively deliver time-sensitive services and commodities after a disaster when infrastructure is impaired. Doing so requires scheduling infrastructure recovery efforts and coordinating multiple types of service providers. We present extensions to the p-median problem and covering problems that seek to install arcs in a network with one set of service providers while delivering critical services over a finite time horizon. We propose methods for solving the models using Lagrangian relaxation and we demonstrate the effectiveness of the algorithms in a computational study.

2 - Tackling Drug Shortages by Examining Resiliency and Robustness in Pharmaceutical Supply Chains

Jacqueline Griffin, Northeastern University, Boston, MA, United States, ja.griffin@neu.edu, Rana Azghandi, Ozlem Ergun

Over the past five years, there has been an epidemic of drug shortages affecting patients throughout the United States. While the drug shortage problem is widespread, there is a poor understanding of the features of disruptions in the complex system that lead to these shortages, which are difficult to recover from. Using a stochastic optimization modeling framework, we identify system features and policies that are needed to operate a robust and resilient pharmaceutical supply chain, with minimal drug shortages and quick recovery from shortages.

3 - New Scheduling Problems with Applications in Assembly Supply Chain Restoration

Thomas Sharkey, RPI, sharkt@rpi.edu, Huy Q Nguyen

We consider the problem of modeling the impact of and the recovery from disruptive events within an assembly supply chain. This supply chain produces a single final product for distribution to its customers. At each facility within the supply chain, a component is assembled (or produced) from a series of sub-components that were received from other facilities. We consider problems that arise at a facility level in terms of allocating its scarce production to the multiple facilities that require its components and extend our approaches to the entire supply chain. Our approaches are applied to a data set modeling an industry partner's supply chain.

4 - Pairwise Connection Restoration Problems in Networks

Igor Averbakh, Professor, University of Toronto Scarborough, Department of Management, University of Toronto Scarborough, 1265 Military Trail, Scarborough, ON, M1C 1A4, Canada, averbakh@utsc.utoronto.ca

We consider the problem of finding an optimum schedule for restoring a transportation network damaged as a result of a disaster that destroyed connectivity between some vertices. For each disconnected pair of vertices, a due date for restoring the connectivity of the pair is given. The restoration speed is constant. The restoration crews can access any part of the network at any time. It is required to find a restoration schedule that minimizes the maximum lateness of vertex pairs. We discuss complexity of the problem and its structural properties, a mixed-integer linear programming formulation, and present a branch-and-bound exact algorithm and results of computational experiments.

■ SB03

King's 3

Potpourri of Behavioral Operations Management

Sponsored: Behavioral Operations Management

Sponsored Session

1 - Behavior of Humans in Organizational Networks and Fish in Social Networks: A Fuzzy Rule-based Model of Task and Risk Orientation

Margaret Shipley, Univesity of Houston Downtown, shipleyM@uhd.edu

This research extends the discourse of Behavioral Operations to include human behavior in intra-networks within organizations with the behavior of fish ecosystems. Fish cultural behavior affects survival based upon individual biomass and energy expended toward growth and survival as well as collective behavior in foraging. In an organizational unit, the cultural values of task and risk orientations influence intra-networks by the effects of cooperation and collective rewards. Thus, this research uses swarm intelligence theory to premise learning for organizational intra-networks; and provides a fuzzy set-based model for managerial decision making considering task and risk orientation.

2 - Choice of Subjects for SupplyChain and Operations Management Behavioral Experiments: When Does Work Experience and Normative Response Certainty Matter?

Aleda Roth, Clemson Unversity, 606 Cross Creek, Clemson, SC, 29678, United States, aroth@clemson.edu

This paper informs researchers on the choice of subjects in Supply Chain and Operations Management (SC/OM) behavioral experiments under contextually richness. We compare the responses and reactions to experimental cues provided by three groups of subjects: 1) SC/OM work experience, 2) non-supply SC/OM work experience, and 3) no work experience. Our empirical results reveal substantive significant differences among these three different types of subjects for experiments. We provide insights into when each type of subject most appropriate in experimental research that examines complex SC/OM phenomena.

3 - Motivation of Proenvironmental Professional Behavior

Kenneth Schultz, Air Force Institute of Technology, Department of Operational Sciences, 2950 Hobson Way, WPAFB, OH, 45433, United States, kschultz@afit.edu

What makes a pilot conserve fuel? Will feedback type, public or private, matter? The ultimate Pilot study.

■ SB04

Queen's 4

Decision Making for Colorectal Cancer Screening and Treatment

Invited: Global Health

Invited Session

Chair: Zhichao Zheng, Assistant Professor, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, danielzheng@smu.edu.sg

1 - Personalized Treatment Decisions for Metastatic Colorectal Cancer Patients

Iakovos Toumazis, Postdoctoral Research Fellow, Stanford University, Stanford, CA, United States, iakovost@stanford.edu, Murat Kurt, Toumazi Artemis, Karacosta Loukia, Changhyun Kwon

Colorectal cancer (CRC) is the third most lethal cancer in the US affecting both genders. Metastatic CRC (mCRC) is inoperable and rarely curable. Chemotherapy is the only treatment option for mCRC patients. Treatments' toxicity and tumor's drug resistance are identified as main reasons for treatment's failure. We formulated the chemotherapy scheduling problem as a finite-horizon, discrete-time Markov decision process that jointly optimize the duration and sequence of the available drugs. We calibrated our model using a clinical database developed from published clinical trials. The resulting optimal policy improves survival without compromising quality of life.

2 - How Understanding the Sensitivity and Stability of Preferences Among Colorectal Cancer Screening Alternatives Could Lead to "Better" Medical Decisions

Gabriela Magda Sava, Joseph M. Katz Graduate School of Business, University of Pittsburgh, Pittsburgh, PA, 15260, United States, mgsava@katz.pitt.edu, Luis G Vargas, Jerrold H May, James G Dolan

Patients are faced with multiple alternatives when selecting the preferred method for colorectal cancer screening, and there are multiple criteria to be considered in the decision process. We model patients' choices using a multi-criteria decision model and propose a new approach for characterizing the idiosyncratic preference regions for individual and group of patients. We show how insights derived from the sensitivity and stability of patients' preferences could be used within the medical decision making process.

3 - Optimizing Colorectal Cancer Screening Policies using a Combination of Fecal Occult Blood Test and Colonoscopy

Zhichao Zheng, Singapore Management University, danielzheng@smu.edu.sg

Over the years, various countries have adopted a combination of fecal occult blood test (FOBT) and colonoscopy as the preferred protocol for colorectal cancer screening and surveillance. Current guidelines ignore many individual risk factors and screening history, and they have not been followed closely in practice. We propose a finite-horizon, partially observable Markov decision process model to optimize the screening policy that combines FOBT and colonoscopy, and to assess the values of having the FOBT as a pre-screening method before colonoscopy. Our model incorporates information from prior screening history and individual risk factors, including age, body condition, lifestyle, etc.

■ SB05

Queen's 5

Healthcare Management 2

Invited: Global Health

Invited Session

Chair: Jie Song, Peking Univesity, Zhong Guang-Cun, Beijing, 00000, China, jie.song@pku.edu.cn

1 - A Stochastic Stackelberg-Nash-Cournot Equilibrium Model for Long-term Care Capacity Planning

Nan Kong, Purdue University, nkong@purdue.edu

Long-term care (LTC) is needed by people having limited activities of daily living. LTC needs will increase due to population aging. We develop a stochastic Stackelberg-Nash-Cournot (SNC) equilibrium model to determine the optimal capacities (e.g., # of beds) for nursing home (NH) care and home-based care (HBC). In the model, HBC capacity is controlled by a public insurer so it is regarded a lead er in a Stackelberg game whereas NHs are regarded followers with knowledge of the public insurer's policy and they compete with each other to reach Nash equilibrium in a Nash-Cournot game. We propose an efficient approximation algorithm to solve the stochastic SNC equilibrium problem with demand uncertainty.

2 - A Non-cooperative Patient Choice Model with Incomplete Information

Jie Song, Peking University, jie.song@pku.edu.cn, Jianpei Wen

We introduce a game theoretic framework that consider both the influence of static and dynamic factors on patients' choices among healthcare facilities. We formulate a non-cooperative game with incomplete information and regard the equilibrium of this game as a best prediction of patients' hospital choice results. We provide a quantitative case analysis on the equilibrium to study how those factors affect patients' hospital choices. The non-cooperative game with incomplete information model functions as a quantitative tool to help the government decision maker to improve the patient flow distribution in urban China.

3 - Meaningful Healthcare Security Management

Kwon Juhee, City University of Hong Kong, juhee.kwon@cityu.edu.hk

In the U.S. healthcare sector, financial incentives linked to a certification process, (referred to as "meaningful-use" attestation) have been a key policy initiative to accelerate secure EHR adoption. This attestation regime motivated us to identify how hospital attestation influences the occurrence of subsequent data breaches. Using a propensity score matching technique, we find that both financial incentives and penalties significantly decrease breaches. However, financial incentives linked to meaningful-use attestation are more effective in reducing accidental internal breaches than penalties, while penalties are more effective in reducing external breaches.

4 - Predict Nosocomial Infection with a Risk Factor Tree Structure

Tingyan Wang, Tsinghua University, Beijing, 100084, China, wangty14@mails.tsinghua.edu.cn, Ming Yu, Xin Tian

Nosocomial infection (NI) is one acquired in hospitals and the patient is admitted for reasons other than the infection. NI frequently occurs and has great impact on patient's treatment and medical expenses. This paper aims to predict the general probability that a patient has NI, unlike literature focusing on certain types of NI. According to suggestions of clinical experts, this paper considers risk factors with a hierarchical network structure to establish a predictive model. Finally, real clinical data derived from a hospital in Beijing is used to train and test the model. It reveals that the proposed model is effective in predicting NI and can be a reference for prevention of these infections.

■ SB06

Queen's 6

Online Markets and Networks

Invited: Sharing Economy, Matching Markets, and Networks

Invited Session

Chair: Azarakhsh Malekian, Rotman School of Management, 105 St. George St, Toronto, ON, M5S 3E6, Canada, azarakhshm@gmail.com

1 - Optimal Auctions vs. Anonymous Pricing
Saeed Alaei, google research, alaei@google.com

For selling a single item to agents with independent but non-identically distributed values, Hartline and Roughgarden (2009) showed that the the second-price auction with an optimal anonymous reserve is between two to four times the optimal. We consider the more demanding problem of approximating the revenue of the ex ante relaxation of the auction problem by posting an anonymous price (while supplies last) and prove that the worst-case ratio is e. As a corollary, the upper-bound of anonymous pricing or anonymous reserves versus the optimal auction improves from four to e. We conclude that, up to an e factor, discrimination and simultaneity are unimportant for driving revenue in single-item auctions.

2 - How Much Real Choice Do I Have in a Two-Sided Matching Market?
Itai Ashlagi, Stanford University, iashlagi@stanford.edu

Abstract not available.

3 - Where to Sell: Simulating Auctions from Learning Algorithms
Hamid Nazerzadeh, University of Southern California, nazerzad@marshall.usc.edu

Ad Exchange platforms connect publishers and advertisers and facilitate selling billions of impressions every day. We study these environments from the perspective of a publisher who wants to find the profit maximizing exchange to sell his inventory. Ideally, the publisher would run an auction among exchanges. However, this is not possible due to technological and other practical considerations. The publisher needs to send each impression to one of the exchanges with an asking price. We model the problem as a variation of multi-armed bandits where arms can behave strategically in order to maximizes their own profit. We propose a mechanism that finds the best exchange with sub-linear regret.

4 - Informational Braess' Paradox: The Effect of Information on Traffic Congestion
Azarakhsh Malekian, University of Toronto, azarakhshm@gmail.com

To understand the effect of extra info. about routes provided to certain users, we introduce a new class of congestion games in which users have differing info. sets about the available edges, and study whether additional information can be harmful. After defining the notion of Information Constrained Wardrop Eq. (ICWE), we formulate this question in the form of Informational Braess Paradox(IBP). We show that in any network in the series of linearly independent (SLI) class, IBP cannot occur, and in any network not in the SLI class, there exists a config. of edge-specific cost functions for which IBP will occur.

■ SB07

Kohala 1

Data-Driven Decision Making in Uncertain and Changing Environments

Invited Session

Chair: Omar Besbes, Columbia University, New York, NY, United States, ob2105@gsb.columbia.edu

1 - Data-driven Decision Making in Uncertain and Changing Environments
Omar Besbes, Columbia University, New York, NY, United States, ob2105@gsb.columbia.edu

Technology has significantly reduced the costs of price, product and service experimentation, and has dramatically increased the ability of firms to incorporate rich data and real-time information into their decisions. The interplay between the availability of data, the ability to collect and analyze it in real-time, and the technology to rapidly deploy analyses to improve a firm's operational decisions has created exciting new opportunities and challenges. This tutorial will review approaches to data-driven decision-making, with a focus on two classical problems: pricing and inventory management.

■ SB08

Kohala 2

Recent Advances on Supplier and Consumer Behavior

Invited: Operations/Marketing Interface

Invited Session

Chair: Leon Zhu, Associate Professor, University of Southern California, University Park Campus, Los Angeles, CA, 90089, United States, leonyzhu@usc.edu

1 - The Informative Role of Reward-based Crowdfunding
Rachel Chen, University of California, Davis, rachen@ucdavis.edu, Esther Gal-Or, Paolo Roma

This paper investigates the incentives of an entrepreneur to run a reward-based crowdfunding campaign in an environment where VC's supplemental capital is needed to commercialize the entrepreneur's new product. In case the entrepreneur decides to run a campaign, we examine how the entrepreneur chooses the campaign instruments. We also investigate the preference of the VC in favor of running crowdfunding campaigns.

2 - The Sharing Newsboys
Ming Hu, University of Toronto, Ming.Hu@Rotman.Utoronto.Ca

I study resource sharing or demand referral behaviors among a network of connected newsboys. The focus is to investigate the impact of increasing network connectedness on the sharing behaviors and social welfare.

3 - Managing Consumer Deliberations in a Decentralized Distribution Channel
Yanzhi David Li, City University of Hong Kong, Hong Kong, China, yanzhili@cityu.edu.hk, Xi Li, Mengze Shi

Consumers have to incur deliberation costs in learning about their valuations for a new product. In a decentralized channel, the retailer directly influences consumers' deliberation efforts and their subsequent purchase decisions through the retail price, but the manufacturer can also affect consumer deliberations indirectly through the retailer's response to the wholesale price. The paper explores the impact of deliberation cost on the channel members' behavior and makes some interesting findings. For example, our analysis shows that a large enough deliberation cost can enhance the manufacturer's ability to achieve channel coordination through the wholesale price.

4 - RFQ, Sequencing and the Most Favorable Bargaining Outcome
Leon Zhu, University of Southern California, leonyzhu@usc.edu, Ying Rong, Huan Zheng

When the suppliers are imperfect substitutes, it is typically the best interest of the buyer to procure from various suppliers to match the needs of different customer segments. A natural question is how the buyer should contract with multiple suppliers through a negotiation process. A plethora of equilibrium exists under a flexible bilateral negotiation setting. We show that, by running a simple Request for Quotation (RFQ) as a pre-cursor to the bargaining process, the most favorable bargaining outcome for the buyer can be achieved when the bargaining sequence is determined by the quoted prices.

■ SB09

Kohala 3

Signaling, Legitimacy and the Performance of Entrepreneurial Firms

Invited: Entrepreneurship and Innovation

Invited Session

Chair: Metin Onal Vural, IE Business School, Madrid, Spain, onal.vural@ie.edu

1 - Legitimacy and Illegitimacy: The Case of Cuban Paladares
Sharon Alvarez, Daniels College of Business, University of Denver, Sharon.Alvarez@du.edu

As a patron enjoys a sumptuous meal prepared by a world class chef, in the garden of a private home it is difficult to imagine that this charming restaurant could be a source of contention among stakeholders. Exiting the restaurant, is a currier waiting to take the earnings for the evening into safe keeping. This successful, enchanting restaurant with food that rivals any world-class establishment is in the center of Havana, Cuba, a planned economy. Indeed, the restaurant is at the heart of a clash between the traditions of a planned economy and the market based entrepreneurship of the restaurant resulting in the polarization of illegitimacy on one hand and legitimacy on the other hand.

2 - Decomposing Cognitive Legitimation
Metin Onal Vural, IE Business School, onal.vural@ie.edu,
Taiyuan Wang

Initial public offering (IPO) is a key milestone for the development of high-tech ventures. To achieve this milestone, high-tech ventures often need to signal the viability and distinctiveness of their businesses to investors. By analyzing data on 710 biotech ventures in the US, we found that viability and distinctiveness signals help these ventures undertake IPOs quickly. We also found that business domain uncertainty mitigates the effect of viability on IPO timing. These findings further our knowledge about IPO timing and improve legitimacy theory by decomposing cognitive legitimation into the viability and distinctiveness dimensions.

3 - Winning the Multistage Startup Funding Game: An Analysis of Round-Specific Signals to Attract Venture Capital
Daniela Nuscheler, TU Dortmund University,
Martin-Schmeißer-Weg 12, Dortmund, 44221, Germany,
daniela.nuscheler@tu-dortmund.de

Guidance for entrepreneurs seeking funding is abundant but remains inconclusive. We aim to solve existing ambiguities on investment signals and propose a more nuanced round-specific model, also accounting for moderating effects from recurring investors. By means of a new, multi-source secondary panel data set, we link life cycle and signaling theories and place extant findings on investment criteria to their legitimate stage and investor type. We show the sequence of signals to be aligned with conventional growth theories, but recurring investors strongly influence their relevance. Moreover, we discuss early rounds to be most complex yet worthy to pursue, as later stage investors risk lock-in.

■ SB10

Kohala 4

The Stable Marriage Problem

Sponsored: Optimization

Sponsored Session

Chair: James Orlin, Massachusetts Institute of Technology, MIT E62-570, Cambridge, MA, 02139, United States, jorlin@mit.edu

1 - What Matters in School Choice Tie-breaking? How Competition Guides Design
Itai Ashlagi, Stanford University, iashlagi@stanford.edu,
Afshin Nikzad

School districts that adopt the deferred acceptance (DA) mechanism to assign students to schools face a tradeoff between fairness and efficiency when deciding how to break ties among students. We compare two common tie-breaking rules: single tie-breaking (STB), in which all schools share a common lottery, and a multiple tie-breaking (MTB), in which each school uses a separate lottery. We analyze these rules with respect to three different measures. Our findings suggest that "popular" schools should use a common lottery to break ties. Numerical experiments using New York City school choice data confirm our findings.

2 - Near Feasible Stable Matching
Thanh Nguyen, Purdue University, nguye161@purdue.edu

The National Resident Matching program strives for a stable matching of medical students to teaching hospitals. With the presence of couples, stable matchings need not exist. Nevertheless, for any student preferences, we show that each instance of a matching problem has a "nearby" instance with a stable matching. The nearby instance is obtained by perturbing the capacities of the hospitals.

3 - Stable Matchings with Imperfectly Transferrable Utilities
James B Orlin, M.I.T., jorlin@mit.edu, Rajan Udwani

We consider a matching equilibrium problem that includes the stable marriage problem and the optimal assignment problem as special cases. In this problem utility can be transferred from the man to the woman, (or vice versa) but there is a loss of utility during the transfer. The goal is to determine a matching that is "stable", that is, it satisfies the equilibrium conditions. We extend polyhedral results from the stable marriage problem to this problem, and characterize the convex hull. In addition, we consider various approaches for identifying a stable matching.

■ SB11

Kona 1

Applications of Mechanism Design

Invited: Mechanism Design and Game Theory

Invited Session

Chair: Ozan Candogan, University of Chicago, Chicago, IL, 60637, United States, ozan.candogan@chicagobooth.edu

1 - Bundling over Time and Martingale Auctions
Santiago Balseiro, Duke University, srb43@duke.edu,
Vahab Mirrokni, Renato Paes Leme

We study the dynamic mechanism design problem of a seller who repeatedly sells independent items to a buyer with private values. In this setting, the seller could potentially extract the entire buyer surplus by running efficient auctions and charging appropriate participation fees at the beginning of the horizon; effectively bundling all items together over time. In some markets, such as internet advertising, participation fees are not plausible since buyers expect to inspect items before paying. Thus motivated, we study the design of dynamic mechanisms under successively more constrained models that capture the implicit business constraints of these online markets.

2 - Optimal Contract for Motiving Efforts in the Long Run
Peng Sun, Duke University, peng.sun@duke.edu,
Alessandro Arlotto, Feng Tian

We study a model in which a principle contracts an agent to exert effort in order to bring in "customers." High level of effort is costly to the agent but yields a high arrival rate of customers, each of which generates a fixed revenue to the principle. Effort level is not observable to the principle. As a result, general payment contracts are functions of the entire history of customer arrival times. We characterize the form of the the optimal contract, which motivates the agent to always exerting high level of effort. Despite general format of feasible contracts, the optimal dynamic contract has a simple structure.

3 - Intermediation in Online Advertising
Ozan Candogan, University of Chicago,
ozan.candogan@chicagobooth.edu, Santiago Balseiro,
Huseyin Gurkan

In display advertising, the prevalent method advertisers employ to acquire impressions is to contract with an intermediary. This problem can naturally be formulated as a multi-dimensional dynamic mechanism design problem, which in general is hard to solve. We tackle this problem by employing a novel performance space characterization technique, which relies on delineating the expected cost and value achievable by any feasible (dynamic) bidding policy. Using this formulation, together with a duality-based approach, we characterize the optimal mechanisms of intermediaries. Our results indicate that an intermediary can profitably provide bidding service to a budget-constrained advertiser.

■ SB12

Kona 2

Scheduling and Optimization in Logistics, Energy, Manufacturing Industries

Invited: Scheduling and Project Management

Invited Session

Chair: Lixin Tang, Northeastern University, Institute of Industrial Engineering and Logistics Optimization, Shenyang, 110819, China, lixintang@mail.neu.edu.cn

1 - A Queueing Service Problem with Congestion-based Staffing Policy in Steel Slab Yard
Yanhe Jia, Northeastern University, lixintang@mail.neu.edu.cn

We analyze a serving storage problem of slab yard in iron and steel enterprises. Slabs from a continuous casting stage are stored in a slab yard (as a buffer) for further processing in a hot rolling stage. The coming slabs well be carried by some servers-cranes, these slabs come randomly. In this paper, we consider the slab serving storage problem to minimize the service cost. For better service, we need to use more servers. But this can make the cost increasing. If we use a few servers, the action can make the waiting time of the slab so long. So we need to find a balance in these two conflicting goals. We give a queueing model and propose a dynamic programming algorithm to present a staffing policy.

2 - A Subpopulation-based Differential Evolution for Scheduling with Batching Decisions under Energy Constraints in Steelmaking-continuous Casting Production
Wenjie Xu, Northeastern University, lixintang@mail.neu.edu.cn

We address a scheduling problem with batching decisions under energy constraints in Steelmaking-continuous Casting production. We develop an MILP model with energy-intensive tasks by continuous-time representation to optimize the total makespan, LDG releasing and costs of electricity purchasing. To solve the problem, we propose a subpopulation-based Differential Evolution algorithm with a real-coded vector representaiton for each individual, a decoding procedure by a cooperation of a heuristic method and a commerical solver for the reduced MILP model. Computational experiments show that the poposed alorithm outperforms other state-of-the-art DE variants and competes well with CPLEX.

3 - Stochastic Optimization for Unit Commitment with Wind Power Generation
Jin Lang, Northeastern University, lixintang@mail.neu.edu.cn

We present a stochastic unit commitment model which takes into account the volatility of wind power generation. Uncertainty of wind is simulated via the scenario tree. As a large-scale wind power penetrate into power grid systems, we group wind turbines based on their physics locations to formulate the problem. Because the batching model is hard to solve with commercial optimizers, a Lagrangian relaxation algorithm is developed. Case study in randomly generated instances demonstrates the validity of the batch model and algorithm.

4 - Coordinate Scheduling of Production and Logistics with Energy in the Steel Industry
Lixin Tang, Northeastern University, lixintang@mail.neu.edu.cn

This talk discusses some interesting topics on coordinated scheduling of production, logistics and energy, including production scheduling in process industry, logistics scheduling in storage/stowage, shuffling, transportation and (un)loading operations, energy analytics including energy consumption estimation, energy diagnosis and benchmarking, energy prediction and dynamic energy allocation.

5 - Energy-efficient Scheduling of a Welding Shop by Multi-objective Modeling and Optimization
Xinyu Li, Huazhong University of Science and Technology, Huazhong University of Science and Technology, Wuhan, China, Wuhan, China, lixinyu@hust.edu.cn

As welding process is very important in modern manufacturing industry and the energy consumption is very high, it is of great significance to solve the welding shop scheduling problem (WSP) from the perspectives of efficiency and energy saving. The previous energy consumption model based on machine work cannot be applied in WSP. In this paper, firstly the energy consumption in WSP is investigated and a mathematical model is developed to minimize makespan and energy consumption. Then, a novel multi-objective discrete artificial bee colony algorithm is designed to solve the WSP. Finally, some instances from a plant are tested. The comparison results show the effectiveness of the model.

■ SB13

Kona 3

Application of Stochastic Processes

Sponsored: Applied Probability

Sponsored Session

Chair: Tolga Tezcan, London Business School, London, 00000, United Kingdom, ttezcan@london.edu

1 - Service Systems with Unknown Quality and Customer Anectodal Reasoning
Kenan Arifoglu, University College London, k.arifoglu@ucl.ac.uk, Hang Ren, Tingliang Huang

We consider service systems where customers estimate service quality using anecdotes. We characterize the server's pricing, quality information disclosure, and quality control decisions under revenue and welfare maximization. Bounded rationality changes the server's pricing decision greatly, and more quality information may lead to lower price and lower consumer surplus.

2 - Yardstick Competition in Queues: An Application to Emergency Departments
Tolga Tezcan, London Business School, ttezcan@lbs.edu

Yardstick competition is a regulatory scheme for local monopolists (e.g., hospitals), where the monopolists' reimbursement is linked to its performance relative to other equivalent monopolists. This regulatory scheme is known to work well in providing cost-reduction incentives and offers the theoretical underpinning behind the hospital prospective reimbursement system used throughout the developed world. This paper investigates how yardstick competition performs in service systems (e.g., hospital emergency departments), where in addition to incentivizing cost reduction, the regulator's goal is to provide incentives to reduce customer waiting times. We show that i) the form of yardstick competition used in practice results in inefficiently long waiting times; ii) yardstick competition can be appropriately modified to achieve the dual goal of cost and waiting-time reduction, and present several extensions that help guide on how it could be used in practice.

■ SB14

Kona 4

Healthcare Decision Models with High Dimensional Data

Sponsored: Health Applications

Sponsored Session

Chair: Mohsen Bayati, Stanford University, Stanford, CA, United States, bayati@stanford.edu

1 - Online Decision Making with High Dimensional Covariates
Hamsa Sridhar Bastani, Stanford University, Stanford, CA, United States, hsridhar@stanford.edu, Mohsen Bayati

Big data has enabled decision-makers to personalize choices based on an individual's observed characteristics. We formulate this problem as a multi-armed bandit with high-dimensional covariates, and present a new efficient algorithm that provably achieves near-optimal performance. The key step in our analysis is proving convergence of the LASSO estimator despite non-iid data induced by the bandit policy. We evaluate our algorithm using a real patient dataset on warfarin dosing; here, a patient's optimal dosage depends on her genetic profile and medical records. Our algorithm outperforms existing bandit methods as well as physicians to correctly dose a majority of patients.

2 - Estimating Externalities In an Emergency Department
Sara Kwasnick, Stanford University, kwasnick@stanford.edu

We use an instrumental variables approach to estimate the queue externality imposed by emergency department (ED) patients on the wait times of other patients. We use the externality model to analyze when it may be socially optimal to dissuade or encourage patients from visiting a given ED. Empirical work at a partner ED suggests that wait time information may shape patient arrival, departure and revisit rates.

3 - Accurate and Efficient Imputation for Medical Prediction
Erika Strandberg, Stanford University, estrandb@stanford.edu

The availability of electronic medical records (EMRs) enables the use of large amounts of clinical data for predicting clinical outcomes; however, the high proportion of missing entries make predictive modeling difficult. Few methods exist to impute EMR data with high dimensionality and sparsity and even fewer for optimizing predictive performance. We present a novel matrix completion method and compare its performance to existing methods using simulated and real laboratory test data. Our method performs comparably to out of the box methods in terms of predictive performance while remaining computationally tractable, thus enabling improved real-time prediction and quality of care.

■ SB15

Kona 5

Economic Models in Operations Management

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Tao Li, Santa Clara University, School of Business, Santa Clara, CA, 95053, United States, tli1@scu.edu

1 - Strategic Uncertainty in Assembly Systems: An Experimental Investigation of Information Sharing Strategies
Saibal Ray, McGill University, saibal.ray@mcgill.ca, Jud Kenney

This behavioural study investigates how partners in an assembly system react to three different strategies of communication when facing only strategic risk. We find effective communication strategies can significantly improve performance and such improvements are more significant under higher critical ratios.

2 - Retail Pricing and Quantity Decisions with Strategic Consumers in the Platform Market
Xin Liu, University of North Carolina at Charlotte, xliu43@uncc.edu

November 11 has become the biggest shopping day in the world with sales of $14.3 billion by Alibaba in 2015. We analyze whether a online retailer should sell using the Alibaba platform and her price and quantity commitment decisions. We evaluate the benefit resulting from joining the platform under different conditions.

3 - Five Steps to Supply Chain Coordination
Tao Li, Santa Clara University, tli1@scu.edu, Suresh P Sethi

In supply chain coordination literature, most papers study four steps: 1. Solve centralized problem; 2. Solve decentralized problem; 3. Show double marginalization exists and hence the need for coordination; 4. Obtain a coordinating contract. The coordinating contract is obtained by equating follower's best response to centralized channel's optimal decision. We present the missing (the 5th) step by showing the coordinating contract obtained in the conventional way is a Stackelberg equilibrium. We conclude the paper by extending the 5-step approach to two-period supply chains.

4 - The Impact of Referral Services on Online Retail Competition
Kihoon Kim, Korea University, Korea Univeristy Business School, LG-POSCO #316, Anam-dong, Seongbuk-gu, Seoul, 136701, Korea, Republic of, kihoonk@gmail.com

When two competing online retailers adopt a referral service, a referral-offering online retailer faces a trade-off between generating additional revenues from referral fees and the risk of exposing its loyal consumers to the price of its referred online retailer. We first show that the proportion of strongly loyal consumers of the referral-offering retailer among all its (potential) consumers mainly determines the chance that the referral service will be adopted. We then provide the market-share conditions under which that the referral service is likely to improve the profits of the two competing retailers.

■ SB16

Waikoloa 1

Location Analysis and Network Design

Sponsored: Facility Location

Sponsored Session

Chair: Daisuke Watanabe, Tokyo University of Marine Science and Technology, 2-1-6 Etchujima, Tokyo, 135-8533, Japan, daisuke@kaiyodai.ac.jp

1 - Dynamic Flow Analysis for Tsunami Evacuation with Respect to Road Blocking
Yudai Honma, University of Tokyo, yudai@iis.u-tokyo.ac.jp

By the Great East Japan Earthquake of March 11, 2011, a tsunami with unimaginable proportions was induced and it assailed the region, killing many lives. In its aftermath, tsunami evacuation procedures came under review. The Japanese government had set evacuation on foot as the rule for tsunami evacuation, but many people attempted to evacuate to a higher ground by cars in subsequent earthquakes, causing major traffic congestion.

This study attempts to reduce preferential car use in major earthquake disasters by setting road closures. By introducing a dynamic flow analysis, it will be shown that the strategy leads to a reduction in traffic congestion and evacuation time.

2 - Demand Forecasting of Both Accommodation and Transportation for Tokyo Olympic 2020
Shigeki Toriumi, Chuo University, toriumi@ise.chuo-u.ac.jp

The number of visitor arrivals to Japan in 2015 was over 19 millions, which is the highest yearly number ever recorded. Japan National Tourism Organization (JNTO) forecasts growth of the number of visitor arrivals until 2020. So, it is an issue to increase accommodations. Moreover, a lot of visitors cause congestion of a railway. In this presentation, we forecast demand and supply using traffic census data and travel agent's website data, and we discuss about those problem.

3 - Evaluation of Travel Efficiency on Road Network and Proximity Graphs using Route Factor
Daisuke Watanabe, Tokyo University of Marine Science and Technology, daisuke@kaiyodai.ac.jp

The purpose of this paper is to evaluate the travel efficiency of road network pattern using Route Factor by considering relationship between neighborhood intersections. The proximity graphs like Delaunay Triangle(DT), Gabriel Graph(GG) and Relative Neighborhood Graph(RNG) are used to analyze the road network pattern of major cities in United States of America as network construction model.

4 - An Optimal Approach for a Set Covering Version of the Refueling-station Location Problem
In-Jae Jeong, Hanyang University, Department of Industrial Engineering, 17 Haengdangdong, Seoul, 133-791, Korea, Republic of, ijeong@hanyang.ac.kr

This paper deals with the refueling-station location problem for alternative fuel vehicles in a traffic network. I consider a special case of the refueling-station location problem in which the construction costs are equal for all nodes. In this case, the problem is to determine refueling station locations to minimize the total number of stations while making possible multiple predetermined origin-destination round trips. I propose an optimal algorithm applicable when no refueling stations currently exist in a traffic network and a dynamic programming based algorithm applicable when a set of refueling stations already exists.

■ SB17

Waikoloa 2

Consumer Behavior in Pricing and Revenue Management

Sponsored: Revenue Management and Pricing Section

Sponsored Session

Chair: Qian Liu, Hong Kong University of Science & Technology, Clear Water Bay, Kowloon, 00000, Hong Kong, qianliu@ust.hk

1 - Pricing Game with Customer Choice Based on the Product Performance-price Ratio
Yangyang Xie, City University of Hong Kong, xie-089@163.com, Lei Xie, Meng Lu, Houmin Yan

We explore a market where customers make choices based on the product performance-price ratio. We derive customer choice probability with a transformation from a multinomial logit model. We characterize a closed-form solution of the unique equilibrium in an oligopoly market, and calibrate the model with data from China's TV retail market. In addition, we incorporate an interesting finding in psychology, namely, that more isn't always better, into the model and reveal that the entrance of a new product may benefit all existing products. Moreover, the closed-form equilibrium enables us to further analyze how the equilibrium varies with respect to changes in game settings and market structures.

2 - To Markdown or Not to Markdown: Inventory and Markdown Management for Strategic Customers
Stephen Shum, City University of Hong Kong, swhshum@cityu.edu.hk

Abstract not available.

3 - The Reference Effects on a Retailer's Dynamic Pricing and Inventory Strategies with Strategic Consumers
Shining Wu, Hong Kong Polytechnic University, sn.wu@polyu.edu.hk, Qian Liu, Rachel Q Zhang

We consider a retailer that sells the same or different versions of the product season after season. At the beginning of each season, the retailer places an order and sells the product at the full price. As the sales unfold, the retailer has an opportunity to mark down the price. Consumers learn from the retailer's past prices and form their estimate of the markdown price, called the reference price, to decide if they purchase at the full price or wait for the markdown. We characterize the properties of the optimal ordering and markdown decisions and show that the consumers' reference exhibits a mean reverting pattern under certain conditions; that is, the reference fluctuates around a mean value.

4 - Product Launch Decisions in a High-tech Industry
Tulin Inkaya, Uludag University, Industrial Engineering Department, Bursa, 16059, Turkey, tinkaya@uludag.edu.tr

When to launch new products, when to phase out old products, what performance improvements to introduce, what pricing mechanisms to follow are important strategic decisions for the companies. In this study, we consider a vertically differentiated company serving to forward-looking customers. We develop an infinite horizon dynamic programming model to determine the optimal launch cycle length and the optimal performance improvement amount. Our numerical results show how the customer expectations and the type of the industry affect the product launch decisions. The insights gained from this study are useful for high-tech companies.

■ SB18

Waikoloa 3

Big Data Analytics in Statistics

Invited: Big Data Analytics

Invited Session

Chair: Dan Yang, Rutgers University, 110 Frelinghuysen Road, Piscataway, NJ, 08854, United States, dyang@stat.rutgers.edu

Co-Chair: Dong Wang, Rutgers University, 110 Frelinghuysen Road, 501 Hill Center, New Brunswick, NJ, 08854, United States, dongwangunc@gmail.com

1 - Nonparametric Shrinkage Estimation

Cun-Hui Zhang, Rutgers University, cunhui@stat.rutgers.edu

We revisit the classical problem of estimating the mean vector of three or more uncorrelated observations with a known common variance. James and Stein (1962) claimed that when the fourth moment of the noise has a known upper bound, a shrinkage estimator of Stein (1956) always has a smaller average of the mean squared error than the common variance, provided that certain parameters of the shrinkage factor are properly specified. James and Stain (1962) further commented "It would be desirable to obtain explicit formulas for estimators one can seriously recommend" in this nonparametric setting.

2 - Bilinear Regression with Matrix Covariates in High Dimensions

Dan Yang, Rutgers University, Piscataway, NJ, United States, dyang@stat.rutgers.edu, Dong Wang, Hongtu Zhu, Haipeng Shen

Traditional functional linear regression usually takes a one dimensional functional predictor as input and estimates the continuous coefficient function. Modern applications often generate two dimensional covariates, which when observed at grid points are matrices. To avoid inefficiency of the classical method involving estimation of a two dimensional coefficient function, we propose a bilinear regression model and obtain estimates via smoothness regularization method. The proposed estimator exhibits minimax optimal property under the framework of Reproducing Kernel Hilbert Space. The merits of the method are further demonstrated by numerical experiments and real imaging data.

3 - Overview and Categorization of Human Resources Analytics and Quality of Service

Irad Ben-Gal, Tel Aviv University, Tel-Aviv University, Dept of Industrial Engineering, Tel-Aviv, 69978, Israel, bengal@tau.ac.il

This talk provides an integrative review of research works and tools on the topic of human resources (HR) analytics. The analysis is performed from a cluster-based perspective and categorizes recent literature in a structured manner. In particular, we analyzes close to hundred carefully selected works and developments on the topic of HR analytics and quality of service. Four clusters are identified: empirical, conceptual, case-based and technical. HR tasks are analyzed in the light of various analytical approach, quality of service and data sources.

4 - Normal Approximationfor Squared Hilbert-Schmidt Norm Errors of Spectral Projectors of SampleCovariance

Karim Lounici, Georgia Institute of Technology, Atlanta, GA, 30303, United States, klounici@math.gatech.edu

Let $X,X_1,\dots, X_n$ be i.i.d. Gaussian random variables in a separable Hilbert space ${\mathbb H}$ with zero mean and covariance operator $\Sigma={\mathbb E}(X\otimes X),$ and let $\hat \Sigma:=n^{-1}\sum_{j=1}^n (X_j\otimes X_j)$\ be the sample (empirical) covariance operator based on $(X_1,\dots, X_n).$ Denote by P_r the spectral projector of Σ corresponding to its r-th eigenvalue μ_r and by $\hat P_r$ the empirical counterpart of $P_r.$ We derive the asymptotic normality for (properly rescaled) version of $\|\hat P_r-P_r\|_2^2$ where $\|\cdot\|_2$ denotes the Hilbert—Schmidt norm. Conditions for the validity of this normal approximation is characterized in terms of so called effective rank of Σ defined as ${\bf r}(\Sigma)=\frac{{\rm tr}(\Sigma)}{\|\Sigma\|_{\infty}},$ where ${\rm tr}(\Sigma)$ is the trace of Σ and $\|\Sigma\|_{\infty}$ is its operator norm, as well as another parameter characterizing the size of ${\rm Var}(\|\hat P_r-P_r\|_2^2).$

Sunday, 2:00pm - 3:30pm

■ SC01

King's 1

Deterrence Analysis

Sponsored: Decision Analysis

Sponsored Session

Chair: Richard S John, Assoc. Professor, University of Southern California, 3620 McClintock Ave., Los Angeles, CA, 90089-1061, United States, richardj@usc.edu

1 - Behavioral Experimentation of Cyber Attacker Deterrence with Deter Testbed

Heather Rosoff, University of Southern California, rosoff@usc.edu

Deterrence is now being considered to prevent and defend against cyber attacks. We study the complexities of cyber deterrence by conducting behavioral experiments within DETER (cyber defense technology experimental research interface) on the effects of enhanced security, retaliation, and attribution on attacker, defender, and user actions and decision making. By using DETER, a more realistic exchange of the attacker, defender and user can be monitored allowing for the collected data to more aptly represent the stakeholders' interactions when different deterrence strategies are implemented.

2 - Deterrence on Cyber Attackers in a Three-player Behavioral Game

Jinshu Cui, University of Southern California, jinshucu@gmail.com, Heather Rosoff, Richard S John

This study describes a three-player cyber security game involving attackers, defenders, and users. An attacker can choose to attack the defender or the user. Deterrence is measured by the third option of the attacker - no attack. Conversely, the defenders and users can select either a standard or enhanced security level. We conducted a behavioral experiment. Subjects played as attackers over 20 rounds of the game and were incentivized based on their performance. Defenders' and users' strategies were manipulated. Results indicated that deterrence is affected by the coordination between defenders and users.

3 - An Interactive Real-time Behavioral Game for Cyber Security

Sule Guney, University of Southern California, suleguney@gmail.com

This study presents an interactive cyber security game involving three players; attacker, defender and user. We aim to simulate a real-life cyber attack environment in a laboratory setting through presenting uncertainty, so we contrast how decision strategies of each player are shaped when success probability of a cyber attack is known (i.e., representing risk as a form of uncertainty) to all players and when completely unknown (i.e., representing ambiguity as a form of uncertainty). We predict that players' decisions will be more aversive (i.e., attacker avoids attacking defender but user; defender prefers enhanced security etc.) when success probability of an attack is unknown than known.

4 - A Framework for Assessing the Value of Deterrence (VoD)

Richard John, University of Southern California, richardj@usc.edu

Countermeasures in homeland security and defense have the dual purpose of deterrence and interdiction. The benefits of interdiction can be measured in terms of adversaries detected and caught. In contrast, the benefits of deterrence are often more difficult to identify and estimate. In many contexts, the benefits of deterrence are many times the benefits of interdiction. We utilize a game theoretic model in the form of an attacker-defender decision tree to develop a framework for defining the Expected Value of Deterrence (EVoD). Our goal is to provide a framework for cost-effectiveness analyses for selecting among alternative countermeasures in which the primary benefit is deterrence.

■ SC02

King's 2

Military Applications

Contributed Session

Chair: Logan Michael Mathesen, ASURE, 85257, United States, lmathese@asu.edu

1 - Strategy Development and Modeling the Environment

Brede Wegener, Lockheed Martin Corporation, 1111 Lockheed Martin Way, Sunnyvale, CA, 94089, United States, brede.j.wegener@lmco.com

As business increases within operationally intense and data rich environments, operations analysts must think critically about the analytic approaches used to evaluate customer needs. For example, decomposing the simple notion of doing business in the Asia-Pacific region reveals a complex world. Visualization helps articulate at a macro level this scope and complexity and how perturbations might present challenges. Further utilization will facilitate strategic analysis, contingency planning, and regional change detection. This presentation provides a viewpoint on the importance of analysis for strategy, within a military context, and can be appreciated across many industries.

2 - Human Decision-making Behavior and Cognitive Degradation in Simulation

Daniel O Rice, Senior Vice President, Technology Solutions Experts, Inc., 209 West Central Street, Suite 301, Natick, MA, 01760, United States, daniel.rice@tseboston.com

Operational stressors, such as fatigue, environmental conditions, and information overload, may significantly degrade Soldier cognitive function and consequently reduce the soldier's mission performance. We will present our research modeling cognitive degradation for human decision making and building tools to enable scientists and engineers to better understand the impacts stressors on human performance and the development of analysis tools to provide cognitive degradation models that will be integrated with other applications such as military constructive simulations, engineering tools, and human performance modeling and analysis applications.

3 - Past, Present, and Future of Military Operations Research

Greg H Parlier, Past President, INFORMS MAS, Institute for Defense Analyses, 255 Avian Lane, Madison, AL, 35758, United States, gparlier@knology.net

Ongoing and 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 current trajectory of the profession must be realigned. 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 for applying strategic analytics to present challenges are described. Future directions are suggested to guide transformational endeavors during a period of inevitably disruptive change. Several recommendations are offered to resurrect, restore, renew, and transform MOR.

4 - An Approach to Modeling Megacities through Design of Experiments Techniques

Logan Michael Mathesen, Arizona State University Research Enterprise, 1475 N. Scottsdale Road, Suite 161, Scottsdale, AZ, 85257, United States, lmathese@asu.edu

We propose a modeling approach for megacities and their interactively complex systems, through a Design of Experiments (DOE) application, to support humanitarian operations by the United States Army. To understand megacity complexity, a controllable, statistically viable, representative urban ecosystem was selected to execute a design experiment. We selected a subset of key factors pertaining to city systems and developed an interactive model. The DOE results determined optimal factor levels that maximize model performance for urban disaster management.

■ SC03

King's 3

Behavioral Operations Management

Sponsored: Behavioral Operations Management

Sponsored Session

Chair: Reidar Hagtvedt, University of Alberta School of Business, 3-23 Business Building, Edmonton, AB, T6G2R6, Canada, hagtvedt@ualberta.ca

1 - Network Effects on Hand-Hygiene Behavior and Pathogen Transmission

Reidar Hagtvedt, University of Alberta, School of Business, Alberta, AB, Canada, hagtvedt@ualberta.ca

Hand-hygiene in healthcare has been studied in individuals and groups, but to our knowledge, not in networks. We use sociometric badges in a hospital to gather network data and swab for bacterial counts. We model the relationship between the network and individual behaviors and relate these to bacterial counts.

2 - Adaptive Behaviors in Outpatient Clinics

Chester G. Chambers, Asst. Professor, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21202, United States, cchamber@jhu.edu

Virtually all queueing, modeling, and simulation models of patient flows in outpatient facilities assume that processing times are independent of system status. We analyze data from one small, one medium, and one large clinic within the same system to test this assumption. We find that both patients and physicians exhibit adaptive behavior based on system status. We then use simulation to demonstrate the impact of state dependent processing rates on clinic performance. We suggest that this calls for a modification of many rules for appointment scheduling in these settings.

3 - How to Make Patient Engagement Effective in New Medical Environment

Jianjie Zhang, Beijing Institute of Technology, Beijing, China, zhjj_2013@163.com

how to better play the patient initiative and engagement in the process of the diagnosis and treatment,how to realize patient engagement effectively,these are problems that the workers interested in medical health care considered.in order to make the patient engagement become more effective,we need to consider each participate nodes.so we intend to establish a optimization model,which is involved in the optimization problem of every stage patinet engagement behavior.thereby improve patient engagement,further enhance the effectiveness of health care decisions.

■ SC04

Queen's 4

Learning in Healthcare Operations

Sponsored: Health Applications

Sponsored Session

Chair: Hari Balasubramanian, University of Massachusetts Amherst, 160 Governors Drive, Amherst, MA, 01002, United States, hbalasubraman@ecs.umass.edu

1 - Delays in Transfer Out of the ICU

David Scheinker, Stanford University, dscheink@stanford.edu

Few studies examine delays in transfer out of the ICU. We studied four years of patient flow through six ICUs at a large academic medical center. Over 36% of ICU patients transferring to a general care unit experienced a non-clinical delay of over 12 hours. Each day a patient was delayed added approximately a full day to their total hospital length of stay. These results have direct implications for hospital capacity design, bed assignments, and care processes across units within the hospital.

2 - Predicting Pediatric Surgical Case Durations

Neal Master, Stanford University, Stanford, CA, United States, nmaster@stanford.edu, David Scheinker, Nicholas Bambos

Effective operating room scheduling depends on accurate predictions of surgical procedure durations. However, previous work in the medical literature has demonstrated that pediatric surgical case durations are very difficult to accurately predict. We show that with appropriate feature engineering and a novel choice of loss function, we are able to improve prediction accuracy with practical and statistical significance. This work uses data from the Lucile Packard Children's Hospital at Stanford University.

3 - Care Coordination for High-utilizing Patients
Hari Balasubramanian, University of Massachusetts, Amherst, MA, hbalaubraman@ecs.umass.edu

We present results from a unique dataset on the time effort involved in coordinating care for complex, high-utilizing patients. The dataset comes from a new care delivery model being piloted in Camden, New Jersey. We demonstrate how longitudinal encounter data involving care team staff (nurses, social workers, health coaches etc.) can be used to answer key operational questions.

■ SC05

Queen's 5

Social Media Analytics and Health

Invited: Global Health

Invited Session

Chair: Qingpeng Zhang, City University of Hong Kong, Kowloon, H.K., 0000, Hong Kong, qingpeng.zhang@cityu.edu.hk

Co-Chair: Joanne Luciano, 110 8th st, Tetherless World Constellation, Winslow, Troy, NY, 12180, United States, jluciano@gmail.com

1 - Substitution or Augmentation: The Impact of Online Healthcare Consultation on Doctors' Offline Medical Service
Xi Chen, Zhejiang University, chen_xi@zju.edu.cn

Via online healthcare platform, patients can submit consultancy requests and physicians are empowered to offer healthcare advices to their selected patients. This paper investigates the impact of physicians' online healthcare consultancy on their offline medical service portfolio. We find that (1) a significant augmentation effect on more-intensive inpatient and high-value outpatient services, and (2) a substitution effect on revisit services. More interestingly, the augmentation effect is stronger for physicians in high-risk specialty; while the substitution effect is not significant in physicians with low-risk specialty.

2 - Knowledge Automation in Online Medical Inquiry Platforms
Yifei Zhao, Institute of Automation, Chinese Academy of Sciences, yfyf.zhao@163.com, Feiyue Wang, Jing Wang, Xiaobo Shi, Qingpeng Zhang

Online Medical inquiry platforms have become a popular supplement of the traditional healthcare systems over the past few years. Most platforms are without the capability to deal with medical knowledge automatically, often leading to poor user experience. In this paper, we apply the idea of knowledge automation in online inquiry platforms. In particular we recommend similar cases from the semantic perspective, evaluate the quality of answers and improve the bad ones, recommend patients to doctors and vice versa, improve a semi-automatic triage system. Experimental results on a real world online inquiry platform data show that our work can improve user experience of the platforms significantly.

3 - Online Peer-to-peer Lending: A Comparison of First-time and Repeated Borrowing Requests
Shun Cai, Xiamen University, caishun@xmu.edu.cn, Xi Lin, Di Xu, Wei Jiang

The past decade has witnessed a growing number of business models that facilitate economic exchanges between individuals with limited institutional mediation. One of the important innovative business models is online Peer-to-Peer (P2P) lending. Based on the signaling theory, we compare the effects from various signals on the likelihood of successful funding in 3 models (i.e., first-time borrowing, repeated borrowing without prior lending, and repeated borrowing with prior lending). Using the data collected from ppdai.com, we verify the three proposed models by employing logistic regression. Results and implications are analyzed and discussed.

4 - Why are Some Health-related Websites Successful (at Health Behavior Change)?
Joanne S Luciano, Predictive Medicine Inc and Rensselaer Polytechnic Institute, jluciano@gmail.com

■ SC06

Queen's 6

Operations of Dynamic Online Marketplaces

Invited: Sharing Economy, Matching Markets, and Networks

Invited Session

Chair: Siddhartha Banerjee, Cornell University, Cornell University, Ithaca, NY, 14850, United States, sbanerjee@cornell.edu

1 - Dynamic Type Matching
Ming Hu, University of Toronto, ming.hu@rotman.utoronto.ca, Yun Zhou

We consider an intermediary's problem of dynamically matching demand and supply of heterogeneous types in a periodic-review fashion. There is a reward associated with each possible matching of a demand type and a supply type. In each period, demand and supply of various types arrive in random quantities. The platform's problem is to decide on the optimal matching policy to maximize the total discounted rewards minus costs, given that unmatched demand and supply will incur waiting or holding costs, and will be carried over to the next period with abandonments. For this dynamic type matching problem, we obtain a set of distribution-free structural results on the optimal and heuristic matching policies.

2 - On-demand Service Platforms
Terry Taylor, University of California Berkely, taylor@haas.berkeley.edu

An on-demand service platform (e.g., Uber, Instacart) connects waiting-time sensitive customers with independent service providers. This paper characterizes how two defining features of an on-demand service platform—congestion-driven delay and service provider independence—impact the platform's optimal per-service price and wage.

3 - Dynamic Pricing in Ride-sharing Platforms
Siddhartha Banerjee, Cornell University, sbanerjee@cornell.edu

Much of their success of ride-sharing platforms like Lyft and Uber is ascribed to their ability to do fine-grained fast-timescale dynamic pricing - where prices can react to instantaneous system state, and across very small geographic areas. We explore the value of such fast timescale dynamic pricing via a model which combines a queueing model for the dynamics of the platform's operations with strategic models of both passenger and driver behavior. In particular, we suggest that dynamic pricing may not be better than the optimal static price, but rather, allows the platform to realize the optimal price with limited knowledge of system parameters. Joint work with Ramesh Johari and Carlos Riquelme.

■ SC07

Kohala 1

Establishing Trust and Trustworthiness in Global Supply Chains

Invited: Global Supply Chains

Invited Session

Chair: Ozalp Ozer, The University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, 75080, United States, oozer@utdallas.edu

1 - Establishing Trust and Trustworthiness in Global Supply Chains
Ozalp Ozer, The University of Texas at Dallas, oozer@utdallas.edu

In this presentation, we will discuss when, how, and why the behavioral motives of trust and trustworthiness arise to support credible information sharing and cooperation within and across businesses. We identify four building blocks of trust and trustworthiness: personal values and norms, market environment, business infrastructure, and business process design. We will elaborate on these building blocks and offer tangible insights about how to establish trusting and cooperative business relationships. To do so, we will provide a high level summary of some research results and case studies from across industries.

■ SC08

Kohala 2

Game Theory Models in OM/Marketing Interface

Invited: Operations/Marketing Interface

Invited Session

Chair: Jeff Shulman, University of Washington, jshulman@uw.edu

1 - Autoscaling in Cloud Computing and Market Entry

Jeffrey D Shulman, University of Washington, jshulman@uw.edu

Technology startups often rely on computational resources to serve their customers, though rarely is the number of customers they will serve known at the time of market entry. Today, many of these computations are run using cloud computing. A recent innovation in cloud computing known as autoscaling allows companies to automatically scale their computational load up or down as needed. We build a game theory model to examine how autoscaling will affect market entry and equilibrium prices, profitability, and consumer surplus.

2 - Multi-level Marketing Business Opportunities: Defining and Assessing Economic Viability, Benefit, and Harm

Anne T. Coughlan, Polk Bros. Chair in Retailing, Kellogg School of Management, 2001 Sheridan Road, Evanston, IL, 60208, United States, a-coughlan@kellogg.northwestern.edu

This paper analyzes the operation of multi-level marketing (MLM) distribution channels, with an eye toward defining and analyzing "economic harm" to MLM distributors. This is an issue of policy importance, as erroneous attributions of harm to distributors are sometimes ascribed to legitimate MLM firms and their channels. For example, "inventory loading" is viewed as an indicator of possible illegal behavior. Among the results of the paper's model are that it is economically rational for a person to join the MLM as a personal-consumption-only distributor, and that economic harm can (but may not always) result from purposeful over-stating of the quality of the business opportunity by the MLM firm. .

3 - Co-creation and Competition in the Supply Chain

Amit Pazgal, Rice University, Houston, TX, United States, pazgal@rice.edu, Dinah Cohen-Vernik, Niladri Syam

We analyze the strategic choices of two competing firms who decide whether or not to co-create with an upstream supplier. We incorporate endogenous pricing and effort choices by all parties and show that firm competition allows the supplier to exert lower innovation effort when co creating with more firms. Further, ex-ante symmetric firms may pursue asymmetric strategies. When competition is intense all parties prefer the asymmetric outcome. For moderate competition, both firms prefer co-creation, but the supplier refuses to co-create with one of them. Counter intuitively, a higher degree of product fit for the rival can benefit the co-creating firm even though it improves its rival's product.

■ SC09

Kohala 3

Innovation and Entrepreneurship

Contributed Session

Chair: Max Groberg, Zurich, 8003, Switzerland, max.groberg@gmx.de

1 - Values of Social and Commercial Entrepreneurs – Same, Different or Both?

Susanne Schmidt, Technical University Dortmund, Dortmund, Germany, susanne2.schmidt@tu-dortmund.de

We propose that similarities and differences in social (SE) and commercial (CE) entrepreneurship are linked to founders' basic human values. In our model, SE's intention to create value for society is rooted in founders' self-transcendence values (universalism and benevolence) - CE's goal to capture value is related to entrepreneurs' self-enhancement values (power and achievement). The preference for the formation of a new venture that is characteristic for both SE and CE is linked to values related to openness to change (self-direction and stimulation). We empirically test this theoretically derived model on a cross-national sample of 288 Master's students from 36 countries.

2 - How to Spot Social Entrepreneurs

Peter Waleczek, PhD Candidate, Technical University of Dortmund, Dortmund, Germany, peter.waleczek@udo.edu

The current refugee crisis is yet another call for a new wave of social entrepreneurs in order to develop innovative approaches addressing issues in the social, educational, environmental and economic sector. Consequently, numerous authors have examined social entrepreneurial intention as antecedent of social entrepreneurship. However, a valid measurement construct for this phenomenon is still missing. The present study develops a 12 item scale, covering personality characteristics and environmental factors, from a unique sample of 281 individuals in 39 countries. The multidimensional scale helps educators and policy makers to provide a suitable environment for social entrepreneurship.

3 - Organizational Ambidexterity as a Result of the CEO's Regulatory Focus

Adrian Enke, Research Associate/PhD Candidate, University of Giessen, Giessen, Germany, adrian.enke@wirtschaft.uni-giessen.de

Organizational ambidexterity is a commonly accepted driver of firm performance in management research. Nevertheless, past research has widely neglected to study the antecedents of ambidexterity. The present study shows that the CEO's personality, specifically her regulatory focus, sets the course either for pursuing exploration (radical innovation), for exploitation (incremental innovation) or ambidexterity as the combination of both. We use secondary data from S&P 500 firms to validate our research model. This study contributes to extant innovation literature as well as upper echelon theory and raises awareness for the impact of the CEO's personality on firm strategy.

4 - Successful Digital Transformations: A Cross-cultural Study of Organizational Preparedness for Corporate Entrepreneurship as a Driver of the Degree of Digitization

Max Groberg, TU Dortmund, Vogelpothsweg 87, Dortmund, 44227, Germany, max.groberg@tu-dortmund.de

An organization's Degree of Digitization (DoD) is a determinant of its innovative success and thereby serves as the basis for sustaining a competitive advantage. Organizations face a digital transformation of their business along five DoD dimensions. Such a transformation requires that the employees act as entrepreneurs and detect and use digital opportunities. Organizations can promote such behavior by achieving high levels of organizational preparedness for corporate entrepreneurship (OPCE). Accounting for the contingencies of IT capabilities and national culture in our analysis of 617 organizations from Europe, South Africa, and India, we find that OPCE positively affects DoD.

■ SC10

Kohala 4

Optimization and Applications

Contributed Session

Chair: Mehdi Behroozi, University of Southern California, University of Southern California, Los Angeles, CA, 90034-2930, United States, behro040@umn.edu

1 - An Optimization Approach to Genomic Selection

Lizhi Wang, Iowa State University, IMSE and ECPE, Ames, IA, 50011, United States, lzwang@iastate.edu

Genomic selection is widely used by plant breeders and animal breeders to improve the phenotype of the breeding population. We propose new genomic selection approaches based on optimization models. The performance of the proposed approach will be compared with those of conventional approaches using computer simulation.

2 - Robust Technique for Linear Optimization with Correlated Uncertainties

Hongxia Yin, Minnesota State University, Mankato, Department of Mathematics and Statistics, 273 Wissink Hall, Mankato, MN, 56001, United States, hongxia.yin@mnsu.edu

A tractable robust counterpart is proposed for a linear optimization problem with correlated uncertainties under a time series setting, which is in contrast to the independent or simple correlated uncertainty assumption in literatures of robust optimization. The feasibility of the robust solution is established under reasonable assumptions. A numerical method is given for the selection of the parameters which controls the tradeoff among the robustness, the optimality and the tractability of the robust counterpart. Numerical results show that the model provides a more attractive robust solution compared to exiting robust counterparts without time series.

3 - Wasserstein Metric and the Distributionally Robust TSP

Mehdi Behroozi, Visiting Scholar, University of Southern California, 3120 Bagley Ave., Apt. 5, Los Angeles, CA, 90034-2930, United States, mbehroozi@umn.edu

Recent research on the robust and stochastic Euclidean travelling salesman problem has seen many different approaches for describing the region of uncertainty, such as taking convex combinations of observed demand vectors or imposing constraints on the moments of the spatial demand distribution. In this paper, we consider a distributionally robust version of the Euclidean travelling salesman problem in which we compute the worst-case spatial distribution of demand against all distributions whose Wasserstein distance to an observed demand distribution is bounded from above. This constraint allows us to circumvent common overestimation that arises when other procedures are used.

4 - When R&D Alliances Among Product Market Competitors Makes Sense

Arun Gopalakrishnan, Assistant Professor, Washington University in St Louis, Olin Business School, One Brookings Drive, St Louis, MO, 63130, United States, agopala@wustl.edu

We study a new product development dilemma that firms face: when should product market competitors eyeing the same market collaborate on R&D? Using an analytical model incorporating market size and each firm's private and collaborative R&D capabilities, we obtain a series of counterintuitive results. First, firms with asymmetric private R&D costs are more likely to engage in an R&D alliance. Second, collaboration increases (decreases) a strong (weak) firm's private R&D efforts. Finally, and most surprisingly, R&D alliances are shunned by firms when cost of collaboration is too low.

■ SC11

Kona 1

Applications of Economic Models on Competition, Innovation, and Crowdsourcing

Invited: Mechanism Design and Game Theory

Invited Session

Chair: Ersin Korpeoglu, UCL School of Management, Gower Street, London, WC1E 6BT, United Kingdom, e.korpeoglu@ucl.ac.uk

1 - Consumer Coalitions: Blessing or Curse?

C. Gizem Korpeoglu, University College, London, c.korpeoglu@ucl.ac.uk

We study whether and when cooperation among consumers is beneficial to consumers when producers have market power. We refer to cooperation of consumers as consumer coalition. By considering market power of producers and consumer coalitions, we gauge how size of these coalitions affects consumers. We establish, contrary to a first intuition and prior literature, that consumer welfare decreases with coalition size when coalition size is above a threshold. We prove that a larger coalition size discourages production capacity expansion, which has repercussions for long-term consumer welfare. We then show that fostering competition among producers is more effective in promoting consumer welfare.

2 - Jack of All, Master of Some: Information Network and Innovation in Crowdsourcing Communities

Elina Hyeunjung Hwang, Assistant Professor, Foster School of Business at University of Washington, Seattle, WA, United States, elina7@uw.edu

This study investigates the complementarity of individuals' activities between two crowdsourcing communities hosted by one firm: a customer support community and an innovation crowdsourcing community. Our empirical analysis using a machine learning technique reveals that generalists, who have provided solutions on diverse problem areas in a customer support community, are more likely to create greater number of new ideas than non-generalists. Yet, only those generalists who possess expert knowledge in at least one domain area tend to outperform non-generalists in their ability to create higher quality ideas that are later implemented by the firm.

3 - Incentives in Contests with Heterogeneous Solvers

Soo-Haeng Cho, Carnegie Mellon University, soohaeng@andrew.cmu.edu

In a crowdsourcing contest in which heterogeneous solvers make efforts to develop solutions, existing theories predict different outcomes about how solvers will change their efforts in response to increased competition (i.e., more entrants to the contest). This paper presents a unifying model that encompasses different types of heterogeneity, and offers a precise explanation about solvers' rational behavior. Our theoretical prediction is corroborated by empirical evidence.

4 - Dynamic Priority Scheduling for Automated College Degree Planning

Robert R Meyer, University of Wisconsin-Madison, Dept of Computer Sciences & Statistics, 1210 W. Dayton St., Madison, WI, 53706-1685, United States, rrm@cs.wisc.edu

College degree planning is an important but complex problem faced by millions of college students and their advisors. We consider an automated web-based approach to this task based on dynamic priority scheduling of courses tailored to individual student preferences, and we demonstrate the value of our system via actual user experience at the University of Wisconsin-Whitewater.

■ SC12

Kona 2

Scheduling and Project Management 3

Invited: Scheduling and Project Management

Invited Session

Chair: Xiwen Lu, East China University of Science of Technology, 130 Mei Long Road, Shanghai, 200237, China, xwlu@ecust.edu.cn

1 - Scheduling Reclaimer Operations in Stockyard

Xiwen Lu, East China University of Science of Technology, xwlu@ecust.edu.cn

This paper considers a reclaimer scheduling problem in which one has to collect bulk material from stockpiles in the quay in such a way that the time used is minimized. When reclaimers are allowed to work on the same stockpile simultaneously, a fully polynomial time approximation scheme (FPTAS) is designed. Furthermore, we present a 2-approximation algorithm in the case that any stockpile can be handled by at most one reclaimer at a time. When the number of reclaimers is two, we give a 3/2-approximation algorithm. Computational experiments show that the algorithm performs much better than our worst case analysis guarantees.

2 - Flowshop Scheduling with Interstage Job Transportation

Weiya Zhong, Shanghai University, Shanghai, China, wyzhong@i.shu.edu.cn

In this paper, we study two flowshop scheduling problems where there are two processing stages and a single transporter that deliver the finished jobs from the first stage to the second. In the first problem, there is a single machine in each stage and jobs have different sizes when loaded onto the transporter. In the second problem, there are two parallel machines in the first stage and a single machine in the second stage, and the transporter can carry only one job in each shipment. The objective of both problems is to minimize the makespan. The two problems are both strongly NP-hard. For each problem, we propose a fast heuristic and show that the heuristic has a tight worst-case bound of 2.

3 - Online Scheduling with Machine Eligibility Constraints

Zhaohui Liu, East China University of Science and Technology, zhliu@ecust.edu.cn

We consider the online scheduling problem on several parallel machines with eligibility constraints. The jobs arrive over time and our objective is to minimize the makespan. When the jobs have equal processing times, we present optimal online algorithms for the nested processing set case and the inclusive processing set case with an arbitrary number of machines, as well as the tree-like processing set case with three machines. Also, we develop an optimal algorithm for the inclusive processing set case with two machines and arbitrary job processing times.

4 - Hybrid Evolutionary Optimization of Two-stage Stochastic Truck Scheduling in Crossdocking Terminals

Lars Eufinger, TU Dortmund University, Leonhard-Euler-Str 2, Dortmund, 44227, Germany, eufinger@itl.tu-dortmund.de

Crossdocking in logistics is a practice of unloading goods from an incoming trailer and loading them into outgoing trailers, with little or no storage in between. The efficient operation of a crossdocking terminal requires an appropriate scheduling of the inbound and outbound trucks. To handle the occurring uncertainties we use a two-stage stochastic mixed-integer program, which is handled by a stage-decomposition based hybrid algorithm. An evolutionary algorithm determines the first-stage decisions and mathematical programming determines the second-stage decisions.

5 - The Integrated Bus Driver Scheduling and Rostering Problem

Dung-Ying Lin, National Cheng Kung University, 1 University Road, Transportation and Communication Management, Tainan City, Taiwan, dylin@mail.ncku.edu.tw

In bus transportation, driver management aims to generate the work schedule of bus drivers so that a published timetable can be covered. The driver management problem is typically decomposed into driver scheduling and driver rostering problem. Decomposition of such a problem into two phases can yield inferior solutions. Therefore, integration of driver scheduling and roster problems is of importance. In this research, we proposed mathematical formulations for the integrated bus driver scheduling/rostering problem. To solve these formulations, we develop a depth-first search based implicit enumeration algorithms so that optimal solution can be determined in an efficient manner.

■ SC13

Kona 3

Efficient Optimization Methods for Power Systems

Invited: Energy Systems

Invited Session

Chair: Javad Lavaei, UC Berkeley, 4121 Etcheverry, Berkeley, CA, 94709, United States, lavaei@berkeley.edu

1 - A Unified Framework for Frequency Control and Congestion Management

Changhong Zhao, Caltech, czhao@caltech.edu

We propose a new framework for frequency control and congestion management. We formulate an optimization problem that rebalances power, restores the nominal frequency, restores inter-area flows, and maintains line flows below their limits in a way that minimizes the control cost. By deriving a primal-dual algorithm to solve this optimization, we design a distributed unified control which integrates primary and secondary frequency control and congestion management. Simulations show that the unified control not only achieves all the desired control goals in system equilibrium, but also improves the transient compared to traditional control schemes.

2 - Convexification of Unit Commitment Problem

Javad Lavaei, UC Berkeley, Berkeley, CA, United States, lavaei@berkeley.edu, Morteza Ashraphijuo

The unit commitment (UC) is a fundamental optimization problem that aims to optimize the parameters of a power network, including the commitment status of each generator. UC is a mixed-integer nonlinear program and the existing algorithms mostly rely on solving a series of convex relaxations by means of branch-and-bound or cutting planning methods. In this talk, we show that the classical semidefinite program (SDP) performs as poorly as the linear programming relaxation. We then develop an enhanced SDP relaxation of UC problem and study hard instances of the problem for which the globally optimal values of the discrete and continuous parameters are found by solving the proposed convex problem once.

3 - On Minimal Characterization of Feasible Sets of Security-constrained Unit-commitment Problems

Ramtin Madani, University of California, Berkeley, Berkeley, CA, United States, ramtin.madani@berkeley.edu, Javad Lavaei, Ross Baldick

The objective of this work is to develop a parallel and computationally-cheap algorithm for obtaining a minimal set of linear inequalities that characterize the polyhedral feasible set of a power system optimization problem. The proposed algorithm can be used as a preprocessing step for solving the security-constrained unit-commitment (SCUC) problem for large-scale networks, which is a fundamental discrete optimization arising in both long-term and real-time power system applications. Based on the proposed algorithm, we are able to identify millions of redundant constraints of the SCUC problem for real-world systems and describe the secure feasibility region via a few hundred constraints.

■ SC14

Kona 4

Predictive Analytics in Healthcare

Sponsored: Health Applications

Sponsored Session

Chair: Sean Barnes, Assistant Professor, Univ of Maryland-College Park, 4352 Van Munching Hall, College Park, MD, 20742, United States, sbarnes@rhsmith.umd.edu

1 - Predictive Analytics Model for Healthcare Planning and Scheduling

Shannon Harris, University of Pittsburgh, sharris@katz.pitt.edu, Jerry May, Luis Vargas

Patient no-shows complicate appointment scheduling systems. We present a new model for predicting no-show behavior based solely on the binary representation of a patient's historical attendance history. The model is a parsimonious, pure forecasting model that combines regression modeling and the sum of exponential functions to produce probability estimates. It also generates parameters that give insight into how past human behavior effects future behavior. We illustrate our approach using data from patients' attendance and non-attendance at VA outpatient clinics.

2 - Machine Learning for Clinical Decision Support for Heart Failure Readmission

Sauleh Ahmad Siddiqui, Johns Hopkins University, Baltimore, MD, United States, siddiqui@jhu.edu, Wei Jiang, Sean Barnes, Stephanie Cabral, Eric Hamrock, Lili Barouch, Lili Barouch, Scott R Levin

Predicting risk of HF readmission have gained increasing attention.Previous studies mainly used administrative data. We will focus on using clinical data from EMR for predicting HF readmission by creating structured data from unstructured clinical data and combining it with administrative data. Then we use classification models such as random forest and support vector machine for predicting purpose. In the end, we will demonstrate the value of clinical data in predicting HF readmission.

3 - An Evolutionary Computation Approach for Optimizing Multi-level Data to Predict Individual Patient Outcomes

Sean Barnes, University of Maryland, sbarnes@rhsmith.umd.edu, Scott R Levin

Widespread adoption of electronic health records and objectives for meaningful use have increased opportunities for data-driven predictive applications in healthcare. These decision support applications are often fueled by large-scale, heterogeneous, and multi-level patient data (e.g., diagnoses, co-morbidities, and medications documented at multiple levels of specificity) that challenge the development of predictive models. We present an evolutionary computation framework for optimally specifying multi-level data to predict individual patient outcomes. We evaluate this approach for predicting critical events in emergency department patients across five populations.

■ SC15

Kona 5

Information Aggregation and Supply Chain Management

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Xiaolin Xu, Nanjing University, Nanjing China, Nanjing, 210000, China, xuxl@nju.edu.cn

1 - Dynamic Pricing in a Trade-in Program with Replacement and New Customers

Yongbo Xiao, Tsinghua University, xiaoyb@sem.tsinghua.edu.cn, Jian Chen

We study the pricing strategies in a trade-in program for a manufacturer, who produces and sells a new generation of products to replacement and new customers. We propose to adopt a dynamic trade-in program, in which any replacement customer can return their old product in exchange for a price discount when buying a new product. Starting from the choice behavior of customers, we study the dynamic optimal pricing decisions, investigate trade-in program's impact on the optimal regular selling price, and establish structural properties of the optimal pricing policy.

2 - Sourcing for Traceability Considering Consumer's Willingness to Pay

Shengnan Sun, Southeast University, Nanjing, China, sun.shengnan@seu.edu.cn, Xinping Wang, Jingxian Chen

we analyze the sourcing decision of a buyer choosing between two supplier types: high-level traceability suppliers are costly, where as low-level traceability suppliers are less expensive but may experience recall. A segment of the consumer population, called traceability conscious, is willing to pay a higher price for the food product sourced from a high-level traceability supplier. We identify several possible sourcing strategies that a buyer might employ, and determine when each strategy is optimal and show that efforts to improve food traceability that focus on consumers or supply chain transparency may lead to unintended consequences.

3 - Joint Pricing and Inventory Decisions under Trade Credit

Weili Xue, Southeast University, Nanjing, China, wlxue1981@gmail.com, Lijun Ma, Youhua Chen

In this paper, we study the joint inventory-pricing contro problems in a periodic review, single product system with variable ordering costs and duration-nondecreasing trade credit costs, when the decision maker can choose his payment time. With backlog and zero leadtime, we find that when there is no on-hand inventory, a base-stock listed price policy is optimal and when there exists on-hand inventory, a state-dependent order-up-to policy is optimal. We design myopic heuristics for this problem and study the comparative statics for the optimal policy, with emphasize on how the trade credit induces bullwhip effect. Moreover, we extend our study to include positive leadtimes and lost-sales.

4 - Optimal Purchasing Policies of Fresh Product with Random Arrvials

Lianmin Zhang, Nanjing University, zhanglm@nju.edu.cn, Xiaolin Xu, Xiaoqiang Cai

We consider the problem in which a distributor purchases a fresh product from multiple sources for subsequent sale at a wholesale market which opens for trading only in a fixed-time window. Due to uncontrollable factors such as congestion in the road network or bad weather conditions, the amount of time required to deliver the product from each production origin is uncertain. We formulate the basic problem as a multi-source selection model with random yield, taking into account the trade-off between purchasing cost and other costs such as deterioration loss arising from delivery uncertainty.We derive the optimal order quantities from different origins and propose algorithms to search for them.

■ SC16

Waikoloa 1

Facility Location with Uncertain Demand

Sponsored: Facility Location

Sponsored Session

Chair: Dmitry Krass, University of Toronto, 105 St. George St., Toronto, ON, M5S 3E6, Canada, krass@rotman.utoronto.ca

1 - Location and Capacity Planning with Stochastic Elastic Demand and Congestion

Dmitry Krass, University of Toronto, Rotman School of Management, 105 St George Street, Toronto, ON, M5S 3E6, Canada, krass@rotman.utoronto.ca

We will overview recent contributions to optimal location of facilities under stochastic and elastic demand. Recent results for optimal pricing will be discussed.

2 - Optimal Location and Design of Competitive Facilities under Elastic Demand

Robert Aboolian, California State University, California State University, San Marcos, CA, 92009, United States, raboolia@csusm.edu

We develop a novel methodology to simultaneously optimize locations and designs for a set of new facilities facing competition from some preexisting facilities. We develop a polynomial approximation scheme for the underlying combinatorial problem and demonstrate the efficiency of our methodology through computational results and a small case study.

3 - A Public Facility Location Planning Maximizing the Number of Visitors with a Visiting Probability Given by a Logistic Distribution

Tohru Yoshikawa, Professor, Tokyo Metropolitan University, 1-1 Minami-Osawa, Hachioji, 192-0397, Japan, yoshikawa-tohru@tmu.ac.jp

The aim of the paper is to formulate an alternative evaluation index to the conventional consumer surplus for the location of public facilities with residents whose probabilities of visiting the nearest facility decrease with the distances such as public libraries. To this end, a facility location problem maximizing the expected number of visitors to the nearest facility with a probability given by a logistic distribution is formulated. The characteristics of the solutions on a simple virtual regional space are examined in comparison with the solutions maximizing the consumer surplus and the applicability to the public policy concerning the utilization of existing public buildings is discussed.

4 - Solving Restricted Facility Location Problems on Discrete Networks using Multicommodity Flows

Murat Oguz, University of Southampton, Building 4 University of Southampton, Highfield Campus, Southampton, SO17 1BJ, United Kingdom, mo2g12@soton.ac.uk

This study presents models and a solution algorithm for continuous facility location problems (RFLPs). The models are defined on a discretization of the space and are based on multicommodity flows with unknown destinations. The discretization can be applied to RFLPs using any distance metric. The solution algorithm is based on Benders Decomposition, using which we solve all RFLP instances from the literature. We also introduce and solve new instances inspired from practical applications.

■ SC17

Waikoloa 2

Emerging Problems in Pricing and Revenue Management

Sponsored: Revenue Management and Pricing Section

Sponsored Session

Chair: Mehmet Sekip Altug, Assistant Professor, George Washington University, Funger Hall 413, Washington, DC, 20052, United Kingdom, maltug@gwu.edu

1 - Drug Pricing for Pharmaceutical Manufacturers Distributing through a Common Pharmacy Benefit Manager

Yixuan Xiao, City University of Hong Kong, yixuxiao@cityu.edu.hk, Nan Yang, Panos Kouvelis

We model the competition among branded drug manufacturers on prices when contracting with a common PBM, who manages the prescription drugs of all manufacturers on behalf of their clients. We analyze the PBM's optimal formulary design problem and characterize the equilibrium pricing behavior of competing drug manufacturers. We discuss the impact of various parameters on the equilibrium outcomes for plan enrollees, PBM, and drug manufacturers.

2 - Algorithms for Sequential Advertiser Polling in One by One Solicitation Schemes

Dmitri Arkhipov, University of California Irvine, darkhipo@uci.edu

One by one solicitation (OBOS) is a one of the two dominant ways of filling onlinead spaces on-demand. In OBOS an ad network sequentially polls its in-network advertisers in some order. Polling should take no more than 200ms. We presenta dynamic programming (DP) formulation of the advertiser polling problem. For larger instances of the problem we describe both an approximate DP formulation, and a GRASP based meta-heuristic approach. For the approximate DP formulation we give a firm upper bound, and a pseudo-polynomial time algorithm solution.

3 - Consumer Choice Models with Endogenous Network Effects

Zizhuo Wang, University of Minnesota, zwang@umn.edu

We propose and analyze a new choice model that takes into account network effects. We characterize the choice probabilities under such model and conduct comparative statics studies. Then we investigate the assortment optimization problem under such choice model. We show that a new class of assortments, called quasi-revenue-ordered assortments, is optimal under mild conditions and performs well in practice. We also conduct an empirical study on a mobile game dataset to validate our results.

4 - Policy and Product Launch Implications of Parallel Imports in Pharmaceutical Industry

Mehmet Sekip Altug, George Washington University, Washington, DC, United States, maltug@gwu.edu, Ozge Sahin

While it may be socially optimal to introduce a new drug all over the world at the same time, doing so may have adverse implications for drug developers, such as the emergence of parallel imports. We study a pharmaceutical firm that already introduced a pioneering drug in its home country, where the product is protected by patent rules. The firm has to decide whether to launch in a second country in the same region, where parallel import between these two countries is feasible and if so how to price it. We characterize the joint equilibrium pricing and product launch decision of the firm. We discuss how these decisions are aﬀected by various parameters, including insurance, patient populations and negotiation.

■ SC18

Waikoloa 3

Business Analytics

Invited: Big Data Analytics

Invited Session

Chair: Han Ye, University of Illinois at Urbana-Champaign, 1206 South Sixth St, Urbana, IL, 61820, United States, hanye@illinois.edu

1 - Big Data Newsvendor Practical Insights from Machine Learning

Gah-Yi Vahn, London Business School, gvahn@london.edu

We investigate the newsvendor problem when one has n observations of p features related to the demand as well as historical demand data. We propose two approaches to finding the optimal order quantity in this new setting – that of Machine Learning (ML) and Kernel Optimization (KO). We apply the feature-based algorithms for nurse staffing problem in a hospital emergency room and find that (i) the best KO and ML algorithms beat the best practice benchmark by 23% and 24% respectively in out-of-sample cost with statistical significance at the 5% level, and (ii) the best KO algorithm is faster than the best ML algorithm by three orders of magnitude and the best practice benchmark by two orders of magnitude.

2 - Dynamic Pricing with Demand Covariates
Sheng Qiang, Stanford University, sqiang@stanford.edu

A firm sells products over T periods, without knowing the demand function. The firm sets prices to earn revenue and learn the demand function. In each period before setting the prices, the firm observes some demand covariates, like marketing expenditure, consumer's attributes, etc. The performance is measured by the regret, which is the expected revenue deviation from the optimal pricing policy when demand function is known. We study the asymptotic optimal algorithms to optimize the regret.

3 - Parametric Forecasting and Stochastic Programming Models for Call-center Workforce Scheduling
Haipeng Shen, University of Hong Kong, shenhaipeng@gmail.com

We develop and test an integrated forecasting and stochastic programming approach to workforce management in call centers. We first demonstrate that parametric forecasts, discretized using Gaussian quadrature, can be used to drive stochastic programs whose results are stable with relatively small numbers of scenarios. We then extend our approach to include forecast updates and two-stage stochastic programs with recourse and provide a general modeling framework for which recent, related models are special cases. Experiments with two large sets of call-center data highlight the complementary nature of these elements.

4 - Long-run Average Optimality of Ar(1)-driven Workforce Scheduling Models
Han Ye, University of Illinois at Urbana-Champaign, hanye@illinois.edu

We concern workforce scheduling for service centers. The demand arrival follows a doubly stochastic Poisson process with hidden rates. The problem is to minimize the long-run average staffing cost, subject to the constraint that the long-run proportion of quality-of-service violations among all arrivals is bounded by a target. The optimal control is found analytically. We then consider a practical myopic data-driven forecasting-scheduling method, which solves for daily schedules using discretized forecasting distribution. We show that the myopic method approaches optimal as the number of discretization scenarios grows large.

Sunday, 4:00pm - 5:30pm

■ SD01

King's 1

Decision Analysis and Support

Contributed Session

Chair: Bo Li, Tsinghua University, Tsinghua University, Beijing, China, libo@sem.tsinghua.edu.cn

1 - On the Absence of Industry Expertise – Why Only Freshmen Found New Ventures
Jessica Moser, PhD Candidate and Assistant Lecturer, Technical University of Dortmund, Vogelpothsweg 87, Dortmund, 44227, Germany, Jessica.Moser@udo.edu

Drawing on human capital theory, this research explores the influence of a nascent entrepreneur's experience and skills on the successful transition from evaluating a business idea towards the establishment of a new firm. While this study validates previous findings regarding the positive influence of general human capital, it is the first to demonstrate a strong negative impact of specific human capital on the ultimate decision to create a venture. Based on a unique sample of 2,107 successful as well as unsuccessful nascent entrepreneurs identified after screening 50,000 completed interviews, industry and managerial experience emerge to be key drivers for the decision to abandon a venture plan.

2 - Value of Information in Crowd Science: A Case Study to Improve Management of an Invasive Wetland Plant
Victoria M. Hunt, Adjunct Asst. Conservation Scientist, Chicago Botanic Garden, Glencoe, IL, 60022, United States, vhunt@chicagobotanic.org

Recent technological advances have facilitated crowdsourcing (leveraging the internet to broadly solicit information to answer targeted questions) in scientific research. We use the Value of Information to evaluate investment strategies aimed at improving the quality and quantity of data collected via "crowd science" as they pertain to decision-making in natural resource management. We use management of common reed (Phragmites australis), an invasive wetland plant, as our case study. The study uses a multi-tiered monitoring protocol for differing levels of interest and expertise, and an adaptive management framework to improve conservation outcomes via reduction of shared uncertainties.

3 - A Contract Negotiation Model for Constituent Systems in the Acquisition of Acknowledged System of Systems
Ruwen Qin, Missouri University of Science & Technology, 218 Engineering Management Building, 600 W. 14th Street, Rolla, MO, 65409, United States, qinr@mst.edu

In the acquisition of acknowledged system of systems (SoS), the SoS manager attempts to reach a coalition agreement with each of selected constituent systems. Contract negotiation is a way of resolving conflicts with self-interested constituent systems. Complexity of the acknowledged SoS acquisition makes the negotiation a hard decision process for constituent systems. This paper develops a contract negotiation model for constituent systems in the acknowledged SoS acquisition. The model is a decision support for constituent systems. It is also a tool with which the SoS manager can develop a better understanding of constituent systems.

4 - Statistical Learning Guided by Decision-making
Bo Li, Associate Professor, Tsinghua University, 440 Weilun Hall, School of Economics and Management, Tsinghua University, Beijing, 100081, China, libo@sem.tsinghua.edu.cn

Data-driven decision-making usually employs statistical learning methods which are merely gauged by classical statistical measures (goodness-of-fit or out-sample prediction). The need to integrate statistical learning with decision optimization has been emphsized in the literature. In this work, we investigate how to tailor the high dimensional statistical learning of the random input for the subsequent decision making objective in a big data environment. We study the model selection and aggregation problems in operations management. Particularly, we look into the feature selection and covariance learning problems in inventory management and financial portfolio management.

■ SD02

King's 2

Logistics

Contributed Session

Chair: Leily Farrokhvar, Virginia Tech, Virginia Tech, Blacksburg, VA, 24061, United States, leily@vt.edu

1 - Research on Resource Allocation Strategy in Humanitarian Logistics Considering Deprivation Costs
Lina Yu, Tsinghua University, Graduate School at Shenzhen, THU, Tsinghua Campus, The University Town, Shenzhen, 518055, China, yuln10@mails.tsinghua.edu.cn

Researchers find that consideration of human suffering would promote the effectiveness of emergency logistics during disaster response phase. Therefore, this paper develops a dynamic multi-period resource allocation model, considering deprivation costs - economic valuation of the human suffering. Dynamic programing method is used to find the optimal allocation strategy. We conduct extensive numerical experiments to analyze (i) computation performance, (ii)the trade-off between logistics and deprivation costs, (iii)structure of deprivation costs. In order to apply the model in real cases, the paper proposes a heuristic allocation strategy which is efficient for large scale problem.

2 - Tactical Traffic Control for Multiple AGV Systems Based on Three Dimensional Space
Yuna Noh, KAIST, Daejeon, Korea, Republic of, ynnoh@kaist.ac.kr

In dynamic environment, it is required to frequently alter pre-defined path for individual automated guided vehicle (AGV). A two-staged traffic control scheme for multiple AGVs is highly efficient in complex environment. The initial path table is generated from the first scheme by dynamic programming. The second scheme is tactical conflict resolution and the traffic controller predicts conflicts by performing the cell overlapping test. Three dimensional map, countable state space which is equally-spaced cells with discrete time domain, makes the algorithm apt for predicting conflicts. Finally, the efficiency of the new algorithm is examined and compared with Breadth-first search algorithm.

3 - Branch and Price for Tug Scheduling in Hinterland Barge Transport
Lu Zhen, Professor, Shanghai University, School of Management, 99 Shang Da Road, Shanghai, 200444, China, lzhen@shu.edu.cn

This study investigates a tug scheduling problem at a sea port, which is located at a river mouth and connects the hinterland ports along the river with the global maritime transportation network. A mixed-integer programming model is proposed to optimize the assignment of barges to tugs as well as the time when the tugs depart from the sea port and go to the hinterland ports. Some properties of the model are also investigated. Moreover, a branch-and-price based exact solution method is developed to solve the proposed model. Numerical experiments are conducted to validate the effectiveness of the proposed model and the efficiency of the proposed solution method.

4 - A Branch-and-price Approach for Bulk Tank Allocation Problem in Industrial Gas Distribution

Leily Farrokhvar, Assistant Professor, West Virginia University, Morgantown, WV, 26506, United States, leily@vt.edu

Bulk tank allocation (BTA) problem is a complex planning problem in industrial gas industry with the goal of allocating bulk tanks to customer locations while considering the effects that this decision has on distribution planning. We formulate the BTA problem as a mixed integer programming model and solve it to optimality using a branch-and-price approach for instances with up to 40 customers. The approach provides a valuable framework for analyzing strategic level asset allocation decisions while incorporating operational characteristics of the distribution system.

■ SD03

King's 3

Operations Management

Contributed Session

Chair: Howard Hao-Chun Chuang, National Chengchi University, 64 Sec 2 Zhinan Rd, Taipei, 11605, Taiwan, hchuang.om@gmail.com

1 - Consecutive Zero Sales and Retail Shelf Audits

Howard Hao-Chun Chuang, Assistant Professor, National Chengchi University, 64 Sec 2 Zhinan Rd, Dept. of MIS, Taipei, 11605, Taiwan, chuang@nccu.edu.tw

To tackle the prevalent shelf out-of-stock in retailing, we use consecutive zero sales as a signal and develop a cost-balancing policy for shelf audit decisions. We also relax the restrictive IID discrete demand assumption by incorporating integer-valued autoregressive processes into policy design. The proposed policy is point-of-sale data-driven and easy-to-implement.

2 - Order Release Planning by Iterative Linear Programming and Simulation: An Analytical Investigation of the Convergence Problems

Hubert Missbauer, Professor, University of Innsbruck, Universitaetsstrasse 15, Innsbruck, 6020, Austria, hubert.missbauer@uibk.ac.at

We deal with order release planning algorithms that allow time-varying lead times by iterating between a release model with fixed lead times and a simulation or queueing model that updates the lead times. These algorithms often do not convergence and thus do not provide a feasible solution. We present an analysis of the theory behind this iterative mechanism. We prove analytically that this coordination mechanism suffers from fundamental problems and it cannot be expected that it converges to the optimum. Resolving this problem does not seem to be straightforward.

3 - Value-added Service Investment Strategy of a Two-sided Platform with the Negative Intra-group Network Externality

Ping He, Zhejiang University, School of Management, 866 Yuhangtang Road, Hangzhou, 310058, China, phe@zju.edu.cn

Value-added service (VAS) are provided by many platforms to sellers to mitigate the seller's utility loss due to the negative intra-group network externality in the seller side. Considering the resource constraint on the VAS, we investigate the VAS investment strategy of a two-sided platform with negative intra-group network externality in the seller side. We find that the optimal VAS investment level is decreasing in the negative intra-group network externality. The VAS investment has positive or negative impact on the prices to two-sided users. Besides, if the intra-group network externality increases, the prices to two-sided users could increase or decrease.

4 - Energy Optimal Signal Control for Arterial Electric Vehicle Traffic

Guizhen Yu, Associate Professor, Beihang University, Beijing, 100191, China, yugz@buaa.edu.cn

With extensive investments in electric vehicles (EVs), EVs could gain significant market penetration in the near future. How to improve the energy efficiency for future electrified transport system, especially on signalized arterials, becomes an urgent concern. To tackle this issue, this paper develops an aggregate energy consumption model for EV flows at signalized intersections. Upon the aggregate model and a sinusoidal functional approximation of intersection queuing process, a rank-constrained semidefinite program (SDP) is formulated to minimize the overall electricity usage of EV traffic on a signalized arterial. A forward-backward approach is also developed to solve the SDP problem.

■ SD04

Queen's 4

Data Analytics and Modeling for Improving Healthcare

Sponsored: Health Applications

Sponsored Session

Chair: Shinyi Wu, Associate Professor, University of Southern California, 1150 S. Olive Street, Suite 1412, Los Angeles, CA, 90015, United States, shinyiwu@usc.edu

1 - Liver Waitlist Composition and Outcomes

Maria Mayorga, North Carolina State University, memayorg@ncsu.edu

Liver transplant is a surgical procedure which is a standard and sometimes the only therapy for end-stage liver disease. Despite the increasing number of transplants in US, demand exceeds supply, with the current waitlist size of about 15 thousand patients. We build a simulation model, informed by UNOS, to predict future liver transplant trends through 2025 which considers characteristics of current patients including demographic and clinical attributes. We predict future wait list size under different possible scenarios. In addition to time on the list, we examine patient survival outcomes by matching patients to donors.

2 - Chronic Kidney Disease Progression: A Simulation Model

Zlatana Nenova, University of Pittsburgh, Pittsburgh, PA, United States, zdn3@pitt.edu, Jerrold May

We have developed a simulation model, which predicts the one-year disease progression of a chronic kidney disease patient. We believe that accurate forecasts will be beneficial when making appointment decisions. Our model uses a case-based analysis method to forecast patient's disease progression. It tracks a number of patient lab values (eGFR, Albumin, Phosphate, and Potassium), vital signs (Systolic and Diastolic Blood Pressure and Weight), as well as disease comorbidities and complications (diabetes, heart failure, dialysis, PVD/CVD and cirrhosis).

3 - Developing Prediction Models to Improve Depression Detection among Patients with Diabetes

Shinyi Wu, Associate Professor, University of Southern California, 1150 South Olive Street, Suite 1400, Los Angeles, CA, 90015, United States, shinyiwu@usc.edu, Haomiao Jin

Clinical prediction has important application for stigmatized and under diagnosed conditions such as concurrent depression among diabetes patients. Three prediction models to assess current and future risk of depression in patients with diabetes are developed from data pooled from two multi-clinic safety-net diabetes-depression trials. Statistical learning methods are used to train and validate the models. Operational performance of a prediction model based approach that assigns depression screening and/or monitoring to diabetes patients who are at high current and/or future risk of depression is evaluated and compared to three alternative depression screening and monitoring policies.

■ SD05

Queen's 5

Healthcare Management Issues

Invited: Global Health

Invited Session

Chair: Hamed Mamani, Associate Professor, WU, Seattle, Seattle, WA, 98195-3226, United States, hmamani@uw.edu

Co-Chair: Elodie Adida (Goodman), School of Business Administration, Riverside, Riverside, CA, 0000, United States, elodie.goodman@ucr.edu

1 - Physician Dual Practice, Waiting Times and the Quality of Care

Dimitrios Andritsos, HEC Paris, andritsos@hec.fr, Vasiliki Kostami

Physician dual practice refers to the simultaneous practice of medicine by physicians in both public and private settings. In the presence of dual-practice, we are looking at the optimal proportion of time that physicians may be willing to invest in a private practice. How does that proportion depend on the physicians' objective? And how does this affect the severity of the patients that are treated in the public versus the private clinics?

2 - Bundled Payments Vs. Fee-for-Service: Impact of Payment Scheme on Performance

Shima Nassiri, University of Washington, Seattle, Seattle, WA, United States, shiman@uw.edu, Elodie Adida, Hamed Mamani

Healthcare reimbursements in the US have been traditionally based upon a fee-for-service (FFS) scheme, providing incentives for high volume of care, rather than efficient care. The new healthcare legislation tests new payment models that remove such incentives, such as the bundled payment (BP) system. The provider may reject patients based on the patient's cost profile, and selects the treatment intensity based on a risk-averse utility function. Our interest is in analyzing the effect of different payment schemes on outcomes such as the presence and extent of patient selection, the treatment intensity, the provider's utility and financial risk, and the total system payoff.

3 - Modeling the Information Propagation in Online Health Groups About E-cigarettes

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

Social media has become an important platform for Web users to discuss health related issues. In this research, we examined the spread of information related to the flavor of E-Cigarettes Facebook. We collected the data of Facebook users discussions in E-Cigarettes related public fans' pages, and model the relation between the occurrence of flavor related keywords in an article and the probability of this article being shared. We found that many flavor related keywords are significantly, either positively or negatively, indicating the popularity of different flavors in the community.

■ SD06

Queen's 6

Exploration in New Markets

Invited: Sharing Economy, Matching Markets, and Networks

Invited Session

Chair: Vahideh Manshadi, Yale University, 165 Whitney Ave, Rm 3473, Yale University, New Haven, CT, 06511, United States, vahideh.manshadi@yale.edu

1 - Mean Field Equilibria for Competitive Exploration

Krishnamurthy Iyer, Cornell University, kriyer@cornell.edu, Pu Yang, Peter Frazier

Inspired by crowdsourced transportation services and other location-based activities, we consider a model comprising of a group of nomadic agents and a set of locations each endowed with a dynamic stochastic resource process. Each agent derives a periodic reward based on the overall resource level at her location, and the number of other agents there. Each agent is free to move between locations, and at each time decides whether to stay at the same location or switch to another one. We study the equilibrium behavior of the agents as a function of dynamics of the stochastic resource process and the nature of resource sharing in the limit where the number of agents and locations increase proportionally.

2 - Crowdsourcing Exploration

Yiangos Papanastasiou, Berkeley Haas, Berkeley, CA, 94704, United States, yiangos@haas.berkeley.edu, Kostas Bimpikis, Nicos Savva

Motivated by the proliferation of platforms that collect and disseminate consumers' experiences with alternative products, we study the problem of optimal information provision when the goal is to maximize aggregate consumer surplus. We develop a decentralized multi-armed bandit framework where a forward-looking principal (the platform designer) commits upfront to a policy that dynamically discloses information on the history of outcomes to a series of short-lived rational agents (consumers). We show that optimal policies are characterized by information obfuscation, whereby the designer employs coarse information structures to induce exploration from the self-interested consumers.

3 - Secretary Problems with Non-uniform Arrival Order

Rad Niazadeh, Cornell University, rad@cs.cornell.edu

For many problems in the theory of online algorithms, the assumption that elements arrive in uniformly random order enables the design of algorithms with much better performance guarantees than under worst-case assumptions. The quintessential example of this phenomenon is the secretary problem. In many applications of online algorithms, it is reasonable to assume there is some randomness in the input sequence, but unreasonable to assume that the arrival ordering is uniformly random. This work initiates an investigation into relaxations of the random-ordering hypothesis, by focusing on the secretary problem and asking what performance guarantees one can prove under relaxed assumptions.

■ SD07

Kohala 1

Service Management with New Elements

Invited: Service Operations

Invited Session

Chair: Xin Geng, University of Miami, P.O. Box 248027, Coral Gables, Miami, FL, 33124-6520, United States, xgeng@bus.miami.edu

1 - Managing Workplace Flexibility: The Case of Agents with Task Preferences

Vasiliki Kostami, London Business School, vkostami@london.edu, Rouba Ibrahim

Flexibility in operations is beneficial in matching supply and demand in both the manufacturing and service industries. We study how the cross training of agents can be exploited in a way that is attractive to both the firm and the agents through an innovative scheme where both sides are decision makers in the task allocation. We compare two flexibility schemes against the traditional one where the task routing is a decision made by the firm. An agent is allowed to prioritize her preferred task, or work exclusively on it, in exchange for a fee. What the optimal fee is, when she will opt in for flexibility, and how the heterogeneity of the agents impacts the system are some of the questions that we answer in this work.

2 - A Study on the Relationship Between Industrial Service Offering and Supply Chain Integration

Weijiao Wang, Zhejiang University, Hangzhou, China, wangweijiao@zju.edu.cn, Yongyi Shou, Kee-hung Lai

Due to the increasingly fierce competition, growing number of manufacturing firms adopt servitization strategy to obtain competitive edge. While there are increasing conceptual developments in industrial services, empirical evidence on the impact of industrial services on supply chain remains scanty. This paper examines the impact of industrial service offering on supply chain integration with test data collected from the International Manufacturing Strategy Survey. The test results demonstrate that service offering has positive performance impact on supply chain integration, implying the value of servitization for enhancing supply chain integration in manufacturing operations.

3 - Uniform Pricing over Quality-differentiated Servers

Xin Geng, University of Miami, xgeng@bus.miami.edu

We study a pricing problem for a service firm facing delay-sensitive customers. Servers are quality-differentiated, where the quality can be improved based on servers' experience. The commonly used pricing scheme fails to effectively facilitate the low quality servers' improvement, and thus impedes the firm's future revenue increase. We propose another pricing scheme where the seller does not disclose the server assignment to the customers until payment is made. Comparing the two schemes based on long run revenue, we establish the superiority of the proposed one. Besides, we investigate how the revenue advantage is affected by the quality improvement process and the degree of differentiation.

■ SD08

Kohala 2

Operations/Marketing Interface

Contributed Session

Chair: Min Shi, California State University-LA, 5151 State University Drive, Department of Management, Los Angeles, CA, 90032, United States, mshi2@calstatela.edu

1 - Research of Service Modularity of Demand Oriented in the Catering

Mengsi Wang, Huazhong University of Science and Technology, Luoyu Road No.1037,Wuhan ,Hubei,China, Wuhan, China, wangms19901230@qq.com

The article explores service modularity based on supply chain environment, in which professional service providers are considered as decision-making maker. On the one hand, we regard downstream clients as the source of value creation, which SDL indicates the co-creation. On the other hand, we combine service aggregation and resources integration to achieve the goal of service value innovation. Considering the value, cost, correlation degree of activities and the capacity of the module, a mathematical model is established and a genetic algorithm is developed. Finally, we make catering industry as a calculation example to evaluate the effectiveness of this method.

2 - Strategic Analysis of Dual Sourcing under Yield Uncertainty in a Co-operatitive Supply Chain

Baozhuang Niu, Professor, South China University of Technology, School of Business Administration, South China University of Technology, 381,Wushan Road, Guangzhou, Guangdong, Guangzhou, China, bmniubz@scut.edu.cn

We consider a co-operatitive supply chain comprising an OEM and a competitive supplier. It is optional for the OEM to shift orders to a non-competitive supplier whose products have yield uncertainty. It is also optional for the competitive supplier to stop contracting with the OEM and focus on its self-branded business. We find that non-competitive supplier may not have incentives to eliminate its yield uncertainty. We also find that the competitive supplier's termination of component-selling is not credible.

3 - The Effect of Isomorphism and Learning on Market Performance of Global OEM Suppliers

Tianjiao Qiu, California State University Long Beach, 1250 Bellflower Boulevard, Long Beach, CA, 90840, United States, tianjiao.qiu@csulb.edu

Grounded in institutional theory, we establish a conceptual model to investigate how coercive isomorphism and normative isomorphism impact market performance of global original equipment manufacturer (OEM) suppliers through learning. We used structural equation technique to empirically test our model with survey data collected through 272 Chinese OEM suppliers. Our findings show that OEM supplier market and technological learning is significantly promoted when coercive formal and informal pressures and normative professionalization expectation from global buyers are high and enhanced learning by supplying contributes to better innovative and market performance of OEM suppliers.

4 - The Effects of Loyalty Program Devaluations on Firm Values

Min Shi, California State University-LA, 5151 State University Drive, Department of Management, Los Angeles, CA, 90032, United States, mshi2@calstatela.edu

Loyalty programs play a critical role in many service industries. In the past decades, many loyalty programs devalued the redemption rates in their award systems. This study examines the effects of loyalty program devaluation on firm values of airline and hotel industries. The results show that the announcements of loyalty program devaluation significantly undermined their firm values in competitive markets.

■ SD09

Kohala 3

Advances in Resource Allocation and Workload Prediction for Cloud Computing

Invited: Cloud Computing

Invited Session

Chair: Filippo Balestrieri, Hewlett Packard Labs, 1501 Page Mill Rd, Palo Alto, CA, 94304, United States, filippo.balestrieri@hpe.com

Co-Chair: Julie Ward, Hewlett Packard Labs, 1501 Page Mill Rd, Palo Alto, CA, 94304, United States, jward@hpe.com

1 - Improving Workload Prediction for the Cloud Via Clustering

I-Ling Yen, University of Texas at Dallas, ilyen@utdallas.edu

Effective resource management requires accurate workload prediction. Clouds may host many one-time jobs which may have bursty workloads and their predictions have to start with very little historical data. Existing prediction methods mainly consider long running jobs whose workloads show seasonality and trends and they do not work well for Cloud workloads. Generally, cloud providers maintain workload profiles for all jobs submitted in many years, which may be generalized to represent the workloads of new jobs. Based on this observation, we integrate clustering and ARIMA to improve the workload prediction for cloud jobs and experimental results show the effectiveness of our approach.

2 - Outcome-based Pricing of Cloud Services

Filippo Balestrieri, Hewlett Packard Labs, filippo.balestrieri@hpe.com, Julie Ward, Bernardo A. Huberman

Cloud services are sold today according to a resource-based model, in which customers pay per instance per unit time. New technologies for prediction of job requirements and completion times allow Cloud providers to consider new business models. We compare the performance of resource-based Cloud business model to a results-based mechanism, in which the provider offers a menu of completion times and prices to each customer for his specific job. We identify conditions under which one mechanism produces higher revenue for the provider than the other.

3 - Selling Guaranteed Completion Times on the Cloud

Andrew Li, MIT, aali@mit.edu

In today's cloud market, users execute their own jobs without a guarantee that deadlines will be met. Instead, providers can take control of job execution and charge for guaranteed completion times, but they face the joint challenges of dynamically pricing such contracts and scheduling jobs to fulfill these contracts. We address these challenges with a revenue management formulation, and apply a fluid approximation that is computationally efficient and optimal for large systems.

■ SD10

Kohala 4

Optimization

Contributed Session

Chair: Mona Hamid, University of Edinburgh, University of Edinburgh, Edinburgh, EH8 9JS, United Kingdom, M.hamid-2@sms.ed.ac.uk

1 - Stochastic Alternating Linearization

Kaicheng Wu, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08817, United States, kw345@rutgers.edu

Recent years have seen tremendous growth of large-scale optimization problems arising in statistics and machine learning related areas. The alternating linearization method (ALIN) is well suited in this setting with its versatility of solving different problems. Pre-conditioning is an effective method in dealing with ill-conditioned problems. We develop a stochastic ALIN framework using a specialized pre-conditioning technique in solving structured regularization problems. We present numerical results for several large-scale real data examples, which illustrate the scalability and efficacy of the method.

2 - Generalized Clusterwise Regression for Pavement Management

Alexander Paz, University of Nevada, 4505 Maryland Parkway, PO Box 454015, Las Vegas, NV, 89154, United States, apaz@unlv.edu

Pavement performance models are a critical component of any Pavement Management System. Although developing a model for each pavement segment is desirable, it is not feasible because of: (i) insufficient pavement condition data, (ii) high development costs, (iii) impractical to maintain a system including thousands of models. In order to avoid pre-specifying explanatory variables and the number of required cluster, this study proposes a generalized Cluster wise Regression model for the simultaneous determination of the significant variables, the assignment of segments into clusters, and the determination of the optimal number of clusters required to minimize the estimation error.

3 - A Pit Design Algorithm for a Mining Process Plan

Ramana Anandakumar, Clemson University, 520B Daniel Drive, Clemson, SC, 29631, United States, ramanawando@gmail.com

The optimization of an open pit mining process has very few well known solutions that include the famous Lerchs-Grossman algorithm. This paper focuses on the application of distance based clustering and geometrical optimization to design the minable area and sequence the minable blocks to be mined. The complexities involved in the problem are the mining angle, bench width, minimum operating width and length of the pit, the ratio of waste material present in the ore, and the reachability of the mining equipment inside the mining area. The proposed algorithm consists of three stages: clustering of the usable blocks; designing of mining cones; and construction of the optimal sequence of minable blocks.

4 - A Hyperheuristic for Optimizing the Parameters of Dual Local Search with Application in Routing

Mona Hamid, PhD, University of Edinburgh, office 3.2, University of Edinburgh Business, 29 Buccleuch Place, Edinburgh, EH8 9JS, United Kingdom, M.hamid-2@sms.ed.ac.uk

Combinatorial optimization problems have been at the origin of the design of many optimal and heuristic solution frameworks such as branch-and-bound algorithms, branch-and-cut algorithms, classical local search methods, metaheuristics, and hyperheuristics. In this paper, we propose a hyperheuristic to optimize the parameters of a generic and parametrised dual local search algorithm. We empirically assess the performance of the proposed framework using instances from the TSPLIB. Empirical results suggest that the proposed framework delivers outstanding performance.

■ SD11

Kona 1

Manufacturing Systems and Process Engineering

Contributed Session

Chair: Freimut Bodendorf, University of Erlangen-Nuremberg, University of Erlangen-Nuremberg, Nuremberg, 90403, Germany, freimut.bodendorf@fau.de

1 - Multi-row Based Heuristic Combined Genetic Algorithm Approach for Job-shop Layout Optimization in Industry 4.0

Jihong Yan, Professor, Harbin Institute of Technology, No.92 West Da-Zhi St., Nan Gang Dist., Harbin, 150001, China, jyan@hit.edu.cn

Targeting on personalized customization service in Industry 4.0 era, this paper proposed a multi-row job shop layout optimization approach by maximizing the sum of comprehensive relationship of operating units instead of traditionally depending on the specific data of logistics capacity. The job shop layout is optimized by systematic layout planning and GA. Influences of two scenarios such as spacing between adjacent operating units in the same row and the clustering of close operating units are discussed. Comparison of differences between personalized customization and logistics capacity based production is given. This work provides valuable guidance for job shop layout in Industry 4.0 era.

2 - A Customer Satisfaction Model: A Tool for Quality Product Improvement

Marvin Gonzalez, College of Charleston, 6 Liberty Street, Charleston, SC, 29424, United States, gonzalezm@cofc.edu

Any technique or approach used to develop systematic procedures for the improvement of quality in an industry must satisfy certain problem solving criteria. First, it must be able to identify the most important variables that impact the manufacturing process. Secondly, it must be able to link and establish relationships among the variables through dynamic analysis using experimental design results as a basis. This paper shows the different analytical steps that arise naturally in the systematic selection of variables that have an influence on the final quality of the product in a typical manufacturing process.

3 - Adaptive Process Modeling for Agile Groupwork

Freimut Bodendorf, Professor, University of Erlangen-Nuremberg, Lange Gasse 20, Nuremberg, 90403, Germany, freimut.bodendorf@fau.de

Traditional process models follow a top-down approach pre-defining tasks and control flows. Today, processes and projects are often characterized by knowledge work with unpredictable and unstructured flows of events and activities as well as changing contexts like persons involved. A modeling technique is introduced that supports process management in highly flexible teams. These processes are weakly structured and partially unpredictable. Management systems need to be based on adaptive models, coping with fuzzy and changing situations. The technique provides "living process blueprints". Following a bottom-up approach it constantly adapts the model to flexible groupwork environments.

4 - The Effect of Online Consumer Reviews on Retail Sales in View of Anchoring Effect – An Empirical Investigation of the Movie Industry

Shiyi Wang, Huazhong University of Science and Technology, Wuhan, 430074, China, 843037639@qq.com

There are controversial voices of whether the WOM valence, namely the persuasive effect, has an impact on retail sales. A unique view is brought up that it is the valence of the first several reviews instead of the average valence of all reviews in online review systems that positively influences consumers' purchase decisions resulting in affecting retail sales because of the existence of anchoring effect, verified by a cross-sectional data of 195 films from Douban, one of the most popular third party review websites in China. Thus, it's important for marketers to pay more attention to improving the first several reviews.

■ SD12

Kona 2

Applications in Scheduling and Project Management

Invited: Scheduling and Project Management

Invited Session

Chair: Rodrigo A. Carrasco, Assistant Professor, Universidad Adolfo Ibañez, Diagonal Las Torres 2640, Of. 537 Edificio C, Santiago, 7941169, Chile, rax@uai.cl

1 - Capacity Allocation of Operating Rooms under Waiting Time Constraints: the Chilean AUGE Program

Susana Mondschein, Universidad Adolfo Ibanez, susana.mondschein@uai.cl

In 2000, Chile introduced a profound Health Reform aiming at a more equitable and fair system. Among other things, it sets a maximum waiting time between diagnosis and treatment for some diseases. If time is exceeded, the patient is treated in the private health system, with the corresponding higher expenses. This creates an important scheduling problem for the hospital. With the collaboration of the Instituto de Neurocirugía, we developed a mathematical model to schedule surgeries in order to minimize the cost of referrals to the private sector.

2 - Robust Cyclical Scheduling with Sequence Dependent Setup Times: The Case of Wine Bottling Lines

Alejandro Francisco Mac Cawley, Assistant Professor, Pontificia Universidad Catolica de Chile, Vicuna Mackenna 4860, Santiago, Chile, amac@ing.puc.cl, Benjamin Bstidas

Cyclical scheduling with sequence dependent setup times for single machine problems have been previously modeled using a traveling salesman problem (TSP) approach. We expand this approach to a multiple machine problem and add variability to the setup times. This problem arises in the scheduling of wine bottling lines where cyclical schedules are desirable and there is significant variability in the setup times. We obtain an efficient frontier of robust solutions that render the minimum variability (variance) for two different scheduling metrics: make span and total completion time. Preliminary results indicate that significant benefits arise from using this type of approach.

3 - Approximation Algorithm for Job Shop Scheduling in a Production Process

Rodrigo A. Carrasco, Universidad Adolfo Ibañez, rodrigo.carrasco@gmail.com

In this work we use alpha-point scheduling techniques to compute approximate solutions for a general family of scheduling problems in a job shop setting: each production order (PO) has several jobs, with precedence constraints between them, and the goal is to compute a schedule that minimizes the sum of the makespan of all the POs. Our numerical experiments, on a real job shop setting, show that the approximation ratio is small even when resource constraints are added.

4 - Scheduling Maintenance Operations at a Wind Farm

Rajesh Tyagi, Principal Scientist, Operations Research, GE Global Research Center, 1 Research Circle, Niskayuna, NY, 12309, United States, rajeshtyagi@yahoo.com

GE Renewable Energy, a major producer of wind turbines, also sells service agreements to guarantee their operating availability. These agreements apply to the whole wind farm which, in the US, typically have anywhere from 5 to 200 wind turbines, each producing 1 to 2.5 MWh of clean electricity. To efficiently maintain these turbines, GE has implemented a daily planning system to schedule planned and unplanned maintenance at these farms. The system determines which tasks across all wind turbines at a site should be performed that day, and then assigns them to crews in the form of a schedule. The underlying algorithm is a multi-criteria optimization problem.

■ SD13

Kona 3

Stochastic Planning in Energy

Invited: Energy Systems

Invited Session

Chair: Javad Lavaei, University of California, Berkeley, 4141 Etcheverry Hall, Berkeley, CA, 94720, United States, lavaei@ee.columbia.edu

1 - Smart Operation Management in Office Spaces based on Human Behavior and Adaptive Control

Ali Ghofrani, Rutgers University, 96 Frelinghuysen Rd. CoRE,, Room 528, Piscataway, NJ, 08854, United States, A.Ghofrani@Rutgers.edu, Khashayar Mahani

This study presents an adaptive and smart control approach based on occupant behavior and the thermal characteristics of an office building. In this approach, we take into account all the physical and thermal features of the building along with adaptive forecast models to investigate energy saving opportunities and optimal building operation plans in thermal zones to satisfy user comfort level. This control system is capable of participating in demand response and demand side management programs. The physical analysis of the thermal behavior of the building makes the control system more reliable, accurate, and optimal. This can be also extended to other types of buildings.

2 - Demand Response for Large Consumers

Golbon Zakeri, University of Auckland, g.zakeri@auckland.ac.nz, Anthony Downward, Mahbubeh Habibian

We will present models for demand response of a price taker and price maker large consumer of electricity in an electricity market where energy and reserve are co-optimized. We will make the observation that in the price taker case, the competitive equilibrium corresponds to a system co-optimization of energy and reserve. In the imperfectly competitive case, we will present a bilevel optimization problem for the consumer optimal behaviour.

3 - Parallel Computing of Large-scale Stochastic Programs with Application To Energy System Capacity Expansion
Andrew Lu Liu, Purdue University, andrewliu@purdue.edu, Run Chen

Power grids' planning and operations exhibit extreme multiscale, ranging from hourly operation to decades of planning. The linkage between decisions at different time scales may be relaxed to produce multiple independent subproblems. We propose a new algorithm that combines the dual ascend and block coordinate descend algorithm to realize parallel computing of large-scale problems, which is more flexible in dealing with coupled constrains than the popular ADMM algorithm. Convergence of the embedded algorithm for convex problems will be shown, along with preliminary numerical results.

■ SD14

Kona 4

Robust Optimization in Healthcare

Sponsored: Health Applications

Sponsored Session

Chair: Omid Nohadani, Northwestern University, Evanston, IL, United States, nohadani@northwestern.edu

1 - Radiation Therapy Planning with Uncertain Tumor Geometry
Omid Nohadani, Northwestern University, nohadani@northwestern.edu

Recently, robust optimization methods have been extended to multi-stage settings with fixed uncertainties. However, in many real-world applications, uncertainties evolve over time, rendering the robust solutions suboptimal. In radiation therapy, changes in cell oxygenation directly affect the response to radiation. We provide a general robust optimization framework that incorporates time-dependent uncertainty sets in a tractable fashion. For a clinical prostate cancer case, the approach improves tumor control and spares critical organs. This approach is general and can be applied to a broad range of applications.

2 - Robust Wait Time Estimation in Resource Allocation Systems with an Application to Kidney Allocation
Phebe Vayanos, University of Southern California, Office OHE 310L, Los Angeles, CA, 90033, United States, phebe.vayanos@usc.edu, Chaithanya Bandi, Nikolaos Trichakis

We consider the problem of estimating candidate wait times in systems that allocate scarce heterogeneous resources based on predetermined priority rules. Candidates have heterogeneous preferences and incomplete information. We model the system as a multiclass multiserver queuing system and propose a novel robust optimization solution approach. We apply our method to develop a wait time estimation tool for patients in the US kidney waitlist based on their preferences and characteristics. We calibrate our model using historical data and obtain out-of-sample errors averaging less than 8%.

3 - Robust and Reliable Emergency Medical Services Network Design under Demand Uncertainty
Chun Peng, Beijing Institute of Technology, pengchun12.18@163.com

This paper addresses an efficient constrained quadratic mixed integer programming for a robust and reliable emergency medical services (EMS) network design problem, in which we consider simultaneously uncertain demand and chanced-constraint. We employ two different sources of uncertainty, symmetric and asymmetric uncertainty, then put forward a chanced-constraint to guarantee the desired service level of EMS. Moreover, we introduce price of robustness and safety parameter to trade off the conservativeness and optimality of the model under unforeseen environment. Managerial insights on the optimal deployment of EMS facilities are drawn.

4 - Robust and Reliable Emergency Medical Services Network Design under Demand Uncertainty
Chun Peng, PhD candidate, Beijing Institute of Technology, 5 southstreet Zhongguancun, Haidian District, Beijing, 100081, China, pengchun12.18@163.com

This paper addresses an efficient constrained quadratic mixed integer programming for a robust and reliable emergency medical services (EMS) network design problem, in which we consider simultaneously uncertain demand and chanced-constraint. We employ two different sources of uncertainty, symmetric and asymmetric uncertainty, then put forward a chanced-constraint to guarantee the desired service level of EMS. Moreover, we introduce price of robustness and safety parameter to trade off the conservativeness and optimality of the model under unforeseen environment. Managerial insights on the optimal deployment of EMS facilities are drawn.

■ SD15

Kona 5

Topics in Inventory Management

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Sandun Perera, Assistant Professor, School of Management, University of Michigan-Flint, 303 E. Kearsley Street, Flint, MI, 48502, United States, sperera@umich.edu

1 - Competitive Pricing with Stockouts and Satisficing Customers
Varun Gupta, Penn State Erie, The Behrend College, vxg15@psu.edu

Stockouts for high inventory turnover products lead to loss of sales as customers may substitute their preferred product (stocked out) with another product (available). We study single period equilibrium prices for competing retailers selling to satisficing customers with stockout-based substitution under lost sales and backorders.

2 - Integrality in Stochastic Inventory Models
Wei Chen, University of Kansas, Lawrence, KS, 66049, United States, wei.chen@ku.edu, Milind Dawande, Ganesh Janakiraman

We study several finite-horizon, discrete-time, dynamic stochastic inventory control models with integer demands and starting inventory levels. Equivalent linear programs are formulated for the corresponding stochastic dynamic programs, and integrality results are derived based on the total unimodularity of the constraint matrices. A second approach based on multi-dimensional piecewise linearity of the cost-to-go functions to establish integrality is also presented.

3 - Optimality of (s,S) Policies in EOQ Models with General Cost Structures
Sandun Perera, School of Management, The University of Michigan-Flint, sperera@umich.edu, Ganesh Janakiraman, Shun-Chen Niu

We show that an (s,S) policy is optimal under minimal assumptions on the ordering and holding/backorder cost. Our work lends theoretical credibility to the practice of using (s,S) policies for virtually any cost structure of practical interest. This result holds whenever an optimal solution exists for the problem of minimizing the long-run average cost within the class of (s,S) policies. Our proof is constructive and elementary, in the sense that it is based on first principles that do not rely on advanced mathematical machinery. We also prove that an optimal policy, not necessarily of the (s,S) type, always exists under our cost assumptions even when the above-mentioned existence does not hold.

4 - Optimality of (s,S) Policies under Poisson Demand and General Cost Structures
Sandun Perera, School of Management, The University of Michigan-Flint, sperera@umich.edu, Ganesh Janakiraman, Shun-Chen Niu

We study a single-stage, continuous review inventory model where demands arrive according to a Poisson process and show that an (s,S) policy is optimal under minimal assumptions on the ordering/procurement and holding/backorder cost functions. Our proof is based on a lower-bounding argument. While there is a large literature on (s,S) optimality in stochastic inventory theory, our method of proof is distinct in that it requires minimal mathematical machinery.

■ SD16

Waikoloa 1

Optimization and Customer Analytics

Invited: Empirical Studies in Operations

Invited Session

Chair: Eric Schwartz, University of Michigan, 701 Tappan St, R5472, Ann Arbor, MI, 48103, United States, ericmsch@umich.edu

1 - Are Patients Patient? The Role of Choice in Smoothing Demand for Emergency Services
K.C. Diwas, Emory University, diwas.kc@emory.edu

We study a natural policy experiment - the Massachusetts healthcare reform law - to examine whether universal healthcare has the effect of redistributing emergency department (ED) demand across hospitals. Specifically, we assemble a novel data set that enables us to track the ED visit behavior of previously uninsured patients over time. The data set allows us to examine whether obtaining insurance (as stipulated by the policy's individual mandate) leads these newly insured patients to alter their choice of ED. We find that a lack of insurance locks in individual patients to specific hospitals, as evidenced by the fact that many newly insured patients choose to switch hospitals post-policy. We next develop an econometric model of patient choice to characterize the drivers of ED volume redistribution. We find that safety-net hospitals (which have historically catered to the uninsured) lose market share of these newly insured patients. Finally, we explore the welfare consequences of the policy. We find that the

newly insured patients who switch to a different hospital experience an improvement in welfare as measured by a relative decrease in their ED length of stay and travel distance. Our findings have significant implications for patients, hospitals, payers and policy makers.

2 - Constrained Assortment Optimization under the Markov Chain Model

Vineet Goyal, Columbia University, vgoyal@ieor.columbia.edu, Antoine Desir, Danny Segev, Chun Ye

We consider a Markov chain choice model introduced in Blanchet et al. (2013) where substitutions are modeled as state transitions in a Markov chain. This model provides a simultaneous approximation for all random utility based discrete choice models. We show that assortment optimization under this model can be solved efficiently. We give an iterative algorithm based on a "local-ratio" framework that computes an optimal for the unconstrained problem and an approximation for the capacity constrained versions. The local-ratio framework allows us to linearize a non-linear revenue function and also provide interesting insights for the assortment optimization problem over other choice models.

3 - Dynamic Robust Pricing with Multi-armed Bandits

Eric Schwartz, University of Michigan, ericmsch@umich.edu

We consider the pricing decision for a firm launching a new product with incomplete demand information. We propose a dynamic price experimentation policy where the firm aims to maximize long run profits without strong parametric assumptions. Our paper builds on the non-parametric multi-arm bandit literature. We extend Upper Confidence Bound algorithms to incorporate economic theory and partially identified econometric approaches in marketing. We show theoretical guarantees as well as improved empirical performance for a range of distributions of customer heterogeneity.

4 - Increasing Sales by Managing Congestion in Self-Service Environments

Vinayak Deshpande, University of North Carolina, Chapel Hill, Chapel Hill, NC, 27599, United States, Vinayak_Deshpande@kenan-flagler.unc.edu, Hyun Seok Lee, Saravanan Kesavan

Managing congestion in a self-service environment such as fitting rooms in apparel retailers is vital as retailers increasingly rely on their customers to perform many tasks independently. In this paper, we examine the impact of customer-induced congestion, defined as additional congestion driven by strategic customer behavior that imposes the negative externalities on other customers during congested periods, in fitting rooms on the store performance for a retailer. We find evidence that customers change their behavior in a way that induces the negative externalities on other customers through an increase in (1) waiting time and (2) phantom stockout. Finally, we use two field experiments at both retailers A and B to show that labor intervention is effective strategy to mitigate the negative effect of congestion: increasing fitting room labor by one person increases sales per hour by 17.7% - 19.02%.

■ SD17

Waikoloa 2

Innovations in Pricing and Revenue Management

Sponsored: Revenue Management and Pricing Section

Sponsored Session

Chair: Katherine Ashley, University of California-Berkeley, Berkeley, CA, United States, kate_ashley@haas.berkeley.edu

1 - Service Pricing with Loss Averse Customers

Liu Yang, Tsinghua University, yangliu@sem.tsinghua.edu.cn, Pengfei Guo, Yulan Wang

We consider a service system in which customers are loss averse towards both price and delay attributes. We first study customers' equilibrium queueing strategies. In contrast to the traditional case without loss aversion, there could exist three equilibrium strategies, among which one is preferred in terms that customers' utility is highest at this equilibrium.We then study the optimal pricing problem for a monopoly server. We show that loss aversion polarizes queues, making long queues even longer and short queues even shorter. Furthermore, loss aversion towards the delay attribute drives down the optimal price whereas loss aversion towards the price attribute pushes up the optimal price.

2 - Learning Customer Valuations From Bundle Prices

Will Ma, Massachusetts Institute of Technology, Cambridge, MA, United States, willma@mit.edu, David Simchi-Levi

Bundling has been widely studied in the literature as a form of price discrimination. We show that it can also be used as a form of price experimentation - a mixed bundling scheme allows the firm to quickly learn the customer valuation distributions without having to change any prices. We present an iterative algorithm to reverse-engineer the valuations based on bundle sales, with theoretical convergence guarantees for Uniform distributions. For other two-parameter families of distributions, our extensive numerical experiments demonstrate that optimizing over the learned parameters still extracts close to 100% of the optimal profit obtainable had we known the exact parameters.

3 - When Pricing and Revenue Optimization Fails to Deliver Profits

Peter C Bell, Ivey Business School at Western University, Canada, pbell@ivey.uwo.ca

Revenue managers often focus on price changes in an attempt to increase revenues but these may not increase profits. This presentation uses a real case example to illustrate how these results arise and reviews some analytical results that suggest when the goals of revenue managers and profit maximizers will be aligned.

4 - Pricing Reservations for Service: An Analysis of No-show Fees and Consumer Behavior

Katherine Ashley, University of California-Berkeley, kate_ashley@haas.berkeley.edu, Pnina Feldman

Many firms allow customers to make reservations for service at a specified time in the future. Reservations provide value to customers, and are costly for firms to offer. We show that implementing a no-show fee, payable only if a reservation-holder fails to show up for service, can make both customers and firms better off relative to free reservation policies.

■ SD18

Waikoloa 3

Applications of Data Management

Contributed Session

Chair: Skarleth Carrales, sms.ed, 29 Buccleuch Pl, Edinburgh, Lothian, EH8 9JS, United Kingdom, s1471551@sms.ed.ac.uk

1 - DEA as a Benchmarking Tool in the Television Industry

Vassilis Dedoussis, Professor, University of Piraeus, 80 Karaoli & Dimitriou Street, Piraeus, 18534, Greece, vdedo@unipi.gr

This paper presents a case study of how Data Envelopment Analysis (DEA) was applied in order to examine how the characteristics of a television, alongside the resources which are used for its production, contribute towards sales success. Various worldwide brands and types of televisions were used as Decision Making Units (DMUs). In our proposed model we consider as inputs, human, tangible and intangible resources and as outputs various characteristics of a television like display size, resolution, refresh rate, viewing angle, power consumption etc. We then compare the efficiency of each DMU with the actual sales of each one of this. This approach may be used as a benchmarking for sales success.

2 - Dynamics of Scale Efficiency of Indian Banks a Deterministic Frontier Approach

Keyur Thaker, Dr, Indian Institute of Management Indore, Rau Pithampur Raod, Indore, 453556, India, thakerkeyur@yahoo.com

We use DEA to estimate scale efficiency of Indian banks during 2008-2012. Results show considerable variation in scale efficiency across various ownership groups of Indian banking system. Public and private banks demonstrate higher efficiency than foreign banks. We find higher efficiency in small public, private and foreign banks than their larger counterparts. The trend of scale efficiency during 2008-2012 across the public, private and foreign banks indicate low heterogeneity in efficiency of public and private banks after 2008, whereas we find higher heterogeneity in foreign banks across the study period 2008-2012.

3 - Profit Analysis: Too Big to Fail? Or too Blind to See?

Zachary Ross, Graduate student in Accounting, Western Kentucky University, Bowling Green, KY, United States, zachary.ross067@topper.wku.edu

This research uses Credit Data. We approach this study from the cost vs. profit perspective. Our assumption is that a correct decision means that a bank will predict that a customer's credit scoring is in a good standing; and therefore would obtain the loan. The selected model (champion model) depends largely on the measurement used to make the decision. Mainly, the selection will be based on the Average Profit. The data mining application will select and report rank order measures at each population depth that is appropriate for the business case. Finally, we will compare the result obtained from using data mining models with the actual lose being reported using the profit matrix.

4 - Assessment of Risk Profiles of Banks: DEA

Skarleth Carrales, PhD Student, University of Edinburgh, 29 Buccleuch Pl, Edinburgh, EH8 9JS, United Kingdom, s1471551@sms.ed.ac.uk

The banking sector plays a crucial socio-economic role at the regional, national and international levels. In fact, banks are at the heart of financial systems because of the role they play as financial intermediaries, and the efficient allocation of financial resources in an economy. Because of the crucial importance of banking systems to the economy and the financial risks they face, banks' performance and risk profiles are continuously monitored by a range of stakeholders. In this paper, we propose a DEA-based framework for assessing the risk profile of banks. The performance of the proposed modelling and analysis framework is assessed using a sample of UK banks.

Monday, 8:00am - 9:30am

■ MA01

King's 1

Decision Analysis Arcade

Sponsored: Decision Analysis

Sponsored Session

Chair: Vicki Bier, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States, bier@engr.wisc.edu

1 - Public Health Preparedness – Choice Among Alternative Medications

Anke Richter, Naval Postgraduate School, arichter@nps.edu

The recent outbreaks of two new viruses have generated renewed interest in the threat of pandemics. For a significant portion of the total fatalities associated with these infections the cause of death was due to an over-reaction of an infected body's immune system. This research explores possible pharmaceutical interventions to expand the options public health could employ in a response. For inclusion in state stockpiles, medications must meet three specific criteria: medical efficacy, cost, and logistical considerations. A basic analysis shows cost as the most limiting factor. To move beyond this analysis, a multi-attribute assessment is needed, which requires an ultimate decision maker.

2 - Maintenance Scheduling Optimization based on Reliability and Prognostics Information

Jian Guo, Western New England University, jian.guo@wne.edu

Maintaining a large fleet of aircraft can be very challenging due to the variety of aircraft models, ages, and operating environments. Usually, the maintenance activities are implemented in a few centered facilities with different levels of maintenance capabilities. This paper is to propose innovative condition-based maintenance scheduling methodologies by integrating complex data processing, feature extraction, prognostic algorithm, and maintenance scheduling optimization. The proposed framework of prognostic-based maintenance scheduling is able to provide tradeoff analysis in terms of key performance metrics such as command possession rate, cost, and capacity expansion. The optimized maintenance schedule based on fleet health status will lead to higher aircraft availability, lower unscheduled maintenance cost, and meeting the continuous improvement initiatives such as the transitioning from PDM-based maintenance to High Velocity Maintenance (HVM) paradigm. The research outcomes will lead to more predictable and efficient maintenance scheduling capability. A numerical example shows how the aircraft reliability and health information can be integrated into the maintenance scheduling and planning optimization.

3 - The Role of Social Networks in Decision Analysis

Ali Abbas, University of Southern California, aliabbas@price.usc.edu

With the rise of the near ubiquitous nature of social media, untapped information is now available to address many types of decisions at a depth that was not previously possible. This talk will discuss the use of social networks in bringing decision skills to the masses and in helping trained analysts make better decisions.

■ MA02

King's 2

Future Research Directions and Funding Opportunities for Homeland Security and Disaster Management

Invited: Contributed

Invited Session

1 - Future Research Directions and Funding Opportunities for Homeland Security and Disaster Management

Jun Zhuang, University at Buffalo, SUNY, jzhuang@buffalo.edu

Society is faced with a growing amount of property damage and casualties from man-made and natural disasters. This panel will talk about future research directions, and funding opportunities for homeland security and disaster management.

2 - Understanding and Mitigating the Impacts of Massive Relocations From Disasters

Vicki Bier, University of Wisconsin, bier@engr.wisc.edu

3 - Future Research Directions and Funding Opportunities for Homeland Security and Disaster Management – An Nsf Perspective

Elise D Miller-Hooks, University of Maryland, elisemh@umd.edu

4 - Future Research Directions and FundingOpportunities for Homeland Security and Disaster Management

Amy Kircher, Food Protection and Defense Institute, University of Minnesota, St. Paul, MN, 55108, United States, akircher@umn.edu

■ MA03

King's 3

Behavioral Operations and Marketing or Cost

Sponsored: Behavioral Operations Management

Sponsored Session

Chair: Anton Ovchinnikov, Queen's School of Business, 143 Union Street, Kingston, ON, K7L 3N6, Canada, ao37@queensu.ca

1 - Anticipating Digital Disruption: How Multi-Order Dynamic Capabilities Effect Organizations' Degree of Digitization under the Moderation of Environmental Turbulence

Hans-Martin Vetter, Research assistent, Ph.D. candidate, TU Dortmund, Vogelpothsweg 87, Dortmund, 44221, Germany, hans-martin.vetter@udo.edu

Digitization is recognized as both, a disruptive force and a strong driver of new product performance. Still, associated research on how to sustain a competitive advantage is scarce. With its disruptive turbulence digitization challenges organizations' dynamic capabilities holding the potential to alter its resources. Applying our newly developed digitization scale and a set of multi-order capabilities we analyze primary data of 617 organizations across 3 continents. Results show that only at high turbulence it is about the firm's self-improvement routines to differentiate on both, digitization and new product development.

2 - Marketing Durable Goods to Consumers with Behavioral Biases

Guangrui Ma, CoME, Tianjin University, Building 25, CoME, Tianjin University No. 92, Nankai District, Tianjin, 300072, China., Tian Jin, China, guangrui.ma@tju.edu.cn

Consumers make purchasing decisions of durable goods, such as automobiles, based on there expectation of future usage patterns. However, miscalibration of their future consumption pattern are quite common. Firm has to adjust its marketing strategy to those consumer behavior biases. In this paper, we analyze how consumers' behavior biases, i.e., overconfidence or underconfidence on their usage patterns change firm's business model decision (selling or leasing) and channel selection (direct or indirect).

3 - Contracting with Learning Worker

Sundara Natarajan Panchanatham, Master's Student and Research Scholar, Indian Institute of Technology - Madras, Sardar Patel Road, Adyar, Chennai, 600036, India, sundarnpanch@gmail.com

In manufacturing setups, a finite work is to be completed by a deadline and workers allot their leisure time based on their cost sensitivity. Existing models for wage design focus only on procrastinating workers with known cost sensitivity in a single contract. We propose a multi-contract model that captures the learning, planning and manipulative efforts using cost of quality and updates the cost sensitivity parameter at every contract. The model portrays delay as a healthy trait in situations where work quality is better than the initial prediction from worker's type. Our work also explores temporal changes to cost sensitivity for gains. Key Words: Positive Procrastination, Behavioral Operations

4 - When to Hire the First Employee? Behavioral Evidence and Insights

Anton Ovchinnikov, Queen's School of Business, 143 Union Street, Kingston, ON, K7L 3N6, Canada, ao37@queensu.ca

Effectively any entrepreneur shifts from doing all the work him/herself to hiring someone to do part of that work. We use an analytical model and behavioral experiments to study when entrepreneurs should and do hire their first employee. Understanding both the optimal timing/conditions of hiring and the deviations of the hiring patterns from optima have the potential to provide insights to a very broad spectrum of entrepreneurs at the critical early stage of their new venture formation process.

■ MA04

Queen's 4

Adaptive Monitoring and Intervention Design

Invited: OR in Medicine

Invited Session

Chair: Shan Liu, Assistant Professor, University of Washington, Box 352650, Seattle, WA, 98195, United States, liushan@uw.edu

1 - Data-driven Modeling and Simulation for the Design and Evaluation of Hiv Viral Load Monitoring Policies in Resource-limited Settings

Diana M Negoescu, Assistant Professor, University of Minnesota, Minneapolis, MN, United States, negoescu@umn.edu, Vaclav Cvicek, Heiner C Bucher, Eran Bendavid

Viral load (VL) testing is the most critical monitoring tool for assessing the effectiveness of treatment in HIV patients. The optimal frequency of VL monitoring remains unknown, despite it being the costliest routine monitoring tool for HIV in Sub-Saharan Africa. We formulate a model parameterized using person-level longitudinal data to simulate adherence behavior and disease dynamics over time, and to develop monitoring schedules that adapt to patient characteristics. We then evaluate the total costs and quality-adjusted life years achieved by monitoring VL at fixed intervals (status quo), as well as at variable intervals based on an individualized risk assessment of virologic failure.

2 - Adaptive Monitoring with Selective Sensing in Depression Treatment Population

Shan Liu, Assistant Professor, University of Washington, Seattle, WA, United States, liushan@uw.edu, Ying Lin, Shuai Huang

30 million Americans use antidepressant medications. Inadequate follow-up monitoring is identified as a major shortcoming in depression treatment. Development of personalized health surveillance is enabled by sensing and electronic health record. We design a decision support algorithm to create patient-specific adaptive monitoring schedules and dynamically identify patients with the highest risk of major depression in a treatment population. The algorithm integrates Markov chain modeling, prognosis, and optimization, which enables monitoring of a large number of individuals by exploiting the similarities of their disease trajectories under limited sensing resources.

3 - Analyzing Health and Cost Impacts for Pediatric Asthma

Pinar Keskinocak, Georgia Institute of Technology, pinar@isye.gatech.edu

Pediatric asthma is one of the 6 priority conditions identified by the CDC for targeted policy interventions including improved access and adherence for medications, self-management education for individuals without well-controlled asthma, and access to home visits for individuals whose asthma is not controlled under the other interventions. In this project, we analyze claims data for children on Medicaid in multiple states to determine which interventions are most appropriate for children with different characteristics with the goal of reducing emergency room visits and hospitalizations. Targeting rules are identified and implications are discussed.

■ MA05

Queen's 5

Effective and Secure Healthcare Management

Invited: Global Health

Invited Session

Chair: Juhee Kwon, City University of Hong Kong, Kowloon, H.K., 0000, Hong Kong, juhee.kwon@cityu.edu.hk

1 - A Personalized Approach for Identifying Drugs with Adverse Reactions

YoungOk Kwon, Sookmyung Women's University, yokwon@sookmyung.ac.kr

Adverse drug reactions (ADRs) are associated with high health and financial costs and have been prevalent as there are more elderly patients who tend to take more drugs over longer periods. Thus, it becomes a challenging task for physicians to identify drugs that can cause a specific adverse reaction. In this study, we propose a new approach to helping physicians respond to ADRs more efficiently by recommending the most likely causative drugs that are personalized for each patient, based on historical ADRs and outcome data as well as patient information. Two representative cases are illustrated to demonstrate the promise of the proposed approach.

2 - A Simulation Optimization of Patient Flow on the Hierarchical Healthcare Delivery System

Jie Song, Peking University, jie.song@pku.edu.cn, Yunzhe Qiu, Su Wu

The mismatching patient flow distribution in the healthcare system in urban China is a great social issue. We propose a simulation-based optimisation method using the Multi-fidelity Optimisation with Ordinal Transformation and Optimal Sampling (MO2TOS) algorithm to evaluate the patient flow distribution, so as to continuously improve the hierarchical healthcare service system. A comparison with other simulation optimisation methods sustains the efficacy of the MO2TOS with the evidence that acquiring effective information from the low-fidelity model indeed assists to retrench the computing budget used to explore the feasible domain.

3 - Social Support Seeking in Patient-centric Online Healthcare Communities

Yu Tong, Assistant Professor, City University of Hong Kong, Hong Kong, yutong@cityu.edu.hk, Na Liu, Hock Chuan Chan, Zheng Lu

Patient-centric online healthcare community (POHC) becomes an important venue for people to deal with uncertainties via seeking social support. However, previous studies provide an inconclusive view on the effects of social support seeking on health-related outcomes. We propose that the seemingly contradictory results can be understood by distinguishing the types of social support seeking behavior (i.e., informational vs. emotional support seeking). Field survey results among actual users of POHCs demonstrate that informational and emotional support seeking behaviors in online healthcare communities exert varying effects on the change in uncertainty in illness.

4 - The Market Effect of Healthcare Data Breaches

Juhee Kwon, City University of Hong Kong, juhee.kwon@cityu.edu.hk

This study investigates the market reaction to a hospital's data breach. It further tests for the effect of market competitiveness on the link between a data breach and the level of market reaction. Our results show that while data breaches do not affect patients' short-term choices, the cumulative effect of breach events over a three-year period significantly decreases the number of outpatient visits and admissions. The cumulative effects in competitive markets are significantly larger than those in non-competitive markets. Our findings provide policy insights on effective security programs utilizing market-based and brand-building initiatives.

■ MA06

Queen's 6

Data-Driven Approaches to Inventory Management

Invited: Inventory Systems

Invited Session

Chair: Cong Shi, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 41809, United States, shicong@umich.edu

1 - Fixing Phantom Stockouts: Optimal Data-driven Shelf Inspection Policies

Li Chen, Cornell University, li.chen@cornell.edu

A "phantom stockout" is a retail stockout phenomenon caused either by inventory shrinkage or by shelf execution failure. Unlike the conventional stockout which can be corrected by inventory replenishment, a phantom stockout persists and requires human interventions. In this paper, we propose a partially-observable Markov decision model for the problem. In the model, the actual inventory level is not known unless an inspection is performed. We derive a probabilistic belief about the actual inventory level based on the system inventory records and historical sales data. We then formulate a joint inspection and replenishment problem and partially characterize the optimal policy.

2 - Distributionally Robust Models with Second Order Asymmetry Information and Applications to the Newsvendor Problem

Joline Uichanco, University of Michigan, jolineu@umich.edu

We introduce asymmetry information in a distributionally robust newsvendor problem using the covariance of the positive part and the negative part of the random demand minus the mean. The problem is NP-hard, but admits a semidefinite program upper bound. We show that with additional asymmetry information, the Expected Value of Additional Information (EVAI) significantly decreases. Experiments on spare parts data show our model performs better than mean-covariance models.

3 - Nonparametric Algorithms for Joint Pricing and Inventory Control with Lost-sales and Censored Demand
Cong Shi, University of Michigan, shicong@umich.edu

We consider the classical joint pricing and inventory control problem with lost-sales and censored demand in which the customer's response to selling price and the demand distribution are not known a priori, and the only available information for decision-making is the past sales data. We develop a nonparametric algorithm that actively integrates exploration and exploitation through carefully designed cycles. The algorithm searches the decision space through a sparse discretization scheme to jointly learn and optimize a multimodal (sampled) profit function, and corrects the estimation bias. We show that the algorithm converges to the optimal policy, and obtain the convergence rate of regret.

4 - Decentralized Control of a Stochastic Multi-agent Service System
Andrew Lim, National University of Singapore, andrewlim@nus.edu.sg

Consider a stochastic decentralized multi-agent service system consisting of a pricing and a service agent, where the pricing agent dynamically controls the customer arrival rate and the service agent controls the rate at which customers are processed. With the aid of transfer/revenue sharing contracts, we show that this integrated problem can be decoupled into a dynamic pricing problem for the pricing agents and a service rate control problem for the service agent, and that contracts can be specified such that decentralized agent level optimization delivers centrally optimal policies. This property is shown to be robust to mis-specification by each of the agents of the impact of other agent on the system and does not require any of the agents to reveal private information (demand models, etc). An iterative algorithm for computing centralized contracts will also be presented and shown to converge to the optimal contract. A key feature of this algorithm is that its implementation does not require agents to reveal private information.

■ MA07

Kohala 1

Computational Medicine, Big Data, and Predictive Analytic

Invited Session

Chair: Eva Lee, Georgia Tech, Industrial & Systems Engineering, Ctr. for Operations Research in Medicine, Atlanta, GA, 30332-0205, United States, evakylee@isye.gatech.edu

1 - Computational Medicine, Big Data, and Predictive Analytic
Eva Lee, Georgia Tech, Industrial & Systems Engineering, Ctr. for Operations Research in Medicine, Atlanta, GA, 30332-0205, United States, evakylee@isye.gatech.edu

Mathematical modeling and computational methods have long been cornerstones for advancement of business analytics in industrial, government, and military applications. They are playing key roles in advancing and transforming medicine and healthcare delivery. In particular, multi-source data system modeling and computational big data analytics and technologies play an increasingly important role in modern healthcare enterprise. Many problems can be formulated into mathematical models and can be analyzed using sophisticated optimization, decision analysis, and computational techniques. In this talk, we will share some of our successes in early disease diagnosis, precision medicine optimal treatment planning design, and healthcare operations through innovation in mathematical modeling and predictive big data analytics.

■ MA08

Kohala 2

Dynamic Assortments

Invited: Operations/Marketing Interface

Invited Session

Chair: Dorothee Honhon, UT Dallas, UT Dallas, Dallas, TX, United States, Dorothee.Honhon@utdallas.edu

Co-Chair: Canan Ulu, Georgetown Univ, DC, DC, DC, 000000, United States, Canan.Ulu@georgetown.edu

1 - Dynamic Assortment Planning
Felipe Caro, UCLA Anderson School of Management, Los Angeles, CA, United States, felipe.caro@anderson.ucla.edu, Rene A Caldentey

We investigate optimal dynamic assortment planning strategies for a retailer with limited shelf space. The retailer can choose among basic and fashion items with low and high risk (and return) respectively. We present a model in which we explicitly model the vogue trend as a stochastic process that the retailer tries to follow. We then look at two supply chain parameters - the cost of new product introductions and the response lead time - and identify optimal assortment strategies for the different possible combinations.

2 - Implications of Choice Paralysis on Operational Decision Making
Rene A. Caldentey, University of Chicago, rene.caldentey@chicagobooth.edu, Srikanth Jagabathula, Anisha Patel

We empirically investigate the notion of choice paralysis (i.e., too many options can paralyze a consumer and make them more prone to not purchasing) and study its implications on assortment and inventory decisions. We propose a modification to the nested logit model to incorporate the choice paralysis effect.

3 - Tell Me What I Want: A Study of Dynamic Assortment Planning with Learning Consumers
Canan Ulu, Georgetown University, cu50@georgetown.edu, Yulia Vorotyntseva, Dorothee Honhon

We study the problem of a retailer learning about consumer preferences, when consumers are themselves learning about the products over time. The retailer can vary the set of products offered in each period and updates his prior distribution on consumer tastes in a Bayesian fashion based on sales. We compare optimal assortment strategies when the retailer accounts for consumer learning and when he ignores it. We also quantify the value of collecting experience information from the consumers, such as product reviews.

4 - Learning From Clickstream Data
Dorothee Honhon, Associate Professor, University of Texas at Dallas, Richardson, TX, United States, dorothee.honhon@utdallas.edu, Bharadwaj Kadiyala, Canan Ulu

We study the problem of an e-tailer who learns about consumer preferences from observing sales or clickstream data in a Bayesian fashion. The e-tailer decides which products to display on the search page and which products are available for purchase. We show that in some cases, it may be optimal to display products which are not purchasable so as to learn about consumer preferences.

■ MA09

Kohala 3

Managing Technology Innovation and New Products

Invited: Entrepreneurship and Innovation

Invited Session

Chair: Wenli Xiao, University of San Diego, San Diego, CA, United States, wenlixiao@sandiego.edu

1 - A Behavioral Analysis on the Use of an Intermediary in Manufacturing Outsourcing
Qiong Chen, University of Science and Technology of China, qcchen@ustc.edu.cn, Aleda Roth, Gulru F. Ozkan-Seely, Fred Switzer

In this paper, we examine how the level of outsourcing competence of the firm, the amount of time-to-market pressure and the buyer's perceived incentive alignment with the agent, act to systematically influence the decision to outsource the new product directly or indirectly through an intermediary.

2 - Addressing Politics in the Implementation of Technology Strategy
Marc Finkelstein, IE Business School, marcfinkelstein@gmail.com

Organizations expend significant resources to develop a technology strategy, yet too often fail to accomplish it. They commonly perceive the failure to stem from a lack of resources and capabilities, yet exploratory research suggests that organizational politics are significantly more impactful. Research will outline the types of political manoeuvring exhibited and how it is impactful to the achievement of the technology strategy, as well as measures to address it.

3 - The Development of a New Product and the Improvement of an Existing Product
Wenli Xiao, University of San Diego, 5998 Alcala Park, San Diego, CA, 92110, United States, wenlixiao@sandiego.edu, Cheryl Gaimon

We use a dynamic model to explore a manager's pursuit of a new product development (NPD) project and an existing product improvement (EPI) project. A key feature of our model is the characterization of the knowledge transfer process from the NPD project to the EPI project. We identity the optimal knowledge development strategies for both projects and the optimal strategy for knowledge transfer. Lastly, we provide results in how different parameters impact the manager's optimal decisions.

4 - Decision Structure and Outcomes in Technology Supply Chains
Jingqi Wang, The University of Hong Kong, Hong Kong, jingqi@hku.hk

We study a networked supply chain where a technology supplier licenses to a design firm and a manufacturer. The capability of a design firm is private information. We find that the supply chain and firm profits depends on whether the design license is kept confidential from the manufacturer. We compare a networked supply chain with an integrated supply chain where the technology supplier licenses to a single integrated device manufacturer. We show that the networked model can outperform the integrated configuration and conditionally produce gains for all supply chain entities.

■ MA10

Kohala 4

Recent Advances in First Order Methods

Sponsored: Optimization

Sponsored Session

Chair: Mert Gurbuzbalaban, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA, 02139, United States, mertg@mit.edu

1 - First-order Methods for Robust Convex Optimization
Nam Ho-Nguyen, Carnegie Mellon University, hnh@andrew.cmu.edu

Robust optimization is a framework to model parameter uncertainty in optimization problems. Inspired by recent developments, we present several efficient first-order methods to approximately solve robust convex optimization problems. We also introduce the notion of weighted regret online learning and the online saddle-point problem, which form key building blocks for our methods. Finally, we discuss some proximal-type algorithms for these problems.

2 - A First Order Method for Solving Convex Bi-level Optimization Problems
Shimrit Shtern, Massachusetts Institute of Technology, Cambridge, MA, United States, sshtern@mit.edu, Shoham Sabach

Consider a convex bi-level optimization problems for which the innerlevel consists of minimization of the sum of smooth and nonsmooth functions. Theouter level aims at minimizing a smooth and strongly convex function over the optimalsolutions set of the inner problem. We analyze a first order method which is based onan existing fixed-point algorithm. Global sublinear rate of convergence of the methodis established in terms of the inner objective function values. We also show how this result can be utilized to deal with a nonsmooth outer objective, through smoothing, and show how the convergence rate changes as a function of the smoothing parameter.

3 - Stochastic First-Order Methods for Optimization with Many Constraints
Yichen Chen, Princeton University, yichenc@princeton.edu

Consider convex optimization problems subject to a large number of constraints. We focus on stochastic problems in which the objective takes the form of expected values and the feasible set is the intersection of a large number of convex sets. We propose a class of algorithms that perform both stochastic gradient descent and random feasibility updates simultaneously. At every iteration, the algorithms sample a number of projection points onto a randomly selected small subsets of all constraints. Three feasibility update schemes are considered: averaging over random projected points, projecting onto the most distant sample, projecting onto a special polyhedral set constructed based on sample points. We prove the almost sure convergence of these algorithms, and analyze the iterates' feasibility error and optimality error, respectively. We provide new convergence rate benchmarks for stochastic first-order optimization with many constraints. The rate analysis and numerical experiments reveal that the algorithm using the polyhedral-set projection scheme is the most efficient one within known algorithms.

4 - Incremental Methods for Additive Convex Optimization: Revealing Mysteries behind Random Reshuffling
Mert Gurbuzbalaban, Massachusetts Institute of Technology, mertg@mit.edu

Motivated by machine learning problems over large data sets and data-driven decision making problems over sensor networks, we consider the problem of minimizing the sum of a large number of convex component functions. We study incremental methods for solving such problems that use information about a single component function at each iteration. In particular, we study first order incremental methods, develop and analyze second order incremental methods and provide convergence rate results. For the random reshuffling method, we provide a sharp convergence rate result which answers a long-standing open question.

■ MA11

Kona 1

Contemporary Topics in Scheduling and Logistics Management

Invited: Scheduling and Project Management

Invited Session

Chair: Chi To Daniel Ng, Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, lgtctng@polyu.edu.hk

1 - Scheduling in Two-stage Flexible Flow Shops with Dedicated Machines
Bertrand M T Lin, National Chiao Tung University, Institute of Information Management, 1001, Tahsueh Road, Hsinchu, 30050, Taiwan, bmtlin@mail.nctu.edu.tw, Feng-Jang Hwang

This study discusses two manufacturing environments, where m+1 machines are configured as two-stage flexible flow shops. In model 1, the bottleneck machine M0 is installed at stage 1, and the m dedicated machines constitute the stage 2. The second configuration has the m dedicated machines at stage 1 and the bottleneck machine M0 at stage 2. We present a concise survey of the existing results of the two models and report new algorithms and complexity status in the context of processing sequences fixed on the dedicated machines.

2 - Capacity and Pricing Policies for an Electricity Company under Time-of-Use Tariff
Chi To Daniel Ng, Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, daniel.ng@polyu.edu.hk, Ciwei Dong, T.C.E. Cheng

We study the capacity and pricing policies for an electricity company with time-of-use (TOU) tariff. There are two periods for the time of electricity usage, namely the the peak period and non-peak period, with different electricity prices. Customers using the TOU tariff may shift some electricity consumption from the peak period to the non-peak period to lower the consumption cost. A Stackelberg game is considered, where the electricity company decides the capacity investment and prices of electricity. The customers decide the amount of electricity consumption to shift from the peak period to the non-peak period. The optimal shifted consumption, capacity and pricing policies are derived. We find that with the TOU tariff, the electricity company can have more profit and customers can save electricity cost.

3 - Flexible Capacity Strategy in an Asymmetric Oligopoly Market with Competition and Demand Uncertainty
Liu Yang, University of International Business and Economics, Beijing, China, yangliu@uibe.edu.cn, Chi To Ng

This paper established an asymmetric oligopoly competition model consisting of flexible capacity strategy (FCS) and inflexible capacity strategy (IFCS) under demand uncertainty. The difference between the two strategies is that FCS enables firms to postpone production decisions until observing the actual demand, whereas IFCS does not. It is shown that the two strategies co-exist only under certainty conditions. We reveal that although flexible and inflexible firms are of different capacity strategies, they follow the same mechanism in determining capacity investment decisions. We have found under certainty conditions, an increasing competition intensity of inflexible (flexible) firms damages the flexible firms' affordability of capacity investment and force the flexible firms to quit the market. We have found that an increase in production cost benefits flexible firms, but is always harmful to inflexible firms. We identify there is a unique costing threshold to determine the optimal strategy in the two-strategy co-existing competition.

■ MA12

Kona 2

Scheduling Problems in Supply Chains

Invited: Scheduling and Project Management

Invited Session

Chair: Lian Qi, Rutgers University, 1, Newark, NJ, 08807, United States, lianqi@business.rutgers.edu

1 - On the Dynamic Surgical Scheduling with Random Emergency Arrival
Feng Liu, Dongbei University of Finance and Economics, Dalian, China, drliufeng@mail.dlut.edu.cn, Jian-Jun Wang

A dynamic scheduling problem in a surgical suite is studied, by re-optimizing the assignment and sequencing of a set of existing elective and emergent patients. The dynamic optimization is required when unforeseen emergent patients arrive. We propose an improved memetic algorithm with two strategies. The first strategy improves the current solution quality, and the second strategy generates a new initial population whenever an emergent patient arrives, from historical information in the previous optimization process. Based on randomly generated numerical instances as well as practical data, the proposed algorithm is shown to locate better solutions compared with other algorithms.

2 - Surgery Scheduling for Two Operating Rooms under Random Emergency Surgery Arrival

Jian-Jun Wang, Dalian University of Technology, Dalian, China, drwangjj@dlut.edu.cn, Fu Gao, Feng Liu

We discuss the surgery scheduling problem under random emergency surgery arrival .Each patient is treated by three stages in the same order. A predictive-reactive scheduling approach is developed to accommodate the influence of surgery's arrival on planned schedule while optimizing the objective of combining efficiency and stability. In the reactive scheduling phase, a "break-in-block" of emergency surgery is determined to satisfy the requirement of non-preemption surgery and the no-wait constraint . It also considers the interests both of the operating rooms rather than the profit of the surgical team which emergency surgery arrived . Finally a computational experiment was conducted.

3 - Personnel Scheduling and Supplies Provisioning in Emergency Relief Operations

Lian Qi, Rutgers University, lianqi@business.rutgers.edu

Emergency operations often involve travelling of medical teams and distribution of medical supplies. The coordination of medical teams and supplies is critical. We introduce a math-programming based rolling horizon heuristic to quickly find near optimal solutions and draw managerial insights. A polynomial time solvable case is also discussed.

4 - A Hybrid Flow Shop Scheduling with Two Objectives in Lens Module Manufacturing System

Dug Hee Moon, Professor, Changwon National University, 9 Sarim-Dong, Changwon, Gyeongnam, Changwon, 641-773, Korea, Republic of, dhmoon@changwon.ac.kr

Phone camera lens module is composed of a barrel, multiple lenses, multiple spacers and a shield. The three major processes for manufacturing lens module are injection molding, coating and assembly processes, and each process has multiple machines. Thus, the manufacturing system is defined as HFS (hybrid flow shop) with various constraints such as the characteristics of injection molds and the available assembly combinations of lenses. Two kinds of performance measures, on-time delivery rate and smoothing rate of parts consumption, are considered for the HFS scheduling problem. We redefine the smoothing rate to combine two objectives, and a heuristic dynamic scheduling algorithm is suggested.

5 - No-wait Scheduling for Locks with Parallel Chambers

Ward Passchyn, KU Leuven, Naamsestraat 69, Leuven, 3000, Belgium, ward.passchyn@kuleuven.be

We describe a problem setting on an inland waterway concerning ships passing through a lock over time. The lock consists of multiple parallel chambers with different operating characteristics. We focus on schedules where none of the ships incur any waiting time. This problem generalizes the well-known interval scheduling problem. We characterize the feasibility of an instance and provide a linear time algorithm for two non-identical chambers. Additionally, we investigate the complexity of several related problem settings, and show that the general problem for multiple chambers is strongly NP-complete.

■ MA13

Kona 3

Applied Probability and Financial Engineering

Sponsored: Applied Probability

Sponsored Session

Chair: Xuefeng Gao, Chinese University of Hong Kong, Sha Tin, Hong Kong, xfgao@se.cuhk.edu.hk

1 - Diversification of Portfolio Tail Risk

Qi Wu, Chinese University of Hong Kong, qwu@se.cuhk.edu.hk

We develop asymptotic expansions of portfolio value-at-risk (VaR) and portfolio expected shortfall (ES) under a parametrized family of multivariate elliptical distribution, whose tail behavior can be either exponential type or power type. These results show that the reduction amount of portfolio risk, via joint margining, depends on both the portfolio dispersion and the tail heaviness of asset return distribution. Further, the difference between ES and VaR is asymptotically zero up to the sub-leading order for exponential type tail behavior, whereas when asset return distribution exhibits power type tail behavior, ES is proportionally larger than VaR starting at the leading order.

2 - Numerical Methods for Option Pricing in Some Non-Levy Jump Models

Gongqiu Zhang, Chinese University of Hong Kong, gqzhang@se.cuhk.edu.hk

This paper considers pricing European options in a large class of one-dimensional Markovian jump processes known as subordinate diffusions, which are obtained by time changing a diffusion process with an independent L evy. These jump processes are non-L evy in general, and they can be viewed as natural generalization of many popular L evy processes used in finance. Subordinate diffusions offer richer jump behavior than L evy processes and they have found a variety of applications in financial modelling. The pricing problem for these processes presents unique challenges that methods based on transforms and existing numerical PIDE schemes are either not applicable or fail to be efficient. We develop a novel method based on finite difference approximation of spatial derivatives and matrix eigendecomposition, and it can deal with diffusions that exhibit various types of boundary behavior. Since financial payoffs are typically not smooth, we apply a smoothing technique and use extrapolation to speed up convergence. We provide convergence and error analysis and perform various numerical experiments to show the proposed method is fast and accurate.

3 - A Supersolution Based Monte Carlo Method for Stochastic Dynamic Programming Problems

Nan Chen, Chinese University of Hong Kong, nchen@se.cuhk.edu.hk

Many financial applications can be formualted as solving stochastic dynamic programming problems. However, tranditional HJB equation based methods often suffer from the curse of dimensionality when they are applied to high dimension problems. In light of this difficulty, people have to rely on approximate policies to solve SDP problems. We use the information relaxation technique to develop a value-and-policy iterative algorithm in this paper. It provides a systematic approach to assess and improve the quality of approximate control policies.The paper discusses the use of the above algorithm in optimized trading execution problems. Our method yields new insights to this classical problem.

4 - Limit Theorems for Markovian Hawkes Processes with a Large Initial Intensity

Xuefeng Gao, Chinese University of Hong Kong, xfgao@se.cuhk.edu.hk

Hawkes process is a class of simple point processes that is self-exciting and has clustering effect. The intensity of this point process depends on its entire past history. It has wide applications in finance, neuroscience, social networks, criminology, seismology, and many other fields. In this paper, we study the linear Hawkes process with an exponential kernel in the asymptotic regime where the initial intensity of the Hawkes process is large. We derive limit theorems for this asymptotic regime as well as the regime when both the initial intensity and the time are large.

■ MA14

Kona 4

Healthcare Operations

Sponsored: Health Applications

Sponsored Session

Chair: Elvin Coban, Ozyegin University, Cekmekoy, Istanbul, 34794, Turkey, elvin.coban@ozyegin.edu.tr

1 - Optimal Pooling Schemes for Prevalence Estimation under Resource Constraints

Ngoc Nguyen, Virginia Tech, Blacksburg, VA, United States, ntn@vt.edu, Ebru Korular Bish, Douglas R Bish

Pooled testing is commonly used as an efficient method for estimating the unknown prevalence rate of an infection. However, large pools lead to a loss in accuracy due to dilution, while small pools incur higher testing costs. We develop a mathematical model that considers this trade-off and determines the optimal pool size that yields a robust prevalence rate estimate under a testing budget. We demonstrate the impact of this optimization-based approach on a case study that uses publicly available or published data.

2 - Helicopter-based Medical Evacuation From the Battlefield

Miguel Lejeune, George Washington University, mlejeune@gwu.edu

We propose MEDEVAC optimization models with endogenous uncertainty to maximize the number of high-priority casualties that can be evacuated from the battlefield within one hour. We derive MINLP reformulations, propose algorithmic methods, and present the application of the model to a real setting.

3 - Integrated Hospital Operations Modeling for Mass Casualty Incidents
Elise D Miller-Hooks, University of Maryland, College Park, MD, United States, elisemh@umd.edu, Mersedeh Tariverdi, Thomas Kirsch, Scott R Levin

We propose a discrete event simulation framework and underlying conceptual open queuing network with time-varying priorities to model hospital operations in both ordinary and surge demand situations. The framework includes detailed, integrated models of critical hospital operations spanning units, incident-related operational disruptions, patient care-paths and resource tracking. A holistic approach to hospital performance modeling enables the study of patient-flow dynamics, demand management strategies, and operational strategies that are responsive to an evolving demand pattern and time-varying service capacities and needs. Experimental findings are presented.

4 - Dynamic New Patient Consult Scheduling for Medical Oncology
Xiang Claire Ma, BC Cancer Agency, 600 West 10th Avenue, Vancouver, BC, V5Z4E6, Canada, claire.ma@bccancer.bc.ca, Antoine Sauré, Martin Puterman

Motivated by an increasing demand for cancer care and long waits for new patient consults, we undertook a study of medical oncology scheduling practices at a regional cancer center. As a result, we formulated and approximately solved a discounted infinite-horizon MDP model that seeks to identify policies for allocating oncologist consultation time to incoming new patients, while reducing waits in a cost-effective manner. The benefits from the proposed method are evaluated using simulation.

■ MA15

Kona 5

MSOM

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Rachel Rong Chen, University of California-Davis, Graduate School of Management, Davis, CA, 95616, United States, rachen@ucdavis.edu

1 - Strategic Analysis of Dual Sourcing under Yield Uncertainty in a Co-opetitive Supply Chain
Baozhuang Niu, South China University of Technology, bmniubz@scut.edu.cn, Jiawei Li, Yinliang Tan, Kenny Cheng

We consider a co-opetitive supply chain comprising an original equipment manufacturer (OEM) and a competitive supplier who provides well-qualified components, but competes with the OEM in the downstream market by producing and selling self-branded products. It is optional for the OEM to shift orders to a non-competitive supplier whose products have yield uncertainty. It is also optional for the competitive supplier to stop contracting with the OEM and focus on its self-branded business. We find that the OEM's dual sourcing induces price war among the suppliers. Interestingly, we find that the non-competitive supplier may not have incentives to eliminate its yield uncertainty.

2 - Approximate Analysis of Dynamic Production Systems for Nonstationary Demand
Ronald Askin, Arizona State University, Tempe, AZ, United States, Ron.askin@asu.edu, Girish Jampani Hanumantha

We propose an efficient analytical approach for the approximate analysis of throughput times, throughput rates and work-in-process inventory levels for multistage production systems with nonstationary demand and capacity. Mean value analysis algorithms are extended through a blending procedure. The model provides a tractable approach for setting order releases and forecasting resource system state and performance.

3 - Fit-revelation Sampling and Advertising
Rachel Chen, University of California at Davis, rachen@ucdavis.edu, Shiming Deng, Lingli Wu

This paper studies the profit implication of the interactions between fit-revelation sampling and advertising. In particular, we examine whether these two strategies are complementary or substitute. We also characterize conditions under which it is optimal to do sampling alone, advertising alone, or a simultaneous offering of sampling and advertising.

■ MA16

Waikoloa 1

Operations strategy

Invited: Empirical Studies in Operations

Invited Session

Chair: Yeming Gong, Em Lyon Business School, Em Lyon Business School, Ecully, 69130, France, gong@em-lyon.com

1 - Configurations of Distribution Strategies: An Integrated Analysis of Quantitative and Qualitative Data in Retailing Industry
Jin Tang, Emlyon Business School, TANG@em-lyon.com, Yeming Gong

This paper develops a theoretical framework of distribution strategy and provides empirical evidence for the configurations and strategic fit of distribution strategies. We identified the configurations of distribution strategies with conducting an integrated analysis of quantitative and qualitative data in retailing industry. Our main contributions are: 1) This is the earliest research to apply configuration approach in distribution strategy. 2) We develop a strategic fit model to understand configurations of distribution strategies. 3) This is among the earliest researches to specify 'strategic fit zone' with rigorous research method and empirical evidence.

2 - Towards a Theoretical Framework of It-enabled Operations Strategy: An Integrated Analysis of Quantitative and Qualitative Data
Yeming Gong, Emlyon Business School, gong@em-lyon.com, Hongyi Hongyi, Ryad Titah, Yuliang Yao

Using an integrated research approach, this paper presents a theoretical framework of IT-enabled operations strategy with the objective of investigating "What is the role of IT capability in operations strategy? How does IT leverage resources and processes for operational agility?" Based on a sample set of 113 organizations in Europe, Asia and North America, we find that the interaction between IT infrastructure and IT reconfiguration positively influences operational agility, while the interaction between IT coordination and IT integration negatively affects operational agility. We have further conducted 56 case studies to validate PLS results, trying to provide a rich explanation.

3 - Towards a Theoretical Framework of Sustainable Operations Strategy
Peiran Gao, Huazhong University of Science and Technology, gaopeiran2008@qq.com

This paper presents a theoretical framework of Sustainable Operations Strategy to handle a problem"How to establish the sustainable operations strategy with strategic fit to operational competencies for superior business performance?" To answer the research question, based on structural equation modeling and case study, we conduct an integrated analysis of quantitative and qualitative data in retailing industry. Our results have empirically demonstrated that sustainable operations neither directly make contribution to business performance nor via flexibility competency, but indirectly make contribution via the moderation effect between supply chain practice and cost competencies.

4 - Configuration of Supply Chain Integration
Dongtao Xu, Huazhong University of Science and Technology, Wuhan, China, xudongtao@hust.edu.cn, Yeming Gong, Jin Tang, Jie Xiong, Jinlong Zhang

This paper presents a theoretical framework of supply chain integration to study a research question "How to identify configurations of supply chain integration with strategic fit to operational competencies for superior business performance?" In quantitative study, we used a sample of 124 organizations for identifying configurations of supply chain integration and operational competencies. In qualitative study, we conducted 56 case studies to provide additional insights for our hypotheses and complex relationships .And than We identified five configurations of supply chain integration.

■ MA17

Waikoloa 2

Big Data and Predictive Analytics in Hospitality and Tourism Revenue Management

Sponsored: Revenue Management and Pricing Section

Sponsored Session

Chair: Yingying Kang, Southwest Airlines, 195 14th St NE, Unit 1204, Atlanta, GA, 30309, United States, Yingying.kang@wnco.com

1 - A New Parallel Processing Application in Hospitality Predictive Analytics

Yingying Kang, Southwest Airlines, 195, Dallas, TX, 1, United States, Yingying.kang@wnco.com

What is the next generation for hospitality industry? Explosive information exchange in our daily life determines the significance of data processing and analytics to a hotel enterprise. This presentation presents a new parallel processing application in hospitality predictive analytics. The new model is based on a load balancing mechanism and a caching strategy. An integrated top-down and bottom-up framework is applied to raise the efficiency of data branching and marshalling process. This model provides the high efficiency of data processing and thereafter significantly reduces the run time of real time market alerting and predictive analysis system.

2 - A Fuzzy Goal Programming for Congestion Toll Pricing Problem

Robert Jackson, Norfolk Southern, Atlanta, GA, 303, United States, robert.jackson@nscorp.com

In congestion toll pricing problem, there are usually two major conflicting beneficial groups, governors and carriers. Governors care more about how to maximize social benefits by adjusting the price on different commodities along different road segments. Their goals include, maximizing the total toll revenue, and minimizing total congestions caused by selfish behavior of individual carriers. Meanwhile carriers care mainly about how to minimize their individual transportation costs under the allowed transport regulation. This model applies a Chebyshev goal programming based method to balance the conflicting objectives between the two beneficial groups. This model focuses on minimizing the worst deviation from any single objective function. To evaluate the model efficiency and accuracy, a comparison with the approach of two different models is presented.

3 - A Bi-Objective Programming-based Regularization Method

Zihan Lin, Majesty Data Systems Inc., 195, Shanghai, China, jia_yinyin@hotmail.com, Yingying Kang

Customer shopping behavior directly impacts the revenue of an online travel agency. The existing predictive analysis models like logistic regression model are highly constrained by model accuracy. Here we propose a new regularization model based on both mini-sum and mini-max error correction objectives. This model has been implemented in customer shopping predictive model and proven to bring a more stable and converge to optimal much faster than L1 and L2.

4 - Adding Value to Online Travel Agency Websites through Predictive Hotel Advertising

Lingling Kang, Tourism College of Zhejiang China, na, Zhejiang, na, China, lisali008@yahoo.com

Nowadays hotels turn to search like marketing to drive bookings through their Online Travel Agency distribution partners. Click-Through-Rate becomes a key factor for maximizing the revenue of an online travel agency. Multiple factors like price, hotel ranking, customer review and ad placement including image and text impact the click through rate. Here we propose a Bayesian Inference based factorial design model to estimate parameters of hotel attractiveness according to the observed CTR distribution. It is proven effective under changeable marketing conditions.

■ MA18

Waikoloa 3

Data Management and Optimization

Contributed Session

Chair: Boxiang Wang, University of Minnesota, University of Minnesota, Minneapolis, MN, 55414, United States, wang3660@umn.edu

1 - Using a Dea-based Data-driven Approach to Predict the Future Performance: An Application to NBA Teams

Feng Li, PhD student, University of Science and Technology of China, Hefei, China, lfeng90@mail.ustc.edu.cn

In this paper, we propose a DEA-based data-driven approach to address the performance prediction problem. The prediction approach is performed by two steps: in the first step, we conduct a DEA-based portfolio efficiency analysis to train the “future“, and obtain the most/least promising outputs. In the second step, a multivariate regression analysis is conducted to estimate the quantity relationship between the future performance and outputs obtained previously. Further, by considering uncertainty we integrate the robust optimization method to obtain robust prediction results. Finally, a ten-season dataset from NBA is provided to illustrate the usefulness of the proposed approach.

2 - Robust Data Envelopment Analysis Based on Common Weights

Ran Zhang, Ph.D. student, Beijing Institute of Technology, 2013 Ph.D. School of Management and Economics, Beijing Institute of Technology, Beijing, 100081, China, zhangranbj@126.com

DEA is a data-oriented method. However, the inputs and outputs data in real-life problems are often imprecise. Thus we should take the data uncertainty into consideration. In this paper, we simplify a multi-objective common weights DEA model proposed by Chen et al. (2009). Under the consideration of data uncertainty, we establish a robust multi-objective DEA model. A numerical example is solved to compare our model with Omrani’s (2013), the results show that our approach has better computational efficiency, and the common weights derived from our model are more reasonable.

3 - Robust Kernel-based Regression with Applications to a Dynamic Virtual Metrology

Jeongsub Choi, Rutgers, State University of New Jersey, 96 Frelinghuysen Road, CoRE Building, Room 201, Piscataway, NJ, 08854, United States, jeongsubc@gmail.com

The kernel based regression (KBR) method can be very sensitive to influential observations. We present a novel robust KBR method that gives reliable result even if a training data set is contaminated with outliers. Direct metrology to monitor the quality characteristics has the limitation due to the time and efficiency. In this case, a virtual metrology system (VMS) could be an efficient and effective method of online and wafer-to-wafer process monitoring. We have applied the proposed robust KBR to construct a VM based on real-time equipment sensor data and validated its efficiency.

4 - Sparse Distance Weighted Discrimination

Boxiang Wang, University of Minnesota, 1062 27 Ave,. SE Apt. F, Minneapolis, MN, 55414, United States, wang3660@umn.edu

Distance weighted discrimination (DWD) was proposed to handle the data piling issue in the support vector machine. In this paper, we consider sparse penalized DWD for high-dimensional classification. The state-of-the-art algorithm for solving the standard DWD is based on second-order cone programming, however such an algorithm does not work well for sparse DWD with high-dimensional data. To overcome the computation difficulty, we develop a very efficient algorithm to compute the solution path of sparse DWD at a given fine grid of regularization parameters. We implement the algorithm in a publicly available R package sdwd. We conduct extensive experiments to show our method is fast and accurate.

Monday, 10:00am - 11:00am

■ Plenary

Monarchy Ballroom

How to Gain Competitive Advantage through Applications of OR/OM

Invited Session

Chair: Catalina Stefanescu-Cuntze, European School of Management and Technology, Schlossplatz 1, Berlin, 10178, Germany, catalina.stefanescu-cuntze@esmt.org

1 - How to Gain Competitive Advantage through Applications of OR/OM

Gang Yu, New Peak Group, Shangjhai, China, 175775343@qq.com

Dr. Gang Yu will use his life experience as a serial entrepreneur, an academic researcher, and a seasoned industry leader to illustrate how to gain competitive advantage through applications of OR/OM. Examples will span industries he once served or is currently in, including digital/mobile health, e-commerce, airlines, and manufacturing.

Monday, 11:00am - 12:30pm

■ MB01

King's 1

Behavioral Decision-making: Methods and Applications

Sponsored: Decision Analysis

Sponsored Session

Chair: Yitong Wang, University of Technology Sydney, Building 8 (Dr. Chau Chak Wing Building), Haymarket NSW, 2007, Australia, yitong.wang@uts.edu.au

1 - Using Means Objectives to Present Risk Information

Candice Huynh, California State Polytechnic University, Pomona, CA, candicehuynh@cpp.edu

When making decisions involving alternatives with risk, individuals are often unable to express or view the possible outcomes in terms of a fundamental objective. In many cases, using a means objective is more practical or more accessible. This paper presents and discusses the results of two experiments regarding decision makers' preferences and decision process when information is presented either in terms of a means objective or a fundamental objective.

2 - A Model for Inferring Market Preferences From Online Retail Product Information Matrices

Ofer Mintz, Louisiana State University, 2117 BEC, Louisiana State University, Baton Rouge, LA, 70803, United States, omintz@lsu.edu, Timothy J Gilbride, Imran S Currim, S. Siddarth

This research extends laboratory based information display board methods employed to study information processing into a field based setting to yield managerially useful estimates of market preferences. A new model is proposed based on statistical, behavioral, and economic theories, which integrates three decisions consumers must make at websites: which product-attribute to inspect next, when to stop processing, and which, if any, product to purchase. The modeling options are empirically tested employing datasets collected at a popular retail-manufacturer's website, while customers were making product evaluation and purchase decisions.

3 - Risk Taking Behavior Following Near Miss Events in Sequential Decision Tasks under Ambiguity

Matthias Seifert, Professor of Decision Sciences, IE Business School, Maria de Molina 12, 5th Floor, Madrid, 28006, Spain, matthias.seifert@ie.edu, Florian Mathis Federspiel

We study near miss events in the context of classic real options tasks. Our central focus thereby lies on understanding the influence of prior expectations and probabilistic ambiguity on individual risk taking behavior. Our findings obtained from two laboratory experiments strongly support the notion that the often found near miss bias is most likely a function of the level of ambiguity surrounding the decision environment. We further find evidence for a moderation effect which suggests that only decision makers with a prior gain expectation are likely to fall prey to the bias. Finally, we use our empirical findings to propose a descriptive model of risk taking behavior following near miss events.

4 - An Eye Tracking Study on Decision Making: Information Processing and Reading Habits

Yitong Wang, University of Technology Sydney, yitong.wang@uts.edu.au, Tianjun Feng, Antonin Genot, Lei Zhao

We investigates decision makers' information-processing patterns in decisions under risk and over time by using eye-trackers. We find that decision makers employ more alternative-based than attribute-based procedures. In addition, we find that reading habits play an important role in information processing - the results suggest that screen display moderates decision makers' information-processing procedures.

■ MB02

King's 2

Anti-Terrorism and Disaster Management in Chinese Context

Invited: Homeland Security and Disaster Management

Invited Session

Chair: Dehai Liu, Professor, Dongbei University of Finance and Economics, No 217, Jianshan Street, Shahekou District, Dalian, 116025, China, Ldhai2001@163.com

Co-Chair: Hongyi Li, Chinese University of Hong Kong, Rome 904, CYT Building, Department of Desicion Science & Management Economics, CUHK, Shatin, Hong Kong, 999077, Hong Kong, hongyi@baf.cuhk.edu.hk

1 - Self-rescue or Waiting to be Rescued when Facing Catastrophes? Information-structure Co-evolutionary Analysis in Disaster Responses

Hongyi Li, Chinese University of Hong Kong, hongyi@baf.cuhk.edu.hk

For an effective post-earthquake relief operation, the victims' self-rescue ability is of crucial importance, especially in the first 72 hours of prime time. From a spontaneous evolution perspective, we first consider the self-rescue problem in disaster management, and then investigate the deeper causes of the post-earthquake emergency responses, (self-rescue (SR) or external rescue (ER)), that different organizational cultures undertake. We formulate an information-structure coevolutionary game model of post-earthquake emergency response. The paper studies the performance difference and evolutionary mechanism of two rescue modes in different organizational cultures.

2 - Public Warnings vs. Private Warnings: Which is Better in Anti-terrorism?

Dehai Liu, Dongbei University of Finance and Economics, Ldhai2001@163.com

The NTAS faces the greatest challenge that needs the trade-off between the public's right to know and the need to prevent terrorists from using public warnings. We develop a Stackberg game model to formulate the optimal warning strategy for the new NTAS system, and we try to shed light on several important insights for policymakers. First, the different warning strategies must be consistent with special intelligence information about the targets and timing of attacks. Second, we find the specific scope of application of both public warnings and private warnings. Third, if public warnings are issued, the public must be tolerant of higher false alarm rates due to the terrorists' reaction.

3 - Anti-terrorism and Civilian Protection: A Joint Optimization Model Between Air Strike and Ground Attack

Ruirui Chai, Dongbei University of Finance and Economics, chairuirui2013@126.com

Terrorist threats and the relevant refugee problems have presented serious challenges to various countries. It is an important trade-offs between effectively protect civilians and combat terrorists. Considering the distributional characteristics of geographical space between terrorists' controlled areas and civilians' residential area,the paper builds the joint optimization model of resource allocation between air strict and ground attack. The paper sheds light on the complex interactive mechanism between anti-terrorism and civilian protection, especially when their geographical space is a high coincidence.

4 - Tax-efficient Supply Chain of Global Procurement under the Rule of Origin

Zhiqiao Wu, Tokyo City University, Yokohama, Japan, wuzhiqiao@hotmail.com, Jiafu Tang, Zhendong Pan

The Rule of Origin may be vital for the Trans-Pacific Partnership (TPP) to receive a lower-tax rate. It means relocate procurement center (short for PC) to the TPP country. Is it worthwhile to make such strategic move? How should the PC be managed operationally? We address these questions in this paper. Based on different responsibilities, effort and risks a PC takes, there are three adapted structures: limited-risk, buy-sell with and without inventory. A system without the restrictive PC is severed as a benchmark system to conduct comparative studies, which decide whether it is worthwhile to set up a PC and what kind of structure should the new supply chain takes.

■ MB03

King's 3

Bounded Rationality and Social Preferences in Behavioral Operations

Sponsored: Behavioral Operations Management

Sponsored Session

Chair: Kay-Yut Chen, University of Texas at Arlington, 701 S. West Street, Mansfield, TX, 76019, United States, kychen@uta.edu

1 - Pay-it-forward: Theory, Experiments, and Managerial Implications

Narayanan Janakiraman, University of Texas Arlington, TX, janakira@uta.edu

Based on experiments and a real life field study in a local museum we examine whether individuals look back (reciprocity) or look forward (warm glow) when making pay it forward decisions. We look at whether firms can intervene and start a pay it forward chain and whether subsidizing the amount paid forward increases or decreases pay it forward behavior.

2 - Decision Dependent Bounded Rationality in Dual Sales Channel Management

Kay-Yut Chen, University of Texas at Arlington, 701 S. West Street, 2950 Hobson Way, Arlingon, TX, 76019, United States, kychen@uta.edu, Ozalp Oozer

We experimentally study behaviors in a dual sales channel in which a manufacturer sells through his direct channel and an independent retailer. The channels compete on demand. The manufacturer sets the wholesale price for the retailer, and also delivery times for customers in his direct channel. The retailer decides on its inventory level. We show and discuss why bounded rationality differs, in the same subject pool, across three decisions and model the behavior as quantal response equilibrium.

3 - Impact of Previous Fatalities on Future Surgery Outcomes

Sridhar Nerur, University of Texas Arlington, snerur@uta.edu

The primary purpose of this study is to investigate the impact that the mortality of a surgeon's patient has on his/her subsequent surgery. To this end, a relatively large dataset was analyzed to draw insights into the predictors of patient mortality. In addition to looking at patient characteristics, we also explored how the time between a surgery that resulted in mortality and the next surgery would impact a surgeon's performance. Our analysis suggests that the passing of their patients psychologically impacts surgeons. Furthermore, our results indicate that they should wait for a certain period of time before performing their next operation.

4 - Behavioral Impact of Irrelevant Market Information on Buying Decisions

Kay-Yut Chen, University of Texas Arlington, kychen@uta.edu

We study how market information such as past sales, current stock levels and stock-out probability influences purchase behavior. Experiments are conducted where buyers, who are exposed to different information, evaluate trade-offs between the likelihood of out-of-stock and future price discounts. We found that individuals can be swayed by information that is non-informative and irrelevant. We develop a behavioral model that captures such behavioral reactions to explain the lab findings.

■ MB04

Queen's 4

Cancer Prevention and Policy

Invited: OR in Medicine

Invited Session

Chair: Maria Esther Mayorga, North Carolina State University, 376 Daniels Hall, Raleigh, NC, 27695, United States, memayorg@ncsu.edu

1 - Sequential Quadratic Programming for Model-based Parameter Estimation in Colorectal Cancer Disease Progression

Nan Kong, Purdue University, nkong@purdue.edu

The quantification of model parameters is critical for the study of colorectal cancer disease progression, especially those governing the incidence and growth of advanced adenomas for different population subgroups. Model calibration is challenging given the large number of probability distribution parameters to estimate and outcomes to match. We developed a parameter estimation procedure by applying Box and Behnken design and Sequential Quadratic Programming. Our purpose is to use this study to generate insights into efficient calibration procedures for model-based health economic studies.

2 - Exploring the Pre-clinical Phase with Model-based Analysis

Julie Higle, University of Southern California, julie.higle@gmail.com, Jing Voon Chen

Model-based analyses are commonly used to examine the cost-effectiveness of screening and treatment options for various cancers. The pre-clinical phase, where screening can yield its maximum benefit, is rarely observable and thus, is especially difficult to model. We discuss preliminary observations from our exploration of these unobservable health states.

3 - Evaluating the Impact of Medicaid Expansion on Colorectal Cancer Screening Uptake

Maria E. Mayorga, North Carolina State University, memayorg@ncsu.edu

We build an individual level simulation model for colorectal cancer. We consider the population of North Carolina and the impact that the health exchange and Medicaid expansion would have on screening uptake. The model considers screening preferences based on individual socio-demographic attributes as well as by insurance status. Insurance is updated based on a logistic regression and aging of the population.

■ MB05

Queen's 5

Emerging Infectious Diseases

Invited: Global Health

Invited Session

Chair: Zoie Wilkins-Wong, University of New South Wales, Room 214, Samuels Building, Sydney, 2052, Australia, zoie.wong@unsw.edu.au

1 - Key Research Issues and Recent Advances in Epidemic Modeling

Zoie Wilkins-Wong, University of New South Wales, zoie.wong@unsw.edu.au

The Ebola Virus Disease (EVD), Middle East respiratory syndrome (MERS-CoV), and the most recent Zika virus outbreak have caused significant global societal and economic impact. Epidemiologic triangle theory posits that an epidemic of such a communicable disease is an interplay among the pathogen, and the host, as well as the environment. Epidemic modeling should be complex enough to provide a robust answer to the public health question we are trying to address, but at the same time simple enough so we don't get distracted by unrelated details. This talk addresses the key research questions and recent advances of multidisciplinary model methods to aid public health decision-making.

2 - Agent Based Reconstruction of MERS Broke-out Path in Korea

Yun B Kim, Sungkyunkwan University, kimyb@skku.edu, Jinsoo Park

In 2015, South Korea was struck by MERS (Middle East Respiratory Syndrome). It caused death to 38 out of 186 infectees and only 148 survived, and nearly 17,000 people were kept in isolation. We propose a 'Disease Diffusion Model' for MERS using agent-based simulation approach. The model is constructed with historical path data of MERS infectees and mathematical model for disease spread likes SEIR model. The model could help to verify disease policy and systems' efficiency. Moreover, several scenarios are drawn for experimentation that makes a different response to MERS spread using this model.

3 - Exploring a Scalable Discrete Event Stochastic Agent-based Model of Infectious Disease Propagation
Susan M Sanchez, Naval Postgraduate School, ssanchez@nps.edu, Paul J. Sanchez

We explore the behavior of a new stochastic model of infectious disease propagation. The model tracks individual outcomes, but without creating connectivity graphs for all members of the population. Accordingly, it is readily scalable to large populations, while preserving the impact of variability during the critical early stages of an outbreak. Initial explorations show behaviors similar to the observed course of historical Ebola outbreaks: while many outbreaks fizzle out quickly, some flare into more widespread epidemics. Such results may better inform decision makers about risk.

4 - An Optimization Model for Developing Resource Allocation Control Strategies to Minimize Epidemic Spreading Via the Air Traffic Network
Lauren Gardner, University of New South Wales, l.gardner@unsw.edu.au

Real-time strategies for outbreak control are required to minimize the spread of emerging infectious diseases at a national and international level. Currently, there is a gap in the literature for optimization-based decision control models that account for the heterogeneous nature of the air travel patterns and infectious disease spreading dynamics. In this work a bi-level optimization model is proposed where the objective is to minimize the risk of disease spread via the air traffic network, and the decision is the allocation of control resources to airports subject to budget constraints during an on-going epidemic.

■ MB06

Queen's 6

New Developments in Multi-Echelon Inventory Theory

Invited: Inventory Systems

Invited Session

Chair: Alexandar Angelus, University of Texas, Dallas, 800 W. Campbell Road, Dallas, TX, 75080, United States, alexandar.angelus@utdallas.edu

1 - Multiechelon Inventory Management with Short-term Take-or-pay Contracts
Joel Goh, Harvard Business School, Boston, MA, 02139, United States, jgoh@hbs.edu, Evan L Porteus

We extend the Clark-Scarf serial multi-echelon inventory model to include procuring production inputs under short-term take-or-pay contracts at one or more stages. In each period, each such stage has the option to order/process at two different cost rates; the cheaper rate applies to units up to the contract quantity selected in the previous period. We characterize the form of an optimal policy for this system and show that it has a simple structure. We prove a generalization of Karush's lemma, which we use as a key step in our analysis.

2 - Payment Timing in Multiechelon Supply Chains: Cost Assessment, Incentives and Coordination
Gregory DeCroix, University of Wisconsin, Madison, Madison, WI, United States, greg.decroix@wisc.edu, Jordan Tong, Jeannette Song

Developments in information technology have led to increased variety in payment arrangements between supply chain members. In this paper we introduce a new system for capturing the financing costs resulting from a general class of such payment schemes. Under wholesale price contracts, we use this framework to demonstrate the impact of payment timing on firm incentives, and show that partially delayed payments can achieve coordination in settings where standard or fully delayed payments cannot.

3 - Uncovering the Hidden Value of Reverse Logistics with Complementary Product Flows in a Supply Chain
Alexandar Angelus, University of Texas, Dallas, Richardson, TX, United States, alexandar.angelus@utdallas.edu, Ozalp Ozer

We formulate and solve a stochastic multiechelon inventory model to jointly optimize regular, expedited, and reverse-ordering decisions. We identify the structure of the optimal policy that achieves the decomposition of the objective cost function. We prove that, under stationary model parameters and cost functions, it is never optimal to reverse product flow in the system. Even in non-stationary settings, the reverse logistics option, by itself, is found to create very little value for the supply chain. Instead, the contribution of reverse logistics is significant only in the presence of the expedited flow of product, with which the reverse flow of product interacts in a complementary fashion.

■ MB07

Kohala 1

Process Flexibility: Theoretical Performance of Sparse Designs

Invited Session

Chair: Jiawei Zhang, New York University, Stern School of Business, New York, NY, United States, jzhang@stern.nyu.edu

1 - Process Flexibility: Theoretical Performance of Sparse Designs
Jiawei Zhang, New York University, Stern School of Business, New York, NY, United States, jzhang@stern.nyu.edu

In this talk, we present some recent works on process flexibility, a widely used strategy for many manufacturing companies to improve their responsiveness to demand uncertainty. In their seminal work, Jordan and Graves proposed an important flexibility concept, called the long chain design, and studied its empirical performance. We first consider the case when the capacity allocation decision is made after demand realization. In this case, we present distribution-free bounds on the performance of the long chain design. We discuss optimality of the long chain design within a class of flexibility structures. We also present theoretical results about sparse expander graphs. We then consider the case when demand arrive sequentially and the capacity allocation decision has to be made in real time. We show the strong performance of the long chain design under a simple myopic online policy.

■ MB08

Kohala 2

Topics in OM/Marketing

Invited: Operations/Marketing Interface

Invited Session

Chair: Xuying Zhao, Xuying.Zhao.29@nd.edu

Co-Chair: Jun Zhang, Fudan, Shanghai, Shanghai, 78700, China, jzhang4@gmail.com

1 - Online Product Reviews with Biases
Xuying Zhao, University of Notre Dame, xzhao1@nd.edu

Online product reviews may be biased. Consumers who post online reviews may not be representative of the population. The review bias could be either positive or negative. We study the influence of online reviews with biases on consumer purchase behavior and a firm's pricing strategies. We find that online reviews, regardless of positive or negative biases, further increases price uncertainty when product fit uncertainty is high. Because of this increasing-price-uncertainty effect, online reviews with positive biases can hurt a firm's profit while online reviews with negative biases can benefit a firm.

2 - Subsidizing Equilibrium in a Sustainable Supply Chain
Xiangfeng Chen, Fudan University, chenxf@fudan.edu.cn

Abstract not available.

3 - The Impact of Bundled Purchasing on Supply Performance
Jun Zhang, Fudan University, jzhang4@gmail.com, Yongmei Zhang

Bundled purchasing is a new practice used by some hospitals in China to lower the purchasing costs for medicines, medical equipment, or reagents. While this new practice sounds appealing to purchasing managers of hospitals, their real impact on the performance of a whole healthcare supply chain is not obvious. We examine the impacts of bundled purchasing on supply performance using a novel data set.

4 - Financial Cross-ownership and Information Leakage in a Supply-chain with Competing Retailers
Noam Shamir, Tel-Aviv University, nshamir@post.tau.ac.il, Yossi Aviv

Financial cross-ownership describes a situation in which one retailer holds non-voting stocks in his rival. We study the effect of the practice of financial cross ownership on two imperative operational decisions — information acquisition and production quantity in a supply-chain with downstream competition and a mutual supplier. We demonstrate that financial cross ownership may have both pro and anti-competitive effects, and that information can be acquired even when it is later leaked to the competitor.

■ MB09

Kohala 3

Addressing Information Asymmetry Within and Between Organizations

Invited: Entrepreneurship and Innovation

Invited Session

Chair: Jeremy Hutchison-Krupat, University of Virginia, 100 Darden Boulevard, Charlottesville, VA, 22903, United States, krupatj@darden.virginia.edu

1 - Overcoming Barriers to Customer Co-design: The Role of Product Lines

Sreekumar Bhaskaran, SMU-Cox School of Business, 6212 Bishop Blvd.,, Dallas, TX, 75205, United States, sbhaskar@mail.cox.smu.edu, Amit Basu

A key barrier to companies successfully engaging customers in the design of new products is customers fearing that they will be forced to pay much more for the custom products they help design. In this paper, we develop analytical models that capture this effect. Using these models, we examine how a firm can incentivize its customers to engage in co-design, and also how offering co-design can impact the firm's product (line) strategies and the quality of its products. The effect of market and firm characteristics on the value of engaging customers in the co-design process is also examined.

2 - Contracting with External Experts in New Product Development

Shantanu Bhattacharya, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, shantanub@smu.edu.sg

We create a model of new product development where information on external factors like market potential and technology feasibility is sought from external experts. The firm has to adequately incentivize these experts to truthfully reveal their judgment. Contracts are presented to alleviate the resulting adverse selection problem.

3 - Communication, Incentives, and the Execution of a Strategic Initiative

Jeremy Hutchison-Krupat, University of Virginia, krupatj@darden.virginia.edu

Senior leadership can influence a direct report through incentives and communication. Financial incentives are credible and precisely specified, but offer limited flexibility, whereas communication is flexible, but lacks precision and must be deemed credible to affect a direct report's actions. We study senior leadership who seeks to add an initiative to their portfolio. Early on, its potential to create value is not well-understood, however, senior leadership eventually obtains knowledge on its potential which they may communicate to their direct report.

■ MB10

Kohala 4

Robust Optimization and Its Applications

Invited: Robust Optimization

Invited Session

Chair: Henry Lam, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States, khlam@umich.edu

1 - Static vs. Adjustable Solutions in Dynamic Robust Optimization

Vineet Goyal, Columbia University, vgoyal@ieor.columbia.edu, Pranjal Awasthi, Brian Yin Lu

We consider two-stage adjustable robust linear optimization problem with uncertain constraint coefficients. This models many important applications including resource allocation with uncertain requirements. Computing an optimal dynamic solution is intractable in general. We give a tight characterization of the performance of static solutions and give a bound the adaptivity gap. In particular, we show that for a fairly general class of uncertainty set of matrices described by column-wise and row-wise constraints, a static solution provides a near-optimal approximation for the two-stage adjustable robust problem.

2 - Robust Newsvendor Games with Ambiguity in Demand Distributions

Vinh Doan, University of Warwick, xuan.doan@wbs.ac.uk

We investigate newsvendor games whose payoff function is uncertain due to ambiguity in demand distributions. We discuss the concept of stability under uncertainty and introduce solution concepts for robust cooperative games which could be applied to these newsvendor games. Properties and numerical schemes for finding core solutions of robust newsvendor games are presented.

3 - Robust Ranking and Selection: A Sequential Sampling Approach

Xiaowei Zhang, Hong Kong University of Science and Technology, Hong Kong, China, xiaoweiz@ust.hk, Liang Ding

We adopt a robust formulation to address the problem of ranking and selection in the presence of uncertainty of specifying input models. Alternatives are ranked based on their worst-case performance over a group of possible input models and the one with the "best" worst-case performance is selected. Given a finite simulation budget, our objective is to sequentially allocate the budget among the set of pairs of alternative and its input model in order to learn their unknown values and maximize the chance of identifying the best alternative. We propose a new efficient allocation policy that myopically maximizes the information gain of learning the worst-case performance of each alternative.

4 - Robust Extreme Event Analysis

Henry Lam, University of Michigan, khlam@umich.edu

One common bottleneck in tail modeling is that, due to their very nature, tail data are often very limited. The conventional approach uses parametric fitting, but the validity of the choice of a parametric model is usually hard to verify. We propose a robust optimization alternative that does not require any parametric assumption, based on a worst-case analysis under the geometric premise of tail convexity, a feature shared by all known parametric tail distributions. We demonstrate some analytical results and demonstrate numerically how the proposed approach gives a competitive performance versus using conventional parametric methods.

■ MB11

Kona 1

Policy and Planning

Contributed Session

Chair: Yoon Jung Kang, KAIST, Daejeon, Korea, Republic of, 0216kangyj@kaist.ac.kr

1 - A Non Cooperative Bilevel Stackelberg Model to Analyze Global Industrial Grade Wood Pellets Market

Mohammad Sadekuzzaman Roni, Research Scientist, Idaho National Laboratory, P.O. Box 1625,, PC5205505, Idaho Falls, ID, 83415, United States, mohammad.roni@inl.gov

This study analyzes the potential resource distribution in global competitive feedstock markets for industrial grade wood pellets. In contrast to previous trade modeling efforts, this study assumes a fully competitive market, i.e., excluding long-term contract arrangements, to show resource distributions under a potential future commodity market. This is done via a non-cooperative bi-level Stackelberg leader-follower game model. By using the model, the study measures the potential impact of international feedstock competition on the availability of US feedstock resources.

2 - A Mixed Integer Modelling Approach to Natural Gas Distribution Planning in India

Saurabh Chandra, Assistant Professor, Indian Institute of Management Indore, 207, block-A, Main bldg, IIM Indore, Rau-Pithampur Road, Indore, 453556, India, saurabh@iimidr.ac.in

A mixed integer programming approach to strategic capacity planning in India is considered. India has a growing demand for natural gas, spread region wise. The gas pipelines are the major source of transportation. The pipeline infrastructure is not uniformly spread across the nation and there are plans to develop new infrastructure in tune with forecast demand till 2030. The model acts as a decision support for stage wise capacity building.

3 - Wind Farm Layout Optimization for Multiple Turbine Types

Martina Fischetti, DTU, Produktionstorvet, 426 B, Lyngby, 2100, Denmark, martfi@dtu.dk

Modern wind parks are getting bigger, therefore it becomes more and more important to optimize their design. In this work we address the optimal offshore turbine placement, subject to real-world constraints. From an optimization perspective this is a challenging problem due to its large size and due to the presence of several non-linearities. In particular, turbines upwind interfere with turbines downwind (the so called wake effect), causing losses in power production. A main contribution of this work consists in optimizing also turbine type selection, allowing the solution to have different turbine types. The previous work from the authors will be shortly reviewed, and the new results presented.

4 - Environmental Impact of Interstate 680 Express Lane Operation in California: A Quantitative Emission Hot-spot Analysis
Yoon Jung Kang, KAIST, 291 Daehakro yusung gu, Daejeon, Korea, Republic of, 0216kangyj@kaist.ac.kr

This paper examines greenhouse gas emissions(CO2, Methane, NOx) after the conversion of High Occupancy Vehicle(HOV) lane to High Occupancy Toll(HOT) lane in Interstate 680 (I-680) Southbound, California. The emission rates for 24 link on I-680 southbound are generated to identify emission hotspots for hourly series in 2009 and 2011 using EMFAC, an emission module. The three-dimensional graphs illustrates the emission rates for each emission factors for trucks vehicle types such as low-duty auto, low-duty truck, mid-duty truck, and heavy-duty truck. Furthermore, before and after comparison of emission rate in I-680 is carried out to evaluate environmental impacts of HOT lane operations.

■ MB12

Kona 2

Sharing Economy and Operations

Invited: Business Model Innovation

Invited Session

Chair: Guangwen Kong, University of Minnesota, 111 Church Street SE St., Minneapolis, MN, 55455, United States, gkong@umn.edu

Co-Chair: Zizhuo Wang, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States, zwang@umn.edu

1 - We Are on the Way: Analysis of on Demand Booking Systems
Guiyun Feng, University of Minnesota, fengx421@umn.edu, Guangwen Kong, Zizhuo Wang

On demand platforms such as Uber allow passengers with smart phones to submit trip requests and match them to drivers based on their locations and drivers' availability. We build a model to analyze the efficiency of such on demand systems and compare it to systems where people hail taxi on streets. We provide some operational insight on the matching mechanism of on demand systems.

2 - Revenue Management Mechanisms for Multiple-seller Platforms
John R. Birge, University of Chicago, jbirge@chicagobooth.edu

Abstract not available.

3 - Economics of Labors in Sharing Economy
Jianya Ding, University of Minnesota, jding@umn.edu

This paper investigates the differences in labor sourcing between traditional companies and the emerging platforms with sharing economy features. In particular, we consider a service business that matches users with service providers (labors). In traditional companies, labors work a fixed amount of time each day and receives fixed salaries. On the other hand, labors working for sharing platforms can decide on how much to work (and whether or not to work) for the platform each day and receives salaries based on the amount of allocated work. We show under our settings that: compared to traditional companies, the sharing platforms can attract more labors and users and generate a higher profit.

4 - Inventory Rebalancing in Product Rental Networks
Xiaobo Li, University of Minnesota, lixx3195@umn.edu, Xiang Li, Saif Benjaafar

We study the problem of inventory repositioning in a product rental networks. We consider a problem where a fixed amount of inventory is kept at multiple locations. Each location faces stochastic demand for rentals with stochastic rental times. Demand that cannot be satisfied from the location at which it arises is considered lost. A unit rented at one location can be returned to any location and rental periods are stochastic. The objective of the firm is to minimize the sum of repositioning and lost sales costs. We formulate the problem as a Markov decision process and characterize the structure of the optimal repositioning policy. We do so by showing that in each period, the optimization problem is convex.

■ MB13

Kona 3

Stochastic Models and Their Applications

Sponsored: Applied Probability

Sponsored Session

Chair: Junfei Huang, Chinese University of Hong Kong, Sha Tin, Kowloon, Hong Kong, junfeih@gmail.com

Co-Chair: Shining Wu, The Hong Kong Polytechnic University, Hong Hum, Kowloon, Nil, Hong Kong, sn.wu@polyu.edu.hk

1 - Many Server Scaling of the N-system under FCFS-ALIS
Dongyuan Zhan, University College London, d.zhan@ucl.ac.uk, Gideon Weiss

The N-System with Poisson arrivals and exponential server-dependent service times under first come first served and assign to longest idle server policy has explicit steady state distri- bution. We scale the arrival and the number of servers simultaneously, and obtain the fluid and central limit approximation for the steady state. This is the first step towards exploring the many server scaling limit behavior of general parallel service systems.

2 - Optimal Staffing for Ticket Queues
Li Xiao, Chinese University of Hong Kong, Hong Kong, xiaoli@baf.cuhk.edu.hk, Susan H Xu, Hanqin Zhang, David D. Yao

For ticket queues with impatient customers, we use Markov chain analysis and fractional programming to optimize the ticket-based staffing policy so as to minimize the combined delay, abandonment and operating costs. We also develop a random-walk/Brownian motion based approximation approach, and show its asymptotic optimality.

3 - Management of a Shared Spectrum Network in Wireless Communications: A Queueing Approach
Shining Wu, The Hong Kong Polytechnic University, sn.wu@polyu.edu.hk, Jiheng Zhang, Rachel Q Zhang

We consider a band of the electromagnetic spectrum with a finite number of identical channels shared by both licensed and unlicensed users. Such a network differs from most many-server, two-class queues in service systems including call centers due to the restrictions imposed on the unlicensed users in order to limit interference to the licensed users. We first 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. Our analysis reveals a number of distinctive properties of the system.

4 - Beyond Heavy-traffic Regimes: Universal Bounds and Controls for the Single-server Queue
Junfei Huang, The Chinese University of Hong Kong, junfeih@cuhk.edu.hk, Itai Gurvich

This paper pursues a universal approximation - one that maintains the tractability and appeal of the limit approximations but avoids the assumptions that facilitate them. We re-visit the fundamental single server queue and propose an approximation that is derived intuitively from the primitives and can be used universally, i.e., without assuming any specific heavy-traffic regime while allowing for a variety of patience distributions beyond what can be covered by simple limits. The universal diffusion model is provably accurate (with explicit accuracy bounds) and shows stunning numerical performance across a variety of examples. In the second part of the paper we turn from performance analysis to universal optimization, both static and dynamic.

■ MB14

Kona 4

Disease Modeling for Health Policy Decision Making

Sponsored: Health Applications

Sponsored Session

Chair: Lauren Cipriano, Western University, 1255 Western Road, London, ON, N6G 0N1, Canada, lcipriano@ivey.uwo.ca

1 - Calibration Uncertainty in Natural History Models and Implications for Policy Analysis
Julia L Higle, University of Southern California, Los Angeles, CA, United States, higle@usc.edu

Cost / Benefit analyses of disease screening and management strategies are typically based on models of the disease in question. While model development is typically informed by data developed through clinical studies, these data are associated primarily with observable health states. Transitions involving unobservable states are represented via the results of a model calibration process. As a result, the impact of these states on the analysis yields a level of uncertainty on the results. We illustrate this phenomenon, and consider potential ways to mitigate the impact.

2 - A Game Theoretic Model for Pediatric Vaccine Pricing
Banafsheh Behzad, Assistant Professor, California State University, Long Beach, 1250 Bellflower Blvd., MS 850, CBA 440, Long Beach, CA, 90840-8501, United States, banafsheh.behzad@csulb.edu, Sheldon H. Jacobson

Pricing strategies in the United States pediatric vaccines market are studied using a Bertrand-Edgeworth-Chamberlin price game. The game analyzes the competition between asymmetric, capacity-constrained manufacturers producing differentiated products in a market with linear demand. The proposed game is applied to the United States pediatric vaccine market, in which a small number of vaccine manufacturers produce differentiated vaccines. The numerical results indicate that the public sector prices of the vaccines are higher than the equilibrium prices computed for those vaccines.

3 - Allocating Disease Control Funds: Modeling HIV Out of Isolation
Margaret Brandeau, Stanford University, brandeau@stanford.edu

Previous HIV investment frameworks have often considered HIV in isolation and have led to stovepiped programs, duplication of services and wasted expenditure. We present a framework for investment in HIV interventions that considers such investments as part of a broader set of investments in public health and other economic sectors.

4 - Patient Access for Hepatitis C Treatment under Budget Constraints
Lauren Cipriano, Ivey Business School, London, ON, Canada, lcipriano@ivey.uwo.ca, Shan Liu, Jeremy D. Goldhaber-Fiebert

Hepatitis C virus (HCV) affects over 3 million Americans. Curative treatment (>90% efficacy) can cost over $50,000 per patient. Treating all chronically infected individuals would cost more than $100 billion (drug expenditures alone). We present a multi-period HCV treatment budget allocation model to identify economically efficient patient prioritization schemes with and without explicit preference for individuals with advanced liver fibrosis. Prioritizing the treatment of younger patients (< 65 years) with moderate to severe disease (>=F2 fibrosis) while monitoring all patients for potential disease progression maximizes net monetary benefit within current budget constraints.

■ MB15

Kona 5

MSOM/Economic Models

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Shuya Yin, University of California-Irvine, School of Business, Irvine, CA, 92697, United States, syin@merage.uci.edu

1 - The Effect of Sourcing Policies on a Supplier's Sustainable Practices
Vishal Agrawal, Georgetown University, Washington DC, DC, United States, va64@georgetown.edu, Deishin Lee

We investigate the sourcing decisions of firms who want to source sustainably-produced products, e.g., organic ingredients, in order to offer sustainable products. We examine how the firm's sourcing policy and competition between suppliers can influence an upstream supplier's decision to convert to a new sustainable processing standard.

2 - Balanced or Unbalanced Retail Market Structure? An Upstream Supplier's Perspective
Yuhong He, California State University, Fullerton, yuhe@fullerton.edu, Saibal Ray, Shuya Yin

Upstream supplier often faces dilemma over its preference for retail market configuration when selling through downstream partners. Whether balance or unbalanced retail market are preferred could be affected by bargaining approaches and existence of competition within or between supply chains. We propose economic models to gain some understanding of the trade-offs involved in such decision making processes.

3 - Trade-in Price Guarantee: A Triple Bottom Line Perspective
Shuya Yin, University of California-Irvine, Irvine, CA, United States, syin@merage.uci.edu, Wenju Niu, Saibal Ray, Mehmet Gumus, Houcai Shen

This paper aims to analyze a trade-in price guarantee program from perspectives of firms, consumers and the environment. Specifically, we consider a two-period model consisting a value chain with a firm manufacturing and selling a durable product and another firm offering a trade-in price guarantee to consumers. Through this model, we study how such a guarantee affects the firms' performance and the surplus enjoyed by consumers. What is its environmental footprint in terms of its effect on demand for new products that use new materials and energy to produce? We also address how these perspectives are impacted by whether the guarantee is provided directly by the firm itself or a third party.

4 - A Two-period Model of Cooperative Advertising
Salma Karray, Associate Professor, University of Ontario Institute of Technology, 2000 Simcoe street north, Oshawa, ON, L1H 7K4, Canada, salma.karray@uoit.ca

We investigate the long-term effects of advertising in a distribution channel where competing manufacturers can share the cost of retailer's advertising through a cooperative advertising program. We solve a two-stage game theoretic model and obtain closed-form solutions for two games: with and without cooperative advertising. Comparison of equilibrium profits shows that, under some conditions, the retailer should refuse to accept the manufacturers' cooperative advertising offering and ask for additional transfers.

■ MB16

Waikoloa 1

Empirical Operations Management

Invited: Empirical Studies in Operations

Invited Session

Chair: Jingqi Wang, University of Hong Kong, Hong Kong, N/A, jingqi@hku.hk

1 - Higher Prices for Larger Quantities? Non-monotonic Price-quantity Relations in B2b Markets
Wei Zhang, The University of Hong Kong, wzhang15@hku.hk

We study a microprocessor company selling short-life-cycle products to a set of buyers. The seller has a limited capacity for each product and negotiates with each buyer for the price. Our analysis of their sales data reveals that larger purchases do not always result in bigger discounts. Instead, the discount curve is like an "N". While existing theories cannot explain this non-monotonic pattern, we develop an analytical model and show that the non-monotonicity is rooted in how sellers value capacity when negotiating with a buyer. Large buyers accelerate the selling process and small buyers are helpful in consuming the residual capacity. However, satisfying mid-sized buyers may be costly.

2 - Variability Scaling in Healthcare Demands
Jun Luo, Shanghai Jiao Tong University, jluo_ms@sjtu.edu.cn

Demand variability is one of the major sources of uncertainty that affect performance of healthcare systems worldwide. We discover that healthcare demands exhibit a universal variability scaling law in three dimensions, i.e., the temporal, spatial and categorical dimensions. It appears to be the first time that the scaling law is discovered in healthcare management literature. Our findings suggest that commonly used Poisson models are inappropriate in modeling healthcare demands and in healthcare resource planning. We then develop a social network model that is capable of explaining the scaling phenomena caused by different types of demand correlations.

3 - Social Loafing and Queue Driven Speed-up: Evidence From a Supermarket
Jingqi Wang, The University of Hong Kong, jingqi@hku.hk, Yong-Pin Zhou

We study factors affecting server's service time using data from a supermarket. We first derive a prediction that pooling has a negative impact on service rate due to social loafing. We also predict that the service time should be a convex decreasing function of the queue length. Using the supermarket's unique checkout layout that acts as a natural experiment, we find empirical evidence supporting our hypotheses. Specifically, servers in single-server queues are about 5.29% faster than those in two-server queues. And the queue speedup effect is about 5.07% on average for each additional waiting customer.

4 - Price Setting Newsvendor Problem with an Estimable and Flexible Demand
Sirong Luo, Shanghai University of Finance and Economics, luo.sirong@mail.shufe.edu.cn, Haipeng Shen, Jun Zhang

We study the price-setting newsvendor problem using an estimable and flexible demand model, in which the distribution of log-demand belongs to a location-scale family, and the location and scale functions are modeled using cubic regression splines. We prove the unimodality of profit function and show the benefits of new model on operations.

■ MB17

Waikoloa 2

Selected Topics in Pricing and Revenue Management

Sponsored: Revenue Management and Pricing Section

Sponsored Session

Chair: Dan Zhang, University of Colorado, 995 Regent Dr., Boulder, CO, 80309, United States, dan.zhang@colorado.edu

1 - Dynamic Pricing under Revenue Targets: Incentives and Spiraling

Omar Besbes, Columbia University, ob2105@columbia.edu, Dan Andrei Iancu, Nikolaos Trichakis

The implicit or explicit presence of performance targets is widespread in settings in which tactical pricing decisions are delegated. We analyze the incentives induced by such targets on the agent controlling prices in a classical dynamic pricing setting. We show that the agent will always price higher than the system's optimal price. Furthermore, analyzing the dynamics, we show that the agent will always discount items at a lower pace than optimal and that the distortions induced by the performance target compounds over time, leading to some form of spiraling down.

2 - Distribution-free Pricing

Ming Hu, Associate Professor, University of Toronto, 929 Portland Ave., Apt. 1810, Toronto, ON, 55404-1268, Canada, ming.hu@rotman.utoronto.ca, Hongqiao Chen

We study a monopoly robust pricing problem in which the seller does not know the customers' valuation distribution but knows its first and second moments. We propose a robust pricing heuristic and provide its distribution-free, worst-case performance bound. The robust price is lower than the mean valuation, and the higher the variation of the valuation distribution, the more aggressive in setting lower prices the seller should be. We then apply this robust pricing heuristic to the pure bundle pricing problem and show that bundling tends to guarantee higher profits than selling separately. We illustrate our result with a couple of practical examples.

3 - Strategic Consumers, Revenue Management and the Design of Loyalty Programs

Anton Ovchinnikov, Smith School of Business, Queen's University, Kingston, ON, Canada, ao37@queensu.ca, So Yeon Chun

We study an interaction between revenue management and premium-status (e.g., Gold) loyalty program, and the role of strategic consumers. We compare volume-based and spending-based designs and show that when coordinated with revenue management, the spending-based program leads to Pareto improvement under which the firm and each and every consumer can be better off.

4 - A Model of Customer Reward Programs with Finite Expiration Terms

Dan Zhang, University of Colorado at Boulder, Boulder, CO, 80309, United States, dan.zhang@colorado.edu, Yacheng Sun

A prevalent yet little understood phenomenon of customer reward programs is the use of finite reward expiration term. We develop a theoretical framework to investigate the economic rationale behind this phenomenon, and the tradeoff between short and long expiration terms. An empirical investigation of the top 100 US retailers provides directional support for several theoretical predictions. Several extensions of the main model confirm the robustness of these results.

■ MB18

Waikoloa 3

Data Mining and Artificial Intelligence

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 - Improving Workload Prediction for the Cloud Via Clustering

I-Ling Yen, Professor, UTD, 800 W. Campbell Dr., Richardson, TX, 75080, United States, ilyen@udallas.edu

Effective resource management requires accurate workload prediction. Clouds may host many one-time jobs which may have bursty workloads and their predictions have to start with very little historical data. Existing prediction methods mainly consider long running jobs whose workloads show seasonality and trends and they do not work well for Cloud workloads. Generally, cloud providers maintain workload profiles for all jobs submitted in many years, which may be generalized to represent the workloads of new jobs. Based on this observation, we integrate clustering and ARIMA to improve the workload prediction for cloud jobs and experimental results show the effectiveness of our approach.

2 - A Graphical Approach to Maximum Consensus Sequences Mining for Pairwise Comparison Preferences

Li-Ching Ma, National United University, 1 Lienda, MiaoLi, 36003, Taiwan, lcma@nuu.edu.tw

Group ranking problems are commonly found in practice. Most studies have minimized the total disagreement among individual preferences to build an overall ranking list; however, users might have little or no consensus on the final results. This study tries to develop a novel graphical approach to mine maximum consensus sequences. A tournament matrix is constructed via a predefined consensus level, and then an ordinal Gower plot is depicted. By tracking the order of items shown in the Gower plot, maximum consensus sequences can be visualized and found. Compared to previous methods, the proposed approach can discover consensus sequences without generating many candidates and provide visual aids.

3 - Optimization of Electoral Systems using a Polynomial and Genetic Algorithm for Optimal Rounding under Integer Constraints (a New Apportionment Method)

Faezeh Frouzesh, PhD Student, University of Auckland, Auckland, 1010, New Zealand, Ffor011@aucklanduni.ac.nz

After all votes are cast in electoral systems, the total number of votes for each party must be converted to a number of seats in the chamber of representatives. Due to a restriction on the chamber size, the proportion of each party from the total seats as per its share from total votes may not be an integer. Apportionment methods are algorithms for rounding these numbers, while keeping the total number of seats fixed. In this paper, the effects of using well-known apportionment methods are first investigated using historical data from several countries. We then propose a single and multi-objective optimisation method with two fitness functions and a constraint based on a polynomial and genetic algorithm.

4 - Automatic Threat Evaluation of Massive Enemy Aircraft using Radar Information

Hoyeop Lee, Yosnei University, Yonsei-ro 50, Seoul, Korea, Republic of, hoyeop@yonsei.ac.kr

Threat evaluation (TE) is a technique which assigns the threat values to hazard objects. We proposes an automatic TE method of air-breathing threats (ABTs) towards the defended assets using radar information. The proposed method consists of three phases: flight formation clustering of ABTs, target asset prediction of flight formations, and threat value computation. We developed a battlefield simulator based on the pilot's experience and demonstrated that the proposed method performs better than the closest point approach and radial speed vector approach.

Monday, 2:00pm - 3:30pm

■ MC01

King's 1

Decision Analysis: I

Contributed Session

Chair: Tony Barber, George Washington University, George Washington University, Clinton, MD, 20735, United States, barbert@gwu.edu

1 - Decision Sciences for Optimal Labor Strategy Formulation

Naveen Sundaresan, Consultant_Decision Sciences, Hewlett Packard Enterprise, Bangalore, 560066, India, naveen.sundaresan@hpe.com

Optimal labor strategy formulation is key to business strategy planning and has huge impact on the bottom line of the organization. Currently, in most organizations labor demand planning happens in silos and overall company strategy is not always aligned to that of individual business groups. This leads to non-optimal allocation of employees at organization level and revenue loss due to lack of consolidation of right skill sets at right place at the right time. We use decision sciences techniques to unlock non value adding labor costs and also build simulation to identify the impact of various business levers on overall cost savings for the organizations over the planning horizon.

2 - Dynamic Information Fusion Approach Based on Heterogeneous Fuzzy Information

Guangxu Li, School of Management and Economics, University of Electronic Science and Technology of China, Chengdu, Sichuan, China, lgx9889@126.com

Abstract:In the information fusion process, the evaluation attributes may be changed with the environment. Moreover, the decision making attributes are not homogeneous. In order to solve the process and avoid information loss, the dynamic information fusion approach is proposed and the heterogeneous fuzzy information are not transformed in this paper. First, the power average operator is used to aggregate the information of the attributes. Second, the weight of time is determined by entropy method. Third, the weight aggregation operator is used to fuse the evaluation results in different periods. Finally, a numerical example is introduced to illustrate the reasonability of the proposed method.

3 - Decision-making Optimization of Grouping in Dynamic Two-sided Matching Problem

Xinwei Duan, Huazhong University of Science and Technology, Wuhan, China, lanra@qq.com

This paper aims to find out the optimal matching amount for intermediary considering the dynamic two-sided matching, since the trade-off between matching satisfaction and waiting time of customers. A mathematical model is developed to maximize satisfaction and minimize waiting time while its simulation results examine the model effective. It is concluded that for a give arrival rate of customers it is optimal when the number of matching groups is in a range whatever the exact amount of the customers. This model can be applied to many fields such as online ordering and intermediary services.

4 - Applying Decision Analysis to a Systems Uncertainty Framework Complex Systems Development

Tony Barber, George Washington University, 5538 Shallow River Rd., Clinton, MD, 20735, United States, barbert@gwu.edu

Systems Uncertainty is defined as the limitations of information, whether lack of comprehension or the existence of, which negatively impacts the success of systems lifecycle progression and/or the creation of validated systems outcomes. The objective of this research is to extend Hastings and McManus' study on technical uncertainty from a risk and opportunity uncertainty framework into an inclusive approach that leverages decision analysis techniques to assess technical considerations across the Systems Development Lifecycle.

■ MC02

King's 2

Disaster and Disruption Management

Contributed Session

Chair: Eghbal Rashidi, Mississippi State University, Mississippi State University, MS, 39762, United States, er442@msstate.edu

1 - A Large-Scale Airline Disruption Management Dataset

Omer Barkol, Hewlett Packard Labs, Technion City, Haifa, 32000, Israel, omer.barkol@hpe.com

Airline disruptions represent a major challenge for commercial aviation. The complexity of airline operations coupled with tight operational margins and numerous constraints, imposed by route-network and regulatory limitations, make disruption recovery especially challenging. Disruption recovery research is aided by datasets, allowing algorithms and systems to be tested on real-world data. We present a large-scale dataset, featuring multiple hubs, combining actual flight data from the US route-network and simulated passenger itineraries. We test three algorithms, comparing their results on this dataset to the previous European based, single hub, small-scale dataset.

2 - Post-disaster Waste Management for Humanitarian Logistics Operations

Prashant Pandharinath Barsing, Indian Institute of Management-Lucknow, FPM Hostel Room-09, IIM Lucknow, 226013, India, prashant@iiml.ac.in

Over the years, there has been a lot of emphasis on logistics in the area of supply chain management (SCM). It helped in cutting down the cost and also, helped to keep environment clean and green through waste management. Waste management is directly linked with the reverse logistics as it deals with moving wastes from their typical final destination for the purpose of proper disposal. Various governments have always been concerned with recovery from their various disasters they face. Effective utilization of logistics helps us in during that and therefore, we are seeing increasing interest in the field of humanitarian logistics (HL). At the same time, we need to look into sustainability which suggests proper reuse and disposal of waste material produced during humanitarian relief operations. If the waste generated during relief operations can be managed effectively through humanitarian logistics, it will be lead to sustainable humanitarian logistics operations (Klumpp and Regattieri 2015). Waste produced can be divided into degradable and non-degradable components. Degradable waste can be handled easily and have minimum environmental and social impacts (apart from the epidemics, if they are not moved quickly). They can be converted into compost and to generate fuel gases after that residue becomes the part of the soil. recycled in useful products (Gomes et al. 2008; Zurbrugg 2002). As far as non-biodegradable (includes non-readily degradable/practically non-degradable) materials are concerned, they need appropriate measures for its removal from the disaster site. They occupy more space which could have used for the other purposes in relief operations. This requires the non-degradable material to be transported from disaster affected area to other location where they can be handled easily for further processing (Karunasena and Amaratunga 2015; Liu, Wu, and Li 2013). Another challenge is the transportation of non-degradable wastes which may be hazardous to handle. These products are harmful to humans as well as surrounding flora and faunaIn this category we have plastic shelters, food packaging, medicines and health equipments, synthetic wears, water bottles, packaged water etc. The management of non-degradable waste is a big issue as we have very less lead time to dispose them from the disaster site. The quantity of non-degradable waste varies depending on the type of the disaster and affected population size. Waste management strategy changes as per the quality and quantity of the material. Various options present today are as follows: 1)the landfill, 2)thermal recycling, 3)mechanical recycling, 4)chemical treatment, 5)incineration, 6)recycling (to make low-grade plastic). All these options depend on the quantity and quality of the material and it involves cost for processing. It also pollutes air when burned or treated chemically by releasing harmful gases such as CO, CO2, SOX, and NOX (Gupta et al. 1998; Liu et al. 2013; Vego, Kučar-Dragičević, and Koprivanac 2008). Waste Management is studied by many researchers , but our study focuses on selecting methodology to manage non-degradable waste generated by the disaster during the relief operations. Depending on various costs associated and environmental aspects; we can formulate this problem as multi-attribute decision making (MADM) problem. Hence, The alternatives would be various the treatments and various criteria are as follows: 1) associated cost for the treatments 2)various emissions after treatments, 3)the social and legal norms, 4)transportation complexity and cost, 5)land availability, 6)land location, 7)benefits to the society, 8)local community resistance and cultural aspects (Gomes et al. 2008; Soltani et al. 2015; Vego et al. 2008). Decision making flexibility of choosing alternatives can be achieved by using appropriate weights to criteria. Flexibility in such operations can be achieved if we are free to choose between various alternative treatments in order to reduce cost. This can be achieved if we can prioritize them and choose amongst top few. (Finnveden et al. 2007). For such managerial decision making situations, Analytical Hierarchy Process (AHP) becomes useful tool which is applied in vary diverse areas (Vaidya and Kumar 2006). In our study we use AHP as a MADM tool to rank the alternative treatments by pairwise comparison of all criteria given to rank alternatives for an Indian case study.

3 - A Quantitative Gap Analysis of Initial Attack Suppression Resources when Responding to Pyroterrorism

Eghbal Rashidi, PhD Candidate, Mississippi State University, McCain Office 260, c/o Eghbal Rashidi, Mississippi State, MS, 39762, United States, er442@msstate.edu

In this research, we perform a quantitative gap analysis between available capacity and the estimated capacity needs for responding to a pyro-terrorism attack. We model the problem as a Stackelberg game using a bilevel max-min MIP model. The inner level model has binary variables; therefore, we develop a decomposition algorithm to solve it. We use the model to evaluate the impact of pyro-terrorism, i.e., the arrangement of ignition points that causes the maximal damage. We then investigate the relationship between fire response capacity and the rate of spread, fire ignition location and number of fire ignitions in the landscape.

■ MC03

King's 3

Behavioral Operations Management

Sponsored: Behavioral Operations Management

Sponsored Session

Chair: Amnon Rapoport, University of California, 900 University Avenue, Anderson Hall Room 226, Riverside, CA, 92521, United States, amnon@u.arizona.edu

1 - Pollution Discharge Goverance of Enterprise Based on Institutional Design

Shaorong Sun, University of Shanghai for Science and Technology, Shanghai, China, sunshaorong@163.com

Cost allocation institution was used to water pollution governance in perspective of institution design. By established a improved model of cost allocation based on tax deduced two equilibrium points of efforts level under the group utility maximum and individual utility maximum, and got the optimize tax condition when individual enterprise and enterprise group at the same time satisfy the utility maximization. Research shows that when the equilibrium point of optimal effort level of water pollution enterprises deviate from the collective enterprise utility maximum equilibrium levels of individual efforts, both collective enterprise interests and individual interests will be damaged.

2 - Stick to the Plan: The Effect of Myopic Loss Aversion on Planning
Alexander Alexandrovitch Kharlamov, Warwick Manufacturing Group, APC, IIPSI, WMG, University of Warwick, Coventry, CV47AL, United Kingdom, a.a.kharlamov@warwick.ac.uk

Planning in operations management (OM) is challenging because it requires making decisions under uncertainty. Manager's behaviour contributes to the challenge due to over-reactions, mistrust, second-guessing and unnecessary interventions. We test the hypothesis that Myopic Loss Aversion (MLA) affects planning by conducting laboratory and field experiments using a modified newsvendor problem on three groups: naïve students; OM students and; OM professionals. Follows that less frequent interventions to the plan lead to better planning performance, supporting the MLA hypothesis. Implications for planning are suggested to reduce the MLA bias.

3 - Learning with Censored Information: An Application to Inventory Management
Kyle Hyndman, University of Texas at Dallas, 800 W. Campbell Rd, SM31, Richardson, TX, 75080, United States, kyleb.hyndman@utdallas.edu

We conduct an experiment in which subjects simultaneously make two interconnected newsvendor decisions (in that some "consumers" will purchase their less-preferred product if the most preferred product is unavailable). Because of this stockouts create a censoring problem, making sales information unreliable proxies for the unknown demand distribution. When both sales and true demand are given, subjects are less biased and make fewer errors than when demand is not given. Subjects consistently over-estimate demand for the low demand product and under-estimate demand for the high demand product.

4 - The Braess Paradox with Mixed Externalities
Amnon Rapoport, Distinguished Professor of Management, University of California Riverside, 900 University Avenue, Anderson Hall Room 226, Riverside, CA, 92521, United States, amnon@u.arizona.edu

The Braess Paradox (BP) demonstrates that adding links with negative externalities may increase travel costs of all users. Alternatively, deleting such links may benefit all users. Research on the BP traditionally focuses on route choice in congestible networks. We propose a more dramatic version of the BP with mixed externalities involving both congestion and cost-sharing. Our design also involves experimental manipulation of choice observability, where players choose simultaneously routes in one condition and sequentially in another. We report experimental evidence in support of the BP: network augmentation resulted in a 37 percent average increase of travel cost across both conditions.

■ MC04

Queen's 4

Operational Research in Radiation Therapy Planning

Invited: OR in Medicine

Invited Session

Chair: Wei Liu, Mayo Clinic, 5777 East Mayo Blvd, Phoenix, AZ, 85054, United States, Liu.Wei@mayo.edu

1 - 4D Versus 3D Robust Optimization in Intensity-Modulated Proton Therapy for Lung Cancer
Wei Liu, Mayo Clinic, Liu.Wei@mayo.edu

To mitigate uncertainties and interplay effects in optimizing intensity-modulated proton therapy for lung cancers, we used 4D robust optimization that generated plans on 4D-CTs with the clinical target volume of individual phases receiving non-uniform doses to achieve a uniform cumulative dose. Compared to 3D robust optimization, 4D robust optimization provided more robust target dose distribution to uncertainties and led to better target coverage, comparable dose homogeneity, and normal tissue protection with interplay effects considered.

2 - Dose-volume Constrained Optimization for Intensity-modulated Proton Therapy
Neng Fan, University of Arizona, nfan@email.arizona.edu

In intensity-modulated proton therapy (IMPT) treatment planning, we aim to deliver the prescribed dose to the target while minimizing the dose to adjacent normal organs. Mixed integer programming (MIP) has been applied in radiation therapy to generate good treatment plans. In this work, we incorporate dose-volume constraints into MIP model to generate treatment plans for IMPT. Our numerical experiments show that the MIP model with dose-volume constraints can more efficiently generate better IMPT treatment plans compared to the model without such constrains.

3 - Incorporating Functions Information into Radiation Treatment Planning
Marina Epelman, University of Michigan, mepelman@umich.edu

Optimization approaches to Intensity Modulated Radiation Therapy (IMRT) treatment planning aim to optimize adherence to treatment goals using information about patient's anatomy obtained via imaging. Increasingly, biomarker data and other information about biological function can be obtained to provide patient-specific information on response to radiation and predisposition to radiation-induced side effects. We explore methods for incorporating functional information into treatment planning to improve patient outcomes, with examples from lung and liver cancer cases.

■ MC05

Queen's 5

Healthcare Appointment Booking

Invited: Global Health

Invited Session

Chair: Jiafu Tang, Professor, Dong-Bei University of Finance and Economics, Sha He Kou, Dalian, 00000, China, jftang@mail.neu.edu.cn

1 - A Novel Ga-based Feature Selection Approach for Patient Arrival Prediction in Two Different Areas
ShanCheng Jiang, City University of Hong Kong, scjiang2-c@my.cityu.edu.hk, CHIN K.S.

Among a health care system, the emergency department(ED)-which is called outpatient department in China-is facing increasing stress year after year. Prediction of patient arrivals is a premise for rostering and scheduling. Feature selection(FS) process are directly related with the quality of the forecast model. Hence, we designed a modified GA based FS approach, to acquire an optimal input feature subset for prediction. Then, the underlying relationship between patient arrival patterns and different categories of input co-variables are explored. Finally, our methodology is tested via two ED systems in different two areas. The results further validate the universality of our methodology.

2 - Optimization of Outpatient Appointment Scheduling Considering Unpunctuality
Bowen Jiang, Northeastern University, Shenyang, China, ddxx100@sina.cn, Jiafu Tang, Chongjun Yan

Unpunctuality is a stochastic factor inevitable. This paper first researches the unpunctuality in the way of optimization along with other uncertainties. We tend to decide an optimal schedule for patients with a certain no-show rate. The problem is formulated into stochastic linear programming towards minimizing the total cost, and it is approached by sample average approximation (SAA). Numerical experiments are designed to test how schedule adjusts to accommodate the uncertainty of unpunctuality. The most exciting finding is the system no longer double-books patients at the beginning, and the schedule with unpunctuality becomes compact.

3 - Appointment Scheduling Process with Potential Arrivals
Chongjun Yan, Dongbei University of Finance and Economics, yanchongjun0607@163.com, Xuanzhu Fan, Tian Yuanzi

This paper presents a sequential overbooking model with future arrivals. Patients are allocated to the optimal predetermined intervals considering the impacts of reserving this slot for potential same-day patients. It is proved that the evolution of the objective function is unimodal.

4 - A Multi-objective Simulation Optimization for Medical Staff Allocation in Emergency Rooms
Hainan GUO, City University of Hong Kong, Kowloon, Hong Kong, hainaguo-c@my.cityu.edu.hk, Siyang Gao, Kwok-Leung Tsui

Emergency Departments (EDs) play an important role in the healthcare system. The number of ED visits has increased rapidly in the last decade. This increase causes an imbalance between supply and demand and induces long-term overcrowding in hospital EDs. Consequently, medical staff capacity cannot accommodate excessive patient loads, and patients are compelled to wait long hours for medical procedures. In this paper, we propose a framework for multi-objective simulation optimization (MOEA/D-DEA_MOCBA) to optimize the existing medical staff configuration to minimize the average patients' length of stay and medical staff waste costs.

■ MC06

Queen's 6

Recent Advances in Inventory Theory

Invited: Inventory Systems

Invited Session

Chair: Yehua Wei, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States, yehua.wei@duke.edu

1 - Asymptotic Normality of the Optimal Total Cost in a Dynamic Inventory Management Problem

Alessandro Arlotto, Duke University, alessandro.arlotto@duke.edu

In this talk we prove a central limit theorem for the mean-optimal total cost of a classic finite-horizon dynamic inventory management problem. The result demonstrates the applicability to dynamic programming of a new central limit theorem for time non-homogeneous Markov chains.

2 - Inventory Management with Opaque Products

Yehua Wei, Fuqua School of Business, yehua.wei@duke.edu

An opaque product is a product where the retailer hides some attributes of the product until after it has been sold. Although opaque products have traditionally been used for price discrimination, we show that opaque products can also be used for reducing inventory costs. In this talk, we study a model where customers arrive dynamically and choose between two substitutable products and an opaque product, which is sold at a discount. We prove that offering an opaque product can strictly improve the profit of the retailer. We also analytically show that using opaque products to balance inventory has dramatic cost advantages, even when the amount of opaque products sold is relatively small.

3 - Optimal Policies for a Dual-sourcing Inventory Problem with Endogenous Stochastic Leadtimes

Li Xiao, The Chinese University of Hong Kong, xiaoli@baf.cuhk.edu.hk, Jing-Sheng Jeannette Song, Hanqin Zhang, Paul H Zipkin

We consider a single-product dual-sourcing inventory system with a Poisson demand process and complete backlogging. The normal supply source consists of a two-stage tandem queue with exponential production time at each stage. The emergency source skips the first stage, for a fee. We characterize optimal ordering policies.

4 - Demand Clustering and Inventory Optimization for Fashion Products

Tong Wang, National University of Singapore, tong.wang@nus.edu.sg

We study demand estimation and inventory optimization for fashion products. Based on historical product covariates and sales, we construct Bayesian structure model to cluster products that share commonality in covariates and sales pattern. At the beginning of a new season after covariates of new products are observed, they are assigned into the clusters, and their demand distributions are estimated. Inventory decisions are made accordingly. Clustering is updated at the end of the season.

■ MC07

Kohala 1

Analysis of Large Scale Networks

Invited Session

Chair: Kavita Ramanan, Brown University, 182 George Street, Providence, RI, 02912, United States, kavita_ramanan@brown.edu

1 - Analysis of LargeScale Networks

Kavita Ramanan, Brown University, 182 George Street, Providence, RI, 02912, United States, kavita_ramanan@brown.edu

Large-scale stochastic networks arise in a variety of real-world applications, ranging from telecommunications and service systems, to computer networks and health care services. Such networks are complex and typically not amenable to exact analysis. However, it is often possible to provide qualitative and quantitative insight into network performance using tractable approximations. In this tutorial, we will describe some mathematical techniques that are useful for identifying such approximations under realistic assumptions such as generally distributed service times and time-varying arrivals or demand.

■ MC08

Kohala 2

Marketing Operations Interface

Invited: Operations/Marketing Interface

Invited Session

Chair: Chakravarthi Narasimhan, Washington University, Washington University, Saint Louis, MO, 00000, United States, narasimhan@wustl.edu

1 - Opaque Distribution Channels for Competing Service Providers: Posted Price vs. Name-your-own-price Mechanisms

Rachel Rong Chen, University of California-Davis, rachen@ucdavis.edu, Esther Gal-Or, Paolo Roma

Opaque selling has been widely adopted by service providers in the travel industry to sell off leftover capacity under stochastic demand. We consider a two stage model to study the impact of different selling mechanisms, Posted Price (PP) vs. Name-Your-Own-Price (NYOP), of an opaque reseller on competing service providers who face forward-looking customers.

2 - Channel Authorization with Warranty: The Bright Side of Unauthorized

Xiaodong Yang, Beijing Foreign Studies University, Beijing, China, yangxiaodong@bfsu.edu.cn, Gangshu Cai, Charles A Ingene

When a manufacturer distributes its product downstream, it may choose a list of authorized retailers. The authorized retailers are endowed with a warranty while the unauthorized ones are not. Through a model with a manufacturer selling its product through two retailers, we investigate whether it is beneficial for the manufacturer to adopt partial authorization versus full authorization. Our analysis confirms that the manufacturer can benefit from partial authorization and identifies the threshold condition. Moreover, we find that the unauthorized retailer can benefit from being unauthorized. And the authorized retailer under partial authorization would like its rival to be authorized too.

3 - MRP, MSRP and Retailer Service Provision: Competitive Effects and Consumer Welfare

Chakravarthi Narasimhan, Washington University, narasimhan@wustl.edu, Yuanfang Lin

MSRP is a common pricing structure employed in many western markets. MRP is a variant of MSRP that is often binding on the retailer and used in a small set of countries like India and Sri Lanka. In this paper we explore the strategic implications on competition when such pricing structures are adopted under retail service provision. We construct a model of bilateral monopoly and contrast the implications when there is competition at either manufacturer or retail level and explore implications for consumer welfare.

■ MC09

Kohala 3

Forecasting

Contributed Session

Chair: Shuo Zhu, zhushuo_159@163.com

1 - Sales Forecasting with Temporal Big Data: Avoiding Information Overload for Supply Chain Management

Yves R. Sagaert, Gent University, Technologiepark 903 Campus Ardoyen, Gent-Zwijnaarde, B-9052, Belgium, yves.sagaert@ugent.be

Global supply chain decisions occur well in advance to sales. Decisions on raw material procurement, capacity scheduling, production and inventory planning need to be aligned and tactical sales forecasting up to 12 months is an essential input in this process. However, traditional models that extrapolate past data cannot anticipate changing macroeconomic trends. Furthermore, expert judgement is hard in uncertain and volatile markets, and known to be biased. This research uses temporal big data from macroeconomic leading indicators to forecast tactical sales. The proposed framework improves forecasting accuracy over industry benchmarks by identifying and modelling key leading indicators.

2 - A Horse for Almost Every Course; Forecasting and Planning with the Theta Method

Kostas Nikolopoulos, Chair in Decision Sciences, Bangor University, Bangor Business School, College Road, Bangor, LL57 2DG, United Kingdom, k.nikolopoulos@bangor.ac.uk

In this paper we conclude the theoretical underpinning of the method as: a) we consider a non-unit root DGP and a stochastic trend, b) damping that trend via a double Theta smoothing approach, c) echoing local data characteristic via a local Theta method, d) providing a full multivariate extension. But most importantly we provide sound evidence that it is the benchmark to beat (via a thorough literature account) and provide empirical results that show that the method is fully applicable in non-OR/MS contexts with applications in finance and economics, and in any other context: A Horse for Almost Every Course.

3 - Optimal Bike Fleet Management by Smart Relocation Methods: Combining an Operator-based with a User-Based Relocation Strategy
Svenja Reiss, University of the Federal Armed Forces, Munich, Germany, svenja.reiss@unibw.de

Based on an empirical data analysis, a simulation was built up in order to forecast the upcoming demand for an urban Bike Sharing System (BSS). To satisfy this demand, a relocation strategy is applied to rebalance the fleet of the BSS. In case of moderate imbalances, a pricing model incents users to ride bikes from "bad" to "good" spots. This saves operator's cost as no further relocation trips by truck are generated. If the imbalances are severe though, the user-based method is not sufficient and the operator needs to intervene supplementary. Therefore, the relocation model provides an optimal strategy to combine both methods.

4 - A Hybrid Model for Forecasting Daily Crude Oil Prices
Shuo Zhu, PhD Candidate, The University of Hong Kong, Hong Kong, zhushuo_159@163.com

We exploits the advantages of both complementary ensemble empirical mode decomposition (CEEMD) techniques and support vector machines (SVM) techniques by developing a novel hybrid model. The proposed model decomposes the crude oil price series into several intrinsic mode functions and one residual component. The subseries are then forecasted by an SVM model. Finally, another SVM model is constructed to forecast the final price. Tests run for one-period-ahead predictions are performed using daily WTI and Brent crude oil prices. The proposed model compares favourably with other well established models such as the SVM, Artificial Neural Network (ANN), Wavelet ANN, and EMD-FFNN-ALNN model.

■ MC10

Kohala 4

Recent Advances and Applications of Robust Optimization

Invited: Robust Optimization

Invited Session

Chair: Zhichao Zheng, Assistant Professor, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, danielzheng@smu.edu.sg

1 - Ambiguous Joint Chance Constraints under Mean and Dispersion Information
Grani Adiwena Hanasusanto, École Polytechnique Fédérale de Lausanne, grani.hanasusanto@epfl.ch

We study joint chance constraints where the distribution of the uncertain parameters is only known to belong to an ambiguity set characterized by the mean and support of the uncertainties and by an upper bound on their dispersion. This setting gives rise to pessimistic (optimistic) ambiguous chance constraints, which require the corresponding classical chance constraints to be satisfied for every (for at least one) distribution in the ambiguity set. We provide tight conditions under which pessimistic and optimistic joint chance constraints are computationally tractable, and we show numerical results that illustrate the power of our tractability results.

2 - Inventory Allocation for New Item in Online Retailing
Long He, National University of Singapore, longhe@nus.edu.sg

We consider the inventory allocation problem for new item with no sales observations. Based on the historical sales of other items in the same category as well as their product attributes, we develop a robust optimization model that suggests inventory allocation plan for the new item. In the numerical experiments with real sales data, our approach shows improvements over the industry benchmark.

3 - Capacity Planning in Project Management by Adaptive Robust Optimization
Daniel Zhuoyu Long, Chinese University of Hong Kong, zylong@se.cuhk.edu.hk

We consider project planning with partially characterized probability distributions for task durations. First, the project company makes capacity reservations with an outsourcing company. Given those decisions, we consider the worst case distribution of task durations. Based on both its reserved capacity and the worst case distribution of task durations, the company makes decisions about fast tracking and outsourced crashing. Based on typical concerns about downside risks in project companies, the objective of the model is to minimize the project's worst case conditional value-at-risk (CVaR) of its total costs.

4 - Appointment Scheduling with Unpunctual Patients
Zhichao Zheng, Singapore Management University, danielzheng@smu.edu.sg

Unpunctual arrivals in healthcare systems lead to over-congestion of waiting rooms, long idle time and overtime work of physicians. 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 distributionally robust version of the appointment scheduling problem. Our analysis using clinical data suggests that it is important to account for unpunctual patient arrivals in the design of appointment policies only when patients can be scheduled to arrive before the session starts.

■ MC11

Kona 1

Advanced Topics on Reliability Modeling and Analysis

Sponsored: Quality, Statistics, and Reliability

Sponsored Session

Chair: Zhisheng Ye, National University of Singapore, Singapore, yez@nus.edu.sg

1 - A Cumulative-exposure-based Algorithm for Failure Data from a Load-sharing System
Zhisheng Ye, National University of Singapore, yez@nus.edu.sg

In a load-sharing system, failure of one component increases stress of the surviving ones. This study develops an iterative algorithm for analysis of failure data from load-sharing systems. In each iteration, we first obtain the equivalent operating time of each component under a given stress by capitalizing on the cumulative exposure principle. Then the equivalent operating times, which are simply right-censored, are fitted to update the parameter estimates. The algorithm is easy to implement compared with existing methods such as MLE. Convergence properties of the algorithm are investigated.

2 - Component Replacement and Reordering Polices Considering Inventory of Spare Parts with Two-phase Deterioration
Haitao Liao, Professor, University of Arkansas, Fayetteville, AR, 72701, United States, liao@uark.edu, Hongwei Luo

Spare parts demands are usually generated by the need of maintenance either preventively or at failures.For some special spare parts, due to their deteriorating nature, the degradation process takes place when they are stocked in inventory.We introduced two different part consumption scenarios, i.e., Degraded-First (DF) and New-First (NF), in which the order of using the parts is based on the parts' degradation states. Mathematical models are developed for the two scenarios and the operation costs are analyzed through numerical examples.

3 - Aggregate Discounted Warranty Cost Forecast for a New Product Considering Stochastic Sales
Wei Xie, South China University of Technology, bmwxie@scut.edu.cn

Abstract not available.

4 - A Modeling Framework for Resilience Assessment of Critical Infrastructure Systems
Lijuan Shen, National University of Singapore, Singapore, isesl@nus.edu.sg, Loon Ching Tang

Over the last decade, there has been an increasing interest in resilience research. We proposed a two-dimensional resilience index for assessing resilience of infrastructure systems, namely resistance and recovery, which take into consideration the intrinsic system capacities, recovery effort and effectiveness, and the magnitude of external disruptions. The stochastic ordering is used to compare resilience between different systems. Taking the electric power systems in Pennsylvania and New York in the aftermath of Hurricane Sandy as a case study, resilience indices of the two systems are computed and compared.

5 - Fractal System Resilience: Quantification of the Effects of Subsystems Resilience
Dante Gama Dessavre, PhD Candidate, Stevens Institute of Technology, Castle Point on Hudson, Hoboken, NJ, 07030, United States, dgamades@stevens.edu

Resilience is generally understood as the ability of a system to recover from disruptive events. A big challenge is that subsystems are vulnerable to different threats. The number of potential disruptions grows (at least) exponentially when the size and number of sub-systems increases. Along the increased number of possible disruptions,the compilation of the multiple subsystem performances regarding the behavior of the overall system is a big challenge. This work analyzes the compilation of subsystem measurements for system resilience models. Additionally, it is shown how the new metrics and visualizations can be used to estimate subsystem interdependencies and non linear effects.

■ MC12

Kona 2

Learning and Experimentation in Supply Chain

Invited: Business Model Innovation

Invited Session

Chair: Ankur Mani, University of Minnesota, 111 Church Street SE, St. Paul, MN, 55455, United States, amani@umn.edu

1 - Non-stationary Regret Analysis for a Non-convex Online Learning Model

Xiaobo Li, University of Minnesota, Minneapolis, MN, United States, lixx3195@umn.edu, Xiang Gao, Shuzhong Zhang

We present a non-stationary regret analysis for an online learning model with smooth but non-convex cost functions. The cost functions are assumed to satisfy a condition which is more relaxed than the usual pseudo-convexity. Moreover, the cost functions are assumed to satisfy an error bound condition implied by the analyticity. Under this framework, assuming only the loss function values can be evaluated we design a learning algorithm without resorting to the gradient information, and show that the total regret of the algorithm is proportional to the square root of the product of learning periods and the variational budget which is the total variation of the optimal solutions measured in distance.

2 - Online Revenue Management using Thompson Sampling

Kris Johnson Ferreira, Harvard Business School, kferreira@hbs.edu, David Simchi-Levi, He Wang

We consider the dynamic pricing problem where an online retailer aims to maximize revenue over the course of a selling season given limited inventory. The retailer does not know the expected demand at each price and must learn demand from clickstream data. We propose an efficient and effective dynamic pricing algorithm, which builds upon the Thompson sampling algorithm used for multi-armed bandit problems by incorporating inventory constraints into the pricing decisions. Our algorithm proves to have both strong theoretical performance guarantees as well as promising numerical performance when compared to other algorithms developed for the same setting.

3 - Non-stationary Gaussian Process Bandits

Ankur Mani, University of Minnesota, 111 Church St. SE, Minneapolis, MN, United States, amani@umn.edu, Ashish Kapoor, Eric Horvitz

We study the non-stationary version of the correlated multi-armed bandit problem where the correlations between the rewards from different bandits and at different times are captured by a Gaussian process. We identify the rate at which the optimal regret grows and provide an algorithm that achieves the optimal regret.

■ MC13

Kona 3

Regulation of Energy Markets

Invited: Energy Systems

Invited Session

Chair: Anthony Downward, University of Auckland, Level 3, 70 Symonds street, Auckland, 1010, New Zealand, a.downward@auckland.ac.nz

1 - Incentives and Disincentives to Trading under the U.S. Clean Power Plan

David Young, Electric Power Research Institute, dyoung@epri.com

The U.S. EPA recently finalized the Clean Power Plan (CPP), which aims to restrict emissions of CO2 from existing generating units. Under the CPP, each state is set a target, either a cap on emissions or a cap on the emissions rate of existing units. The CPP allows for inter-state trading to lower the cost of compliance. States can trade short tons CO2, or 'ERC' credits (MWh). But there is a third tradable commodity that can help states comply: inter-state power flows. In this talk, we show that, when simultaneously trading multiple commodities, a state may actually end up worse off from trading. This deviates from the conventional wisdom that trading in pollutant markets leaves all participants better off.

2 - Multistage Risk Aversion Applied to the Electricity Sector

Regan Baucke, University of Auckland, rbau155@aucklanduni.ac.nz, Golbon Zakeri, Anthony Downward, Basil Sharp

The notion of risk aversion is becoming increasingly important in energy markets particularly when planning over multiple time periods. Nested risk measures can fail to capture behaviour of risk averse agents in finite-horizon problems. The notion of time consistency is visited and its importance highlighted. We then introduce a new dynamic risk measure which is time-consistent and adapts after each decision so that a beginning to end two-stage risk mapping is made (a more natural model for risk in a multistage setting). We analyse its construction, discuss its algorithmic drawbacks and present an illustrative example based on contract procurement.

3 - Machine Learning in Distribution Networks: Estimation and Security

Deepjyoti Deka, Los Alamos National Lab, 3200 Canyon Road, Los Alamos, NM, 87544, United States, deepjyotideka@gmail.com

Distribution grids provide the final tier in the transfer of electricity from generators to loads. Traditionally, they have been equipped with limited real-time monitoring devices and have low observability. We study learning in the distribution grid using available voltage data at a limited number of grid nodes. For a range of operating conditions, machine learning algorithms based on the physics of power flows are proposed to learn the structure of the distribution network as well as to estimate the statistics of load profiles at the missing nodes. This work can be applied to improve control and optimize operations in the grid as well as to understand the scope of adversarial attacks on grid security.

4 - Transparent Pricing of Transmission Assets in Electricity Markets

Anthony Downward, University of Auckland, Auckland, New Zealand, a.downward@auckland.ac.nz, Andy Philpott, Keith Ruddell

Whenever a transmission asset is put into service it has an effect on the market: either through relieving congestion, increasing reliability, or connecting new generation or load to the grid. Ideally, the costs of the new grid asset should be fairly apportioned amongst those who benefit from the line. Currently, there is much debate around what a fair distribution is, and how one can quantify the benefits accruing from a grid asset. In this work, we propose a beneficiary-pays transmission pricing scheme that is able to appropriately determine the energy-based benefits of grid upgrades.

■ MC14

Kona 4

Data-driven Models in Healthcare Delivery

Sponsored: Health Applications

Sponsored Session

Chair: Joel Goh, Harvard Business School, Boston, MA, 02163, United States, jgoh@hbs.edu

1 - Models Based on Longitudinal Patient Encounter Data

Hari Balasubramanian, Univ of Massachusetts-Amherst, hbalasubraman@ecs.umass.edu

A holistic picture of a patient's medical history is possible only by studying his/her healthcare encounters longitudinally. Each individual is likely to have a different combination of diagnoses and types of encounters (ER events, hospitalizations, office visits, prescription medication events). These encounters can be visualized as evolving point processes that are stochastic, non-stationary in time and non-Markovian (since the complete history of past events is likely to influence future ones). Using concrete examples, this talk will explore and conceptualize how longitudinal patient data can be used to answer a operational questions related to care coordination and continuity.

2 - Evidence of Strategic Behavior in Medicare Claims Reporting

Hamsa Sridhar Bastani, Stanford University, Stanford, CA, United States, hsridhar@stanford.edu, Joel Goh, Mohsen Bayati

Medicare has sought to improve patient care by penalizing providers for hospital-acquired infections (HAIs). However, these efforts may be undermined if providers upcode, i.e. mis-report HAIs (possibly unintentionally) to increase reimbursement. Identifying upcoding is challenging due to unobservable confounders. We exploit state-level variations in adverse event regulation and instrumental variables to estimate that over 10,000 infections (nearly 15%) are upcoded each year, resulting in an added cost of $200 million. Our findings suggest that increasing financial penalties alone may not reduce HAI incidence. We make several policy recommendations accordingly.

3 - Discretionary Task Ordering: Queue Management in Radiological Services

Maria R. Ibanez, Harvard Business School, mibanez@hbs.edu, Jonathan Clark, Robert Huckman, Bradley R Staats

A long line of research examines how best to schedule work to improve operational performance. This literature traditionally takes the perspective of a central planner who can structure work and then expect individuals to execute tasks in a prescribed order. In many settings, however, workers have discretion to deviate from the assigned order. Using data from physicians reading more than 2.4 million radiological studies, we examine the conditions under which discretion is exercised and the performance implications.

4 - Data Uncertainty in Markov Chains: Application to Cost-effectiveness Analyses of Medical Innovations

Joel Goh, Harvard Business School, Boston, MA, United States, jgoh@hbs.edu, Mohsen Bayati, Stefanos Zenios, Sundeep Singh, David W Moore

When Markov chains are used as a modeling framework for cost-effectiveness studies, data inadequacy can manifest as imprecision in the elements of the transition matrix. We study how to compute extremal values for the discounted value of the chain (with respect to a vector of state-wise costs or rewards) as these uncertain transition parameters jointly vary within a given uncertainty set. We show that these problems are computationally tractable if the uncertainty set has a row-wise structure, and generally intractable otherwise. We apply our model to assess the cost-effectiveness of fecal immunochemical testing (FIT), a new screening method for colorectal cancer.

■ MC15

Kona 5

Sustainable Supply Chain Management

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Lindu Zhao, Southeast University, Nanjing China, Nanjing, 210000, China, 101005398@seu.edu.cn

1 - A Model and a Heuristic for the Petrol Station Replenishment Problem with Balancing Drivers' Workload

Lijun Sun, Dalian University of Technology, Dalian, China, slj@dlut.edu.cn, Haiyang Shi

Based on the equity theory, we present a model comparing drivers' workload. Integrating it with the traditional model of vehicle routing problem of petrol distribution, we propose a multi-objective optimization model of the petrol station replenishment problem. To solve the model, we investigate a heuristic algorithm based on NSGA-II. Computational results show that the proposed model and the heuristic can generate a distribution plan that doesn't only optimize the total distribution cost, but also balances drivers' workload.

2 - Research on International Supply Chain Planning with Consideration of Different Carbon Emission Cap-and-Trade Systems

Lindu Zhao, Southeast University, ldzhao@seu.edu.cn, Zhicheng Huang

International companies are facing challenges driven by cap-and-trade systems in different countries or regions. We extend traditional supply chain planning model to incorporate two cap-and-trade systems, one with fix carbon emission price and another with variable carbon emission price. We analyze the impact of different carbon emission price mechanisms on supply chain planning and carbon emission. The results show that different carbon emission price mechanisms lead to different emission cost. Company tends to transfer production tasks to the region with lower emission cost, leading to higher emission in the region and jeopardize the effect of regional cap-and-trade system.

3 - The Order Choice Decision of Irrational Newsvendors and the Pull-to-Center Effect

Haiyan Wang, Southeast University, Nanjing, China, hywang@seu.edu.cn, Juan Zhiru

To study the pull-to-center effect analytically, we propose a choice model of newsvendor under a heuristic decision rule, called mean anchoring and adjustment. By optimizing and analyzing the proposed model, we verify some existed results of the related empirical studies. Also, we show the impact of retail price and computational ability on the pull-to-center effect numerically. In addition, we also provide some managerial implications of the proposed model about the performance of the product portfolio strategy and computational ability on enterprise overall profit.

4 - Spot Trading vs. Wholesale Contract: The Role of Information Acquisition

Xiaolin Xu, Nanjing University, xuxl@nju.edu.cn

In the paper, we analyze two procurement manners, namely, the spot market and the wholesale contract. Under the spot market trading, the supplier and the retailers exchange their demand and supply at an open market and the market price is determined by the marketing clearing condition. We provide analytical solutions on the order decisions and the information acquisition behaviors of those retailers. Moreover, we provide insights on how the information acquisition behavior can influence the choice of supply options and how it affects the supplier, the retailers and the whole supply chain's profits.

■ MC16

Waikoloa 1

Finance- Theory and Empirics

Contributed Session

Chair: Inaki R. Longarela, Stockholm University, Stockholm University, inaki.rodriguez@sbs.su.se

1 - Analysis of BDF2 to Evaluate Option Prices with Nonconstant Volatility under the Jump-Diffusion Models

Younhee Lee, Assistant Professor, Chungnam National University, Department of Mathematics, Chungnam National University, 99 Daehak-ro, Yuseong-gu, Daejeon, 34134, Korea, Republic of, lyounhee@cnu.ac.kr

We present a numerical method to price European options under the jump-diffusion models with nonconstant volatility. A European option is given by a partial integro-differential equation (PIDE) with variable coefficients. We suggest the 2-step backward differentiation formula (BDF2) to solve the PIDE and prove the second-order convergence of the proposed method in the discrete ℓ^{2}-norm. The integral over a nonlocal domain is discretized by applying the extrapolation method so that the derived equation can be solved with the LU decomposition method. Numerical results show the quadratic convergence of the proposed method under the jump-diffusion model with variable coefficients.

2 - Investment Timing under Debt Financing Constraints Based on Collateral

Takashi Shibata, Tokyo Metropolitan University, Tokyo, Japan, tshibata@tmu.ac.jp

This paper examines the optimal investment timing decision problem of a firm constrained to a debt issuance limit determined by collateral value. We find two interesting results which are contrary to our intuition. First, upper limit of debt financing does not always delay the corporate investment, compared with the case without upper limit of debt issuance. That is, upper limit may accelerate the investment. Second, debt financing with upper limit does not always accelerate the investment although debt financing without upper limit always does.

3 - Debt-Equity Swap and Strategic Debt Service with Firms' Cross-Holdings of Debts

Kyoko Yagi, Tokyo Metropolitan University, 1-1 Minami-Osawa, Hachioji, Tokyo, 192-0397, Japan, kyagi@tmu.ac.jp

We analyze the interaction of the debt renegotiation between two firms that issue equity and consol bond, and cross-hold the other firm's issuing consol bond each other. When the firms are reciprocally the debt holders of the other firms, the possibility of debt renegotiation will affect each other. We show the method to specify the security values at debt renegotiation and clarify the sequence of simultaneous and non-simultaneous renegotiation. We derive the comparative statics of the value function and the renegotiation boundaries under cross-holdings of debts.

4 - A Comparison of the SSD- and MV- Efficient Frontiers

Inaki R. Longarela, Assistant Professor, Stockholm University, Stockholm, Sweden, inaki.rodriguez@sbs.su.se

In this paper the set of all second-order stochastic dominance (SSD) efficient portfolios is characterised by using a series of mixed-integer linear constrains. Our derivation employs a combination of the first-order conditions of the utility maximisation problem together with a judicious use of binary variables. This characterisation opens the door to the formulation of optimisations whose objective function is free to select a particular portfolio out of the entire SSD-efficient set. The usefulness of our main result is illustrated by examining the SSD-efficiency of the mean-variance frontier across a variety of datasets and return frequencies.

■ MC17

Waikoloa 2

Response, Relief, and Resilience in Public Sectors

Sponsored: Public Sector OR

Sponsored Session

Chair: Nan Kong, Purdue University, 206 S. Martin Jischke Dr., West Lafayette, IN, 47907, United States, nkong@purdue.edu

1 - Reliable Facility Location Design under Correlated Facility Disruptions

Siyang Xie, University of Illinois, sxie13@illinois.edu

Real-world facilities are subject to probabilistic disruptions. Such disruptions sometimes exhibit complex correlations. This paper builds an overarching methodological framework for reliable facility location design under correlated facility disruptions. We first extend the concepts and methods int Li et al. (2013) and Xie et al. (2015) to capture any facility disruption correlation. We then develop a compact mixed-integer mathematical model to optimize the facility locations. Lagrangian relaxation based algorithms are proposed to effectively solve the model. Numerical case studies are conducted to test the performance of the modeling framework, and to draw managerial insights.

2 - Flood Disaster Relief Services: A Research Agenda for Recovery

Aleda Roth, Clemson University, Clemson, SC, United States, aroth@clemson.edu, Niratcha Tungtisanont, Yann Ferrand

We discuss operational issues around post disaster recovery processes. We present a conceptual typology for natural disasters, in general. More specifically, we focus on floods as the OECD estimates that by 2050 almost one-fifth of the world's population will be affected. We illustrate the opportunities for humanitarian service process improvements for flood recovery in the context of Thailand, and offer a research agenda.

3 - Optimal Patrolling Strategy: A Solution for Incident Response Planning

Leila Hajibabai, Washington State University, leila.hajibabai@wsu.edu, Debashis Saha

Effective operation of incident response programs helps clear traffic accidents in a timely manner, avoids secondary accidents, improves traffic safety, and mitigates congestion. To facilitate transportation and enforcement agencies' decision-making, this research develops mathematical programs to determine the respondents' optimal patrolling strategies under uncertain demand. The objective is to minimize the time needed to access and clear roadway incidents. The numerical results show that the proposed solution approach can solve the problem effectively.

4 - Resiliency: How Perception Informs Action

Michelle MH Seref, Assistant Professor, Virginia Tech, 880 West Campus Drive, Pamplin Hall, Blacksburg, VA, 24061, United States, mmhseref@vt.edu, Roberta S Russell

This research uses text mining to determine if a community's view of resilience (its resilience stance) as reflected in newspaper accounts of disaster events affects subsequent actions by the community, businesses and public policy. Preliminary results show a correlation between resilience stance and type of action, as well as resilience stance and type of disaster.

■ MC18

Waikoloa 3

Data Mining and Machine Learning in Various Applications

Contributed Session

Chair: Vanessa Kummer, University of Zurich, University of Zurich, Zurich, 8044, Switzerland, vanessa.kummer@business.uzh.ch

1 - An Automatic Device for Hybrid Linear-non Linear Ensemble Forecasting Methods in Transportation and Logistics

Luiz Campos de Sa Lucas, Consultant, mc15 Consulting, Rua Vice Governador Rubens Berardo, 65 Bloco 1 Apt. 406, Rio de Janeiro, 22451-070, Brazil, luizsa.lucas@mc15.com.br

We present a hybrid linear-non linear device for automatic time series forecasting, using traditional methods (stl, arima etc.) and non linear predictive models (SVMs, randomForests etc.).The automatic device consists on a two-step algorithm. The first one is based on a Classifier that has as input, for each time series to be forecasted, nine characteristics (Wang, Smith and Hyndman (2006) Characteristic-Data Mining and Knowledge Discovery, 13(3), 335-364.) of these series. The second step is an Ensembler that uses information provided by the first step and the original series (not its characteristics) to produce final forecasts and confidence intervals.

2 - Data Analytics for Venture Evaluation

Sanjeev Naguleswaran, Principal Consultant, QSPectral Systems, VenturePredict, 2/125 Bulimba Street, Brisbane, 4171, Australia, sanjeev@qspectral.com.au

The VC industry has relied on intuition to produced returns in line with the market over the last decade. Venture Predict is a predictive method that qualifies and quantifies ventures, based on proprietary combinations of explanatory variables, achieving (on average) a higher than market return per given level of risk, thereby increasing the Sharpe ratio. We propose a data analytics based method to analyse potential investments and create a regime of data driven decision making to optimise investor portfolios. Machine Learning based multi-factor decision analysis is an approach that can account for alternatives, contingencies and constraints to promote good decision-making under uncertainty.

3 - Clustering Airports using Original Analysis Method for Growth of Networks using Node Categorizations

Hiroko Nakamura, Project assistant professor, University of Tokyo, 7-3-1 Hongo Bunkyo-ku, Tokyo, 1138656, Japan, techhn@mail.ecc.u-tokyo.ac.jp

Aviation network is complex because it's the result of human's economic & cultural divers activities. To make appropriate airport policy decisions, understanding multiple attributions of airports is need. On the other hand, complex network researchers often take the aviation network to demonstrate the researches such as estimation of network growth. Conventional approaches use a single node attribution to cluster nodes or predict links. We propose a method analyzing multiple node attributions. Applying the method to the US aviation network, we clusterlized about 300 airports into 49 clusters based on 4 nodes attribution and enabled discussion of network growth in divers airport attributions.

4 - Optimal Pricing Based on Real Estate Demand Data

Vanessa Kummer, University of Zurich, Moussonstrasse 15, Zurich, 8044, Switzerland, vanessa.kummer@business.uzh.ch

Property portals typically only capture the supply side of housing. Search subscriptions of Swiss portals allow us to estimate the demand of housing, but the data suffers from missing information and discontinuities. In this paper we overcome these problems using a Machine Learning approach. Subsequently, we derive a function determining the optimal combination of price and sale probability for a real estate property, by using information on the supply, the estimated demand, and quality characteristics.

Monday, 4:00pm - 5:30pm

■ MD01

King's 1

Decision Analysis: II

Contributed Session

Chair: Pascal Stachow, University of Manchester, Manchester Business School, Manchester, M4 1BH, United Kingdom, pascal.stachow@postgrad.mbs.ac.uk

1 - Interpretive Structural Modeling to Assess Third Party Logistics Providers

Aman Gupta, Embry-Riddle Aeronautical University-WorldWide, 10733 Copper Ridge Drive, Louisville, KY, 40241-4874, United States, aman.gupta@erau.edu

The research involves identifying the attributes that companies use in the evaluation and selection of third party logistics (3PL) providers. The research also identifies the relationship among the attributes. Understanding the mutual influence among different attributes and the consequences help the decision maker make more informed decisions. Interpretive Structural Modeling (ISM) is used as the methodology to summarize and identify the relationships among attributes for selecting a 3PL. Relationships among attributes are derived and structured into a hierarchy in order to derive subsystems of interdependent elements with corresponding driving power and dependency.

2 - Effectiveness of Network-Based Evacuation Warning Dissemination

Sulian Wang, Ph.D. Student, Tsinghua University, Tsinghua Yuan, Haidian District, Tsinghua University, Beijing, 100084, China, wangsulian13@mails.tsinghua.edu.cn

Effective risk communication with the general public plays a vital role in emergency preparedness and response. Spontaneous dissemination of warning messages in the decentralized channel (e.g., through online social network) is shown to be an efficient way of complementing the traditional channels such as television and radio. We model the individual willingness to spread and respond to warning messages as a function of their trust of the government, which is determined by both the accuracy of historical warnings and losses from past events, we then explore the benefits of improving warning precision in the network context.

3 - The Optimal Cost Transform Mechanism of Duo-resources Purchasing Strategies in Food Raw Material Importers

Shu-Yen Hsu, Ph.D Student, National Dong Hwa University, No. 1, Sec. 2, Da Hsueh Rd., Shoufeng, Hualien, 97401, Taiwan, besshsu7130@gmail.com

This paper investigates the uncertain cost variation of food raw materials importers based on the engineering economic and the risk aversion utility theory to construct the equilibrium model for the duopoly competing markets. This paper uses the optimal cost as the decision variable within the high-low quality market switching cost and operating risk, so as to adjust their strategies under the high-low quality markets. With the cash flows satisfying the value matching and smooth pasting conditions, a feasible model for both sides of market transforming is constructed. The result can serve as the transform mechanism of the optimal cost of the equilibrium strategy in the oligopoly competing market.

4 - Liquidity Risk Assessment of Private Equity Investments: Evidence from European Divestment Processes

Pascal Stachow, The University of Manchester, Booth Street West, Manchester, M15 6PB, United Kingdom, pascal.stachow@postgrad.mbs.ac.uk

This paper proposes a novel approach to assess the liquidity risk level of private equity investments by disentangling risk into the probability of a failed divestment process and its impact. In collaboration with investment professionals, a framework for the assessment of the probability of a failed divestment process has been developed. Applying unique deal-level data, it will be shown how a modified evidential reasoning model is superior to more traditional methodologies such as multiple regression analysis and neural networks in providing investment professionals with a transparent and accurate tool for assessing the probability of a failed divestment process.

5 - An Advertising Distribution Decision Analysis on the Optimal Investment Cost for Aesthetic Medicine Clinic

Hui-Tzu Yen, Ph.D Student, National Dong Hwa University, Taiwan, No. 1, Sec. 2, Da Hsueh Rd. Shoufeng, Hualien, 97401, Taiwan, bellina.yen@gmail.com

This paper aims to build the optimal portfolio selection concept for the advertising marketing of the aesthetic medicine clinic. The main methodology applies a probability distribution model to make the maximum expected profits under the uncertain advertising effect with different locations and adverting types. This paper introduces the optimal advertising distribution so as to increase the expected profits within (1) increasing customer arrival rate to enhance normal service operational profits; or (2) providing higher service quality to enhance high service operational profits. The result can provide a novel viewpoint on the optimal adapting advertising distribution of investment cost.

■ MD02

King's 2

Disaster and Disruption Management

Contributed Session

Chair: Elise D Miller-Hooks, University of Maryland, University of Maryland, College Park, MD, 20742, United States, elisemh@umd.edu

1 - Selection of Recovery Suppliers under Disruption Risks using a Portfolio Approach

Tadeusz J Sawik, Professor and Chair, AGH University of Science & Technology, Al. Mickiewicza 30, Krakow, 30059, Poland, sawik@zarz.agh.edu.pl

A portfolio approach to supplier selection in the presence of supply chain disruption risks is proposed. Given a perfect information on potential future disruption scenarios and using a stochastic MIP, a common primary supply portfolio is selected for all scenarios along with a recovery supply portfolio for each scenario. The recovery suppliers are selected to optimize the recovery process with respect to recovery time and cost with the cost of recovery shared between the supplier and the buyer. The selection of supply portfolios for parts is combined with production scheduling of finished products.

2 - Tsunami Evacuation Support System Considering Impassable Roads

Raito Matsuzaki, Graduate School of Science and Engineering, Kansai University, Osaka, 564-8680, Japan, luigilike8rai@yahoo.co.jp

In Japan, earthquake disasters are frequent, and many people die or go missing when a tsunami strikes after the earthquake. Therefore, we need to evacuate quickly to an elevated position for reducing damage. In our research, we propose the tsunami evacuation support system built with ad-hoc networks using home servers for smart homes in the case of an existing network disconnection. In our proposed system, evacuees can obtain information of impassable roads detected by their behavior and can grasp the evacuation route to the elevated place. We evaluate the proposed system by experiment.

3 - Quantifying and Optimizing Health Care System Disaster Resilience Given its Reliance on Interdependent Critical Lifelines

Elise D Miller-Hooks, Program Director, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA, 22230, United States, elisemh@umd.edu

A multi-stage stochastic, mixed integer program is presented for quantifying and maximizing the resilience of a health care system subject to multiple probabilistic hazard events. The model accounts for the system's dependency on a set of interdependent societal lifelines, including water and power distribution, which are themselves subject to failure. Optimal mitigative, preparedness and response actions are applied across the lifelines given limited resources to maximize health care system resilience. Findings from the model's application on a case study are presented.

■ MD03

King's 3

Operations-Strategy Interface

Invited: Business Strategy

Invited Session

Chair: H. Dharma Kwon, Assistant Professor, College at Business at Illinois, 365 Wohlers Hall 1206 South Sixth Street, Champaign, IL, 61820, United States, dhkwon@illinois.edu

Co-Chair: Kris Johnson Ferreira, Harvard Business School, Harvard Business School, Boston, MA, 02163, United States, kferreira@hbs.edu

1 - Collective Choice in Dynamic Public Good Provision: Real Versus Formal Authority

George Georgiadis, Northwestern University, gjgeorgiadis@gmail.com, Renee Bowen, Nicolas Lambert

Two heterogeneous agents exert effort over time to complete a project and collectively decide its scope. A larger scope requires greater cumulative effort and delivers higher benefits upon completion. To study the scope under collective choice, we derive the agents' preferences over scopes. The efficient agent prefers a smaller scope, and preferences are time-inconsistent: as the project progresses, the efficient agent's preferred scope shrinks, whereas the inefficient agent's preferred scope expands. In equilibrium without commitment, the efficient agent obtains his ideal project scope with either agent as dictator and under unanimity. In this sense, the efficient agent has real authority.

2 - R&D Competition with Spillovers and Uncertain Completion Times

H. Dharma Kwon, University of Illinois at Urbana-Champaign, Champaign, IL, 61820, United States, dhkwon@illinois.edu, Wenxin Xu, Jovan Grahovac

We examine a game-theoretic model of two firms that are competitively engaged in research and development (R&D) projects and address two questions: (1) What is the impact of natural spillover upon innovative firms' payoffs? (2) Does an innovative firm have an incentive to unilaterally increase the spillover to its competitor? To answer these questions, we investigate the impact of natural spillover on R&D investment strategies when the R&D completion times are uncertain and either firm can receive spillover from the other. We characterize the Nash equilibrium of the model and find that natural spillover may or may not diminish the profit of the more innovative firm.

3 - Open or Closed? Technology Sharing, Supplier Investment, and Competition

Ming Hu, University of Toronto, Toronto, ON, M5S 3E6, Canada, ming.hu@rotman.utoronto.ca, Bin Hu, Yi Yang

Competing technologies in emerging industries create uncertainties that discourage supplier investments. Open technology can overcome this, but may also lead to intensified competition if the technology proves successful. We study manufacturers' open-technology strategies. We show that despite the risk of intensifying future competition, open technologies by competing manufacturers may constitute an equilibrium and can indeed induce supplier investments. We also identify a technology-risk-pooling benefit, namely by opening technologies, competing manufacturers can induce supplier investments in both and adopt the more popular technology once the market preference is revealed.

■ MD04

Queen's 4

Health Care: Capacity Planning

Contributed Session

Chair: Sonya Vanderby, University of Saskatchewan, University of Saskatchewan, Saskatoon, SK, S7J0J9, Canada, sonia.vanderby@usask.ca

1 - Resource Planning and Allocation Optimizing the Patients Flow and the Length of Stay Satisfaction in Hospital

Young Hoon LEE, Professor, Dept. of IIE, Yonsei University, 50 Yonsei-ro, Seadaemun-gu, SEOUL, 03722, Korea, Republic of, youngh@yonsei.ac.kr

Hospital resources are required to be utilized efficiently to provide the patient satisfaction and flow optimization as well. Several patients groups are sharing the several facilities which makes the complexity in flow and utilization. In this study, patients flow patterns are investigated using the process mining, which are applied in resource planning and allocation of human and physical resources. The operation productivity and patients satisfactions are simultaneously controlled based on the patient flow density investigated from the patient data. Mathematical modeling is suggested with the optimal solution, and sensitivity analysis are performed for the various environment.

2 - The Benefits of Competing on Process Execution – Evidence from California Hospitals

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

In response to regulatory pressure and competitive threats, hospitals have adopted various operational strategies to gain market share, attract indispensable resources, and advance their caregiving mission. Using hospital-level, secondary data from California hospitals, we investigate the benefits associated with competing on process execution, as defined by significant improvements in key performance metrics such as length of stay and cost per discharge.

3 - Expanding Capacity to Meet Patients' Needs: Where Will Health Care Resources be Needed in the Future? A Mixed-Integer Set Covering Problem

Sonya Vanderby, Assistant Professor, University of Saskatchewan, 57 Campus Dr., Saskatoon, SK, S7N 5A9, Canada, sonia.vanderby@usask.ca

Costly health care resource capacity decisions ought to be made based on quantitative analysis with a long-term, system wide perspective, yet this is rarely the case. Rather, resource acquisition, allocation, and utilization decisions are often reactionary and can be influenced by numerous factors. We present a mixed integer programming model developed to determine when and where computed tomography (CT) resources and capacity ought to be added to meet the needs of a given region over a period of time in order to achieve a threshold level of coverage within a given patient travel time target. CT location planning for the Province of Saskatchewan is presented as a case study.

■ MD05

Queen's 5

Healthcare Decision Support

Invited: Global Health

Invited Session

Chair: Hao Huang, University of Washington, 3900 Northeast Stevens Way, Mechanical Engineering Building, room G6, Seattle, WA, 98195, United States, haoh7493@uw.edu

1 - Stackelberg Game Application for Cost-sharing Design in Healthcare Insurance

Ting-Yu Ho, University of Washington, Seattle, WA, United States, tyhotw@uw.edu, Paul A. Fishman, Zelda B Zabinsky

Patient cost-sharing in healthcare insurance has a critical effect on the utilization and cost of medical services, and on patients' health status. It is thus crucial to design an optimal cost-sharing mechanism for both insurer and patient. In addition, an insurance policy design is a continual process in which the insurer and patient interact to introduce dynamic health states affecting their optimal actions. Here we propose a general incentive-based framework that can capture these long-term interactions subject to underlying uncertainties by applying stochastic Stackelberg games and obtain mixed equilibrium strategies of the both players that maximize their respective payoffs.

2 - Optimal Screening and Treatment Allocation Strategy for Hepatitis C by Simulation Optimization

Hao Huang, University of Washington, Seattle, WA, United States, haoh7493@uw.edu, Yuankun Li, Zelda B Zabinsky, Shan Liu

The U.S. healthcare systems considers combining Chronic Hepatitis C (HCV) screening and treatment efforts with a fixed total budget, where screening and treatment programs are very costly. We evaluate different program design with a system dynamics model for patient cohorts in the next 10 years under yearly budget constraint for a national perspective. We implement a simulation optimization algorithm, probabilistic branch and bound, to search the optimal and good enough HCV screening and treatment allocation strategies to support decision making.

3 - Performance Evaluation of Health Information Systems through Cost Analysis and Discrete Event Simulation

Vincent Augusto, École Nationale Supérieure des Mines de Saint-Étienne, augusto@emse.fr, Xiaolan Xie

We propose a cost analysis of hospital medical consultation taking into account the level of deployment of Health Information Systems (HIS). Discrete-event simulation has been used to evaluate scenarios and to determine which HIS components provide the best improvements. Both quality of care and costs are considered as key performance indicators. The relative cost of the HIS is low (3 to 6 % of total cost). However, the usage rate of computers is high when the HIS is well deployed and integrated (30 to 40 % of total duration). A small reduction of consultation duration thanks to high level HIS components allows a drastic reduction of the total cost because of doctors cost.

■ MD06

Queen's 6

Inventory Management: I

Contributed Session

Chair: Rong Yuan, Massachusetts Institute of Technology, Massachusetts Institute of Technology, Cambridge, MA, 02139, United States, rongyuan@mit.edu

1 - Performance of Class Aggregation in a Multiple Class Inventory Rationing Problem

Sugoutam Ghosh, Antalya International University, Antalya, Turkey, sugoutam@gmail.com

We consider an inventory rationing for multiple classes. We develop the expression for the expected cost for systems involving two or more demand classes and express it succinctly as a recursive function involving nested binomials. Using bounds on the policy parameters, a search based algorithm is proposed to determine the optimal rationing policy. We numerically investigate the impact of collapsing a 5-demand class system into a 2-class system by aggregating several demand classes together. On average, the cost of an aggregated 2-class model is only marginally higher than the 5-class model but for specific problems, the cost saving can be as high as 11.53%.

2 - Inventory Management of a Traveling Salesman

Jing-An Li, Academy of Mathematics & Systems Science-Chinese Academy Sciences, No. 55, Zhongguancun East Road, Haidian, Beijing, 100190, China, ajli@amss.ac.cn

The traditional Traveling salesman problem focuses on "Traveling", where most related research aims to find the shortest route visiting each member of a collection of locations and returning to the starting point. In this paper, we focus on "salesman" more than "Traveling". By considering customer behavior, demand and other parameters, we analyze the inventory management of a Traveling salesman.

3 - Dynamic Inventory Management under Fluctuating Costs with Risk Neutral and Risk Averse Considerations at a Steel Company in Turkey

Dicle Aslan, PhD Student, Istanbul Technical University, Macka, Istanbul, 34367, Turkey, tosunlar@itu.edu.tr

In this study, we analyze the dynamic inventory management problem of a steel manufacturer under fluctuating costs which is influenced by many factors. We develop infinite horizon stochastic dynamic programming models for inventory control with fluctuating costs, considering both risk neutral and risk averse decision making process. In these problems, we assume that demand and purchasing cost of the scrap used for steel production are independent random variables. We show certain characteristic structures of the optimal solutions and perform several computational experiments on the optimal decisions. We compare both decisions as well as variances and utilities.

4 - Velocity-based Storage in a Semi-automated Order Fulfillment System

Rong Yuan, Massachusetts Institute of Technology, 195 Binney, #4102, Cambridge, MA, 02142, United States, rongyuan@mit.edu

We consider a semi-automated fulfillment system in which pickers and stowers are stationary, and the movable storage units are brought to them by robotic drives. We focus on the storage decision, i.e., where to return a pod to the storage field after a picking or stowing operation. We show that the storage decision has a direct impact on the travel times of the inventory pods and consequently the workload requirement of the robotics drives. We provide both analytical and numerical evidence of the benefits of the velocity-based and class-based storage policy.

■ MD07

Kohala 1

Simulation Optimization

Sponsored: Simulation

Sponsored Session

Chair: Michael Fu, University of Maryland-College Park, College Park MD, 20742-1815, United States, mfu@rhsmith.umd.edu

1 - Eco-norta for Efficient Estimation in the Tails of Gaussian Copulas

Raghu Pasupathy, Purdue University, West Lafayette, IN, 47906, United States, pasupath@purdue.edu, Soumyadip Ghosh, Jie Xu, Kalyani S. Nagaraj

We present ecoNORTA for efficient constrained random vector generation within the Gaussian and NORTA contexts. We propose three importance-sampling estimators for such settings, the first of which actively exploits knowledge of the local structure of the feasible region around a dominating point to achieve bounded relative error. The second and third estimators, for use in settings where information about the constraint set is not readily available, do not exhibit bounded relative error but are shown to achieve a slightly weaker form of efficiency that we call polynomial efficiency. Numerical results on various example problems show promise.

2 - Simulation Optimization of National Grain Reserve Policies

Leyuan Shi, University of Wisconsin-Madison, leyuan@engr.wisc.edu, Jingsi Huang, Jie Song

National grain reserve plays an important role in responding to the disaster and unbalance of supply and demand in many countries through release grain to market by auctioning. In this study, we develop an agent-based simulation model of national grain market with detail descriptions of different agents including national grain reserve, grain trading enterprises and grain processing enterprises. Based on the model, we compared two different auction policies (periodic release policy and price peg policy) with the ultimate goal of maximize social welfare via a simulation optimization method.

3 - Multi-information Source Optimization with General Model Discrepancies

Matthias Poloczek, Cornell University, 272 Frank H.T. Rhodes Hall, Cornell University, Ithaca, NY, 14853, United States, poloczek@cornell.edu, Jialei Wang, Peter Frazier

In the multi-information source optimization problem our goal is to optimize a complex design. However, we only have indirect access to the objective value of any design by information sources with inherent model discrepancy, i.e. whose internal model deviates from the unknown true value. We present a novel algorithm based on a rigorous mathematical treatment of the uncertainties arising from these discrepancies that performs a value of information analysis to trade off the predicted benefit and its cost. We show experimental data that indicates that the method consistently outperforms other state-of-the-art techniques, finding designs of considerably higher objective value at lower cost.

4 - Secant Tangents AveRaged (STAR) Stochastic Approximation

Michael Fu, University of Maryland-College Park, mfu@rhsmith.umd.edu, Marie Chau, Huashuai Qu

We introduce Secant-Tangents AveRaged (STAR) stochastic approximation, a new simulation optimization algorithm that uses a hybrid gradient estimator combining a symmetric finite difference-type gradient estimate and an average of two associated direct gradient estimates. The algorithms are provably convergent, and we derive conditions under which the gradients minimize variance. We also investigate their empirical performance against traditional SA algorithms through numerical experiments.

■ MD08

Kohala 2

Marketing and Operations Management

Contributed Session

Chair: Katrin Merfeld, EBS Universitaet fuer Wirtschaft und Recht, EBS Universitaet fuer Wirtschaft und Recht, Wiesbaden, 65189, Germany, katrin.merfeld@ebs.edu

1 - Understanding Peer-to-peer Carsharing Users: A Qualitative Study to Elicit Users' Participation Motives

Mark-Philipp Wilhelms, EBS Universitaet fuer Wirtschaft und Recht, Gustav-Stressmann-Ring 3, Wiesbaden, 65189, Germany, mark-philipp.wilhelms@ebs.edu

The carsharing domain is growing and new service offerings arise. Peer-to-peer (P2P) carsharing, facilitating car rental between private individuals, has attracted attention among automotive manufacturers. Studies on carsharing predominantly focus on users' consumption motives in business-to-consumer contexts. However, no study has considered consumers' motivational drivers to use P2P services. We conducted laddering interviews with German P2P carsharing users, employed means-end-chain analysis, and identified four overarching participation motives: economic interest, comfort, quality of life, and certitude. Implications are drawn for carsharing managers and research.

2 - When Demand Projections are Too Optimistic: A Structural Model of Product Line and Pricing Decisions

Andres I. Musalem, Complex Engineering Systems Institute / Ing.Ind. U. de Chile, Beauchef 851, Santiago, 8370456, Chile, amusalem@duke.edu

A methodology is proposed to estimate structural models of product line competition. This methodology enables researchers to estimate demand systems accounting for the endogeneity of the mix of products available in each market. It is observed that not accounting for this endogeneity leads to overoptimistic estimates of demand due to a sample selection bias. These biased estimates of demand can generate misleading managerial recommendations. The methodology is illustrated using simulated and real data.

3 - Optimal Pricing Policy for Two-Tier Generations in a Supply Chain by Considering Trade-in Rebates

Hui-Chiung Lo, Associate Professor, Tamkang University, New Taipei City, Taiwan, hclo@mail.tku.edu.tw

This research explores the pricing strategies of two generations in a supply chain. Most of companies often launch new generation products by upgrading the design of their original ones in the market. Furthermore, companies offer a trade-in rebate to promote sales of the new-generation products and customer loyalties. When products are durable goods, the used will compete with the new ones, so that all of the new, original and used products coexist in the market. Therefore, we take into account the heterogeneous customers and the trade-in service to build the profit models of the supplier and retailer. The Stackelberg game is also used to assess the optimal pricing policies to maximize their profits.

4 - What Drives Autonomous Vehicle Adaption? A Qualitative Study to Elicit Consumers' Motives

Katrin Merfeld, EBS Universitaet fuer Wirtschaft und Recht, Gustav-Stresemann-Ring 3, Wiesbaden, 65189, Germany, katrin.merfeld@ebs.edu

Autonomous vehicles (AVs) are a cornerstone of the automotive industry's strategy to address future needs by customers and policy makers. However, consumers' wants and fears regarding AVs are unclear. Applying means-end chain analysis, we qualitatively explore the motives and motivational patterns underlying consumers' acceptance of AVs. Preliminary results show that consumers' value efficient utilization of driving periods, reduction of stress levels, increased quality of life through reduced commuting times via route optimization but fear handing over control to the car and a loss of driving pleasure. Findings allow for drawing implications facilitating a successful diffusion process.

■ MD09

Kohala 3

Sustainable Operations

Contributed Session

Chair: Qingyu Zhang, Jonesboro, AR, 72467, United States, q.yu.zhang@gmail.com

1 - Towards a Theoretical Framework of Sustainable Operations Strategy

Peiran Gao, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, China, gaopeiran@hust.edu.cn

This paper tries to handle a problem "How to establish the sustainable operations strategy with strategic fit to operational competencies for superior business performance?" To answer the research question, we conduct an integrated analysis of quantitative and qualitative data in retailing industry. First, we apply structural equation modeling to understand nonlinear relationship among sustainable strategy, supply chain strategy, and business performance. Then, we conducted more than 50 case studies to validate quantitative results and the archive qualitative analysis to provide additional management insights. Our research findings contribute to sustainable operations strategy.

2 - Examining Institutional Pressure and Corporate Environmental Strategy: Moderating Effects of Organizational Values

Jing Dai, University of Nottingham Ningbo China, 199 Taikang East Road, NINGBO, 315100, China, jing.dai@nottingham.edu.cn

Drawing upon organizational value and institutional theory, this study investigates how institutional pressures motivate the firm to adopt proactive environmental management strategy and how such effects are moderated by organizational value.

3 - Low Carbon Supply Chain with Energy Consumption Constraints: Case Studies from China's Textile Industry

Bin Shen, Donghua University, Xuri Building, 1882 Yanan Road,, Donghua University, Shanghai, 210000, China, binshen@dhu.edu.cn

This paper discusses the low carbon supply chain practices in China's textile industry. We examine how the energy consumption constraint affects the optimal decisions of the supply chain members and supply chain coordination. We conduct two case studies from Chinese textile companies and examine the impact of energy consumption constraints on their production and operations management. Based on the real industrial practices, we then develop a simple analytical model for a low carbon supply chain in which it consists of one single retailer and one single manufacturer, and the manufacturer determines the choice of clean technology for energy efficiency improvement and emission reduction.

4 - Drivers and Impact on Economic and Environmental Performance of Green Supply Chain Management

Qingyu Zhang, Prof., Shenzhen University, Shenzhen, China, q.yu.zhang@gmail.com

Green supply chain management has been an important organizational strategy to reduce environmental risks and improve financial performance. This paper presents an empirical study of the drivers of green supply chain management (GSCM) practices and the environmental and economic performance of GSCM implementation in Chinese firms. This study confirms that (1) both internal and external drivers play a significant role in the implementation of GSCM practices; (2) green purchase and investment recovery have a significant impact on firms' environmental and economic performance; (3) with the improvement of the firms' environmental performance, their economic performance will improve.

■ MD10

Kohala 4

Applications of Distributionally Robust Optimization

Invited: Robust Optimization

Invited Session

Chair: Selin Damla Ahipasaoglu, SUTD, 8 Somapah Rd., Level 7, SUTD, Singapore, 487372, ahipasaoglu@sutd.edu.sg

1 - Distributionally Robust Project Crashing with Full, Partial or No Correlation Information

Selin Damla Ahipasaoglu, SUTD, ahipasaoglu@sutd.edu.sg

Project crashing is a method for optimally shortening the project makespan by reducing the time activities in a project network at the expense of additional costs. We propose a distributionally robust project crashing problem to minimize the worst-case expected makespan where the distributions of the activity durations are specified only up to the first two moments. We consider three moments models with full, partial or no correlation information. We show that this problem can be formulated as a saddle point problem with a convex-concave objective function. Based on a characterization of the gradients, the problem can be solved by a global convergent projection and contraction algorithm.

2 - On the Flexibility of using Marginal Distribution Choice Models in Traffic Equilibrium

Ugur Arikan, Middle East Technical University, arikanu@metu.edu.tr

The aim of this paper is to develop a new stochastic user equilibrium (SUE) model, namely the MDM-SUE model, that uses the marginal distribution model (MDM) as the underlying route choice model. By focusing on the joint distribution that maximizes expected utility, we show that MDM-SUE exists and is unique under mild assumptions. We develop a convex optimization formulation for the MDM-SUE. For specific choices of marginal distributions, the MDM-SUE model recreates the optimization formulation of logit SUE and weibit SUE. Furthermore, it relaxes the assumption that the error terms are independently and identically distributed random variables and provides greater modeling flexibility.

3 - Worst-case and Sparse Portfolio Selection: Insights and Alternatives

Yufei Yang, SUTD, yufei_yang@mymail.sutd.edu.sg

In this talk, we will present the insights for the worst-case and sparse portfolio. We extensively explore the portfolio composition and its equivalence to the combination of benchmark portfolios.

■ MD11

Kona 1

Equipment Health Management

Sponsored: Quality, Statistics, and Reliability

Sponsored Session

Chair: Zhigang Will Tian, University of Alberta, 10-356 Donadeo Innovation Centre for Engineering, Department of Mechanical Engineering, Edmonton, AB, T6G 2G8, Canada, ztian@ualberta.ca

1 - A Nonparametric Accelerated Life Testing Method

Qingyu Yang, Wayne State University, 4815 4th street, Room 2167, Detroit, MI, 48202, United States, qyang@wayne.edu, Wujun Si

Accelerated Life testing has been widely applied to quickly obtain the reliability information of a system at use conditions. In the literature, most existing models assume a known parametric relationship between the stress levels and the mean or standard deviation of system lifetime distribution. However, under many situations, the true relationship in the real world is unknown. In this research, we proposed a nonparametric accelerated life testing model in which no assumption of a known parametric relationship needs to be made. A simulation study is conducted to investigate the performance of the proposed model, and a case study is used to illustrate the developed method.

2 - Component Replacement and Reordering Policies for a System Carrying One Deteriorating Spare Part

Haitao Liao, University of Arkansas, liao@uark.edu

Spare parts are in-stock units to meet the demand from system maintenance. Spare parts may deteriorate due to the nature of the product and/or uncontrolled storage conditions. Such deterioration will affect the reliability and availability of spare parts and thereby the future operation of the system. In this research, we consider a system comprised of one operating component and one deteriorating spare part. We investigate the cumulative damage effect for deteriorating spare parts switching between stocking and operation environments. The replacement time along with the spare switching policy for the system are optimized to achieve the minimal long-run cost.

3 - Maintenance Effect Modeling and Reliability Prediction of a Repairable System

Sharareh Taghipour, Ryerson University, sharareh@ryerson.ca

In this presentation, we consider a repairable system with failures following a Non-Homogenous Poisson Process. The system is subject to corrective and multiple types of preventive maintenance (PM). A corrective maintenance has a minimal repair effect on the system, and a preventive maintenance makes the system between as good as new and as bad as old. Each PM type may have a different effect on the system. We develop the likelihood function to estimate the failure process's parameters as well as PM effects, and derive the conditional reliability and the expected number of failures between two PM types. The methods are shown using a case study of several trucks used in a mining site in Canada.

4 - An Integrated Approach for Predicting Gear Surface Wear Propagation

Zhigang Will Tian, Associate Professor, University of Alberta, 10-356 Donadeo Innovation Centre for Engineering, Edmonton, AB, T6G 2G8, Canada, ztian@ualberta.ca, Fuqiong Zhao

Surface wear is one of the main failure modes that gears suffer from due to sliding contact in the mesh process. In this talk, an integrated prognostics approach is presented, which combines the wear propagation physical model and gear mass loss inspection data to predict the wear propagation process. The Bayesian update process is implemented to incorporate the mass loss observations at the inspection times to obtain more accurate distributions of the wear coefficient. The proposed method is validated using a run-to-failure experiment on a planetary gearbox test rig.

■ MD12

Kona 2

Innovative Pricing and Consumer Behavior

Invited: Business Model Innovation

Invited Session

Chair: Dongyuan Zhan, University College London, Gower Street London, London, AL, WC1E 6BT, United Kingdom, d.zhan@ucl.ac.uk

1 - Is Non-linear Pricing Contract Always Better than Linear Pricing Contract?

Behrooz Pourghannad, University of Minnesota, behrooz@umn.edu, Tony Haitao Cui, Guangwen Kong

We study supply chain contracts with consideration of information sharing and bounded rationality. We examine a dyadic supply chain where a supplier sells products to a bounded rational retailer. Our results suggest that, under some conditions, the supplier can be better-off by using a linear pricing contract than adopting a buy-back contract. The supplier either shares information with the retailer or help improve the retailer's bounded rationality but not both in equilibrium.

3 - An Experimental Study of Bounded Rationality and Learning in Strategic Customer Behavior

SeungBeom Kim, Hongik University, sbkim@hongik.ac.kr, Sriram Dasu

We use laboratory experiments to gain insights into how customers make purchasing decisions when they have the option of buying at a higher price or waiting for a lower price but incur the risk of the product being out of stock. We investigate behavioral decision-making based on experimental data sets. If decision-making is consistent with our experimental findings, then pricing models that are based on the assumption that customers are rational expected utility maximizers can result in significant loss in profitability. We also study how customers learn based on past experiences.

4 - Vertical Probabilistic Selling: The Role of Consumer Anticipated Regret

Dongyuan Zhan, University College London, London, WC1E 6BT, United Kingdom, d.zhan@ucl.ac.uk, Yong Chao, Lin Liu

We study vertical probabilistic selling (mixing products with different qualities) when firms compete, and consumers can anticipate the potential post-purchase regret raised by the possibility of obtaining the inferior products. Contrary to the intuition that anticipated regret discourages the provision of random products, our result suggests that the random product provider could profit more by probabilistic selling and adopting this selling strategy more often when consumers can anticipate the potential post-purchase regret. Specifically, the profitability of vertical probabilistic selling depends on how consumers make their purchase decisions.

■ MD13

Kona 3

Power System Resilient Design and Optimization II

General Session

Chair: Seyedamirabbas Mousavian, Clarkson University, 8 Clarkson Avenue, Potsdam, NY, 13699-5790, United States, amir@clarkson.edu

1 - Developing Advanced Resilient Community Microgrid to Improve Disaster Response Capability

Lei Wu, Clarkson University, Potsdam, NY, 1, United States, lwu@clarkson.edu

This presentation will discuss the recent development on the Resilient Potsdam Community Microgrid.Clarkson University is leading the Potsdam Community Microgrid project on designing a resilient community Microgrid in the New York North Country to improve disaster response. The project includes constructing a National Grid underground system for power and communications, which interconnects as many as 12 entities in the Potsdam area. When completed, the Potsdam Community Microgrid design will be the first of its kind, in providing resilient electric power delivery for essential community services during an emergency, and optimizing operating efficiencies under normal conditions.

2 - An Optimization and Simulation Approach for Power System Restoration

Feng Qiu, Argonne National Laboratory, Argonne, IL, 60439, United States, fqiu@anl.gov

In the normal build- up power system restoration process, the system is first sectionalized into a set of subsystems and then the generators are restarted in each subsystem afterwards. In this work, we develop an integer programming formulation, integrating the two problems into a unified operational model to minimize the system restoration time. We also develop an iterative procedure to refine and validate the restoration plan produced by the operational model using AC power flow simulation. We perform computational studies on an IEEE30Bus system and an IEEE118Bus system to demonstrate the effectiveness of the hierarchy of restoration models.

3 - Optimal Resilient Grid Design of Distribution and Transmission Systems

Harsha Nagarajan, Los Alamos National Laboratory, Los Alamos, NM, 87545, United States, harsha@lanl.gov

When natural disasters (hurricanes) occur, the ability of electric grids to provide service is often degraded due to physical damage to the network components. However, well-placed upgrades to these grids can greatly improve post-event network performance. We pose the optimal electrical grid resilient design problem as a two-stage, stochastic mixed-integer program with damage scenarios. Various state-of-the-art relaxations of power flow physics are used in context of 3-phase unbalanced distribution networks and AC feasible, loopy transmission systems. We propose decomposition-based algorithms and metaheuristics to provide cost-efficient resilient upgrades on medium-sized networks.

4 - Cyber Attack Protection for a Resilient Electric Vehicle Infrastructure

Seyedamirabbas Mousavian, Clarkson University, Potsdam, NY, 1, United States, amir@clarkson.edu

Malware pose a significant threat to the power grid and the connected electric vehicle infrastructure. Penetration and propagation of cyber attacks vary depending on the nature of the connected systems. Electric vehicles being the mobile portion of the smart grid may easily spread the attack in a large geographic area. We propose a probabilistic model for the worm propagation in EV to Electric Vehicle Supply Equipment networks, formulate threat levels and then, we propose a Mixed Integer Linear Programming model as a protection scheme that relies on isolating infected nodes. The aim of our protection scheme is to develop a response model that finds an optimal isolation solution for the infected nodes.

■ MD14

Kona 4

Incentives and Operational Guidelines for Global Healthcare

Sponsored: Health Applications

Sponsored Session

Chair: Gonzalo Romero, Rotman, University of Toronto, 105 St. George St., Toronto, ON, M5S 3E6, Canada, gonzalo.romero@rotman.utoronto.ca

1 - Dynamic Scheduling of Home Health Care Patients to Medical Providers

Adam Diamant, Schulich School of Business, adiamant@schulich.yorku.ca

We propose a dynamic scheduling framework to assist in the assignment of patients to home health care practitioners (HHP) who must attend to an individual for the entirety of their care. We formulate the problem as a discrete-time Markov decision process. Since the formulation suffers from the curse of dimensionality, we consider a dynamic heuristic policy. The proposed algorithm assigns new patients to HHP's while considering i) the amount of idle time and overtime; ii) the number of visits each patient will need; and iii) the travel time necessary to serve the HHP's current patient panel. We test our solution methodology with data from a home health care provider.

2 - Donor Product-subsidies to Increase Consumption: Implications of Consumer Awareness and Profit-maximizing Intermediaries
Terry Taylor, University of California Berkely, taylor@haas.berkeley.edu

In the developing world, consumption of socially-desirable products (e.g., recommended malaria drugs, improved cook stoves) depends on consumers' awareness of their benefits and on prevailing prices. This paper studies how the consumer awareness level and the presence of profit-maximizing intermediaries in the distribution channel influences how donors should design subsidies for such products.

3 - Deployment Guidelines for Community Health Workers in Sub-saharan Africa
Jonas Jonasson, London Business School, London, United Kingdom, jjonasson.phd2010@london.edu, Carri Chan, Sarang Deo, Jeremie Gallien

Community health workers (CHWs) are increasingly important to the delivery of health care in many African countries. Leveraging an extensive dataset featuring time, clinical findings and GPS information for CHW visits in Ghana, we develop a stochastic model describing the health dynamics of a population served by a time-constrained CHW. This model supports the design of managerial guidelines for the patient prioritization, catchment area assignment and task profile definition in a CHW operation.

4 - How Good are Uniform Co-payments in Increasing Market Consumption?
Gonzalo Romero, Assistant Professor, Rotman, University of Toronto, Toronto, ON, Canada, gonzalo.romero@rotman.utoronto.ca, Retsef Levi, Georgia Perakis

We analyze the problem of a central planner allocating co-payment subsidies to competing heterogeneous firms, under an endogenous market response and a budget constraint. We present the first worst-case performance guarantees in maximizing market consumption for the frequently implemented policy of uniform co-payments. Namely, allocating the same co-payment to each firm is guaranteed to induce a significant fraction of the optimal market consumption, even if the firms are highly heterogeneous.

■ MD15

Kona 5

E-Commerce

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Xiangpei Hu, Dalian University of Technology, School of Management Science and Engineering, Dalian City, 116085, China, drhxp@dlut.edu.cn

1 - Streamline Processing of Order Picking and Parcel Delivery for Online Supermarkets
Minfang Huang, North China Electric Power University, hmf1006@126.com

For a great amount of personalized orders of online supermarkets, each of them should be fulfilled through the 4-step process of order picking, packing, loading and delivering. Traditional order picking and delivery methods are not suitable for this new order fulfilment problem. The paper attempts to incorporate the thoughts of streamline processing and JIT production of multi-type and small batch items into order fulfilment. It proposes a method for order group picking and parcel delivery under the condition of parallel picking in different storage zones. Its objective is to coordinate 4 key steps to ensure the whole order fulfillment process runs efficiently, accurately, and smoothly.

2 - Multiple Heterogeneous Data Fusion for Early Diagnosis of Alzheimer's Disease
Yi Zheng, Dalian University of Technology, zhengyi8807@163.com, Xiangpei Hu

The progression and spread of Alzheimer's disease heavily aggravates social economic burden, which also brings great pain to the patients. Owing to the improvement of hospital informatization level and the popularity of Electronic Health Record, more testing data has been collected. But the data comes in different formats and also with large volume. We develop an efficient and effective dimensionality reduction algorithm for multiple heterogeneous data sources fusion to early diagnose AD. Results show we can actively support the investigation and development of treatments that slow or stop the progression of AD.

3 - A Multi-item Order Allocation Model of Online Supermarkets with One-city Multi-warehouse System in China
Shan Zhu, Dalian University of Technology, 465028237@qq.com, Xiangpei Hu

Multi-item orders are usually split into several sub-orders in online supermarkets with one-city multi-warehouse system in China, which have increased order fulfillment cost through increasing package cost & shipping cost. The challenge faced by the retailer is to decide to allocate multi-item orders from one warehouse or several warehouses. We construct a multi-objective optimization model to fulfill customers' orders to simultaneously minimize the number of split orders and the shipping cost. Finally, we propose a heuristic algorithm to better allocate the orders.

4 - Understanding the Impact of Social Interaction on Consumers' Brand Choice: A Hierarchical Discrete Choice Model
Yezheng Liu, Hefei University of Technology, Hefei, China, liuyezheng@hfut.edu.cn, Yuanchun Jiang, Yang Qian

Social Interaction has been an important information gathering activity for consumers to support their purchase decision. Through social interaction, consumers observe the purchase decisions of others, interact with others by activities like posting, reposting and querying, and then make the purchase decision based on their individual preferences. This paper models the impact of consumers' individual preferences, social discussions and social relationships on consumers' brand choice decision by a hierarchical discrete choice model. This research can help understand the role of social interaction in the process of consumers' purchase decision.

■ MD16

Waikoloa 1

Financial Engineering

Contributed Session

Chair: Thierry Post, Koc University, Koc University, Istanbul, 34450, Turkey, thierrypost@hotmail.com

1 - Fuzzy Views on Black-Litterman Portfolio Selection Model
Yong Fang, Academy of Mathematics and Systems Sciences, Chinese Academy of Sciences, Beijing, 100190, China, yfang@amss.ac.cn

This paper describe the views of investor in fuzzy sets and proposed two fuzzy Black-Litterman model with fuzzy views and fuzzy random views respectively. We redefine the expected returns and uncertainty matrix of views and show that the fuzzy approaches can formulated the views suitably. Then we test the models we proposed against the traditional porfolio selection models in Chinese financial markets. All criteria reveal that the proposed models perform better which demonstrate that our fuzzy approaches can cover the information in the views efficiently and describe the uncertainty of the views correctly.

2 - Game Russian Options with Finite Maturity
Atsuo Suzuki, Meijo University, 4-3-3 Nijigaoka, Kani-Shi, Gifu, Gifu, 509-0261, Japan, atsuo@urban.meijo-u.ac.jp

In this paper, we study the value function of Game Russian options with the finite maturity and their optimal regions. Russian option is the contract that only the buyer has the right to exercise it. On the other hand, Game Russian option is the contract that the seller and the buyer have both the rights to cancel and to exercise it at any time, respectively. This option value is represented as coupled optimal stopping problem for the seller and the buyer.

3 - Default and Liquidation Timing under Asymmetric Information
Michi Nishihara, Osaka University, Graduate School of Economics, 1-7, Machikaneyama, Osaka, 560-0043, Japan, nishihara@econ.osaka-u.ac.jp

We consider a dynamic model in which shareholders delegate a manager, who observes private information about running and liquidation costs of the firm, to operate the firm. We analytically derive the shareholders' optimal contract. Unlike in the symmetric information case, the shareholders can make the high-cost firm to default in order to reduce the information rent to the manager even if the liquidation value is higher than the face value. The impact of the information asymmetries on the liquidation timing is equivocal, while they accelerate the default timing. Although the information asymmetries decrease the equity and firm values, they can increase the debt value.

4 - Portfolio Choice Based on Third-degree Stochastic Dominance, with an Application to Industry Momentum

Thierry Post, Professor of Finance, Koc University, Koc University Campus, Rumelifeneri Yolu, Istanbul, 34450, Turkey, thierrypost@hotmail.com

We build investment portfolios that dominate a given benchmark in terms of third-degree stochastic dominance. Our approach relies on the properties of the semi-variance function, a new 'super-convex' dominance condition and quadratic constrained programming. We apply our method to historical stock market data using an industry momentum strategy. Our portfolio generates important improvements compared with alternatives based on mean-variance dominance and second-degree stochastic dominance. Relative to the benchmark, our portfolio increases average out-of-sample return by almost 7 percent per annum without more downside risk, using quarterly rebalancing and without short selling.

■ MD17

Waikoloa 2

Exciting and Innovative OR Applications in Public Sectors

Sponsored: Public Sector OR

Sponsored Session

Chair: Nan Kong, Purdue University, 206 S. Martin Jischke Dr., West Lafayette, IN, 47907, United States, nkong@purdue.edu

1 - Mass Murders in the United States: Are They as Random as They Appear?

Sheldon Howard Jacobson, University of Illinois, shj@illinois.edu, Douglas M. King

Mass killings across the United States have brought new attention to the patterns for such events. This paper examines 236 mass killings taking place between 2006 and 2014 to assess how they are distributed over time. A statistical analysis of such data yield insights in their distribution, how communities can prepare for such events, and if the occurrence of one event means that another mass killing event is imminent.

2 - Elastic Pathing: Your Speed is Enough to Track You: How Usage-based Automotive Insurance Can Harm Your Privacy

Janne Lindqvist, Rutgers University, janne@winlab.rutgers.edu

Today, people have the opportunity to opt-in to usage-based automotive insurances for reduced premiums by allowing companies to monitor their driving behavior. Several companies claim to measure only speed data to preserve privacy. With our elastic pathing algorithm, we show that drivers can be tracked by merely collecting their speed data and knowing their home location, which insurance companies do, with an accuracy that constitutes privacy intrusion. This work was originally published in Proceedings of UbiComp'14. More information available at http://elasticpathing.org.

3 - Electoral System Optimization

Mark Wilson, University of Auckland, mcw@cs.auckland.ac.nz

In representative democracy there are inevitable tradeoffs. Decisiveness of government and representativeness of parliament cannot apparently be maximized independently. Carey and Hix claimed that moderate values of the "district magnitude" lead to the best overall outcomes, based on a study of actual elections worldwide over several decades. We study how well this works in theory, by means of simulations of artificial "realistic" societies using a variety of electoral rules, some of which have not been used in practice. For well-defined parametrized families of electoral systems, we can identify clearly suboptimal parameter settings (some of which are still used in practice).

4 - Propositioning of Relief Items with Lateral Transshipment Opportunities

Serhan Duran, Associate Professor, METU, Orta Dogu Teknik Universitesi, Endustri Muh Bolumu No:224, Ankara, 06800, Turkey, sduran@metu.edu.tr

The main objective of this study is to investigate the inclusion of lateral transhipment opportunities into the humanitarian relief chain and to examine the effect of different parameters minimizing the average distance travelled per item to serve the beneficiaries. Direct shipment model (DT), lateral transhipment model (LTSP) and maritime lateral transhipment model (MLTSP) are developed and these models are compared between each other by using a real life earthquake scenario developed for İstanbul by JICA (Japanese International Cooperation Agency). Vulnerability of the roads and heterogeneous capacitated facilities are also considered.

■ MD18

Waikoloa 3

Transportation Planning

Contributed Session

Chair: Cornelius Hardt, Munich University of the Federal Armed Forces, Munich University of the Federal Armed Forces, Neubiberg, 85577, Germany, cornelius.hardt@unibw.de

1 - Investment Time of Metro Lines under Urban Population Volatility

Huimin Zhang, Huazhong University of Science and Technology, Wuhan, 430074, China, zhanghuimin1173@163.com

This paper addresses step-wise investment issues of metro lines under urban population volatility using a NPV approach. One important problem is investigated: when should the second period investment be introduced.The trigger population thresholds for investing the second period of the metro line is explored analytically.Comparative static analyses of the urban system and metro line investment are also carried out and found that: (i) metro line investment can induce urban sprawl; (ii)the investing time of the second period will be earlier if considering the effects of the first period investment on urban spatial equilibrium.

2 - Smart Card Data Enabled Analysis on BRT Passengers' Behavior

Wei Geng, Associate Professor, Southwest Jiaotong University, Chengdu, 610031, China, wgeng@swjtu.cn

We apply a concept of daily behavioral regularity on a dataset collected from a BRT (Bus Rapid Transit) system, and analyze distribution of passenger's trip durations. We observe different patterns of individual regularity in weekdays and weekends, and reveal asymmetry between morning and afternoon traffic. More irregular passengers are found coming out in the afternoon. We also find that the amount of passengers who travel on major arcs (i.e., a longer trip) cannot be neglected. Passengers' choices between clockwise circle and counterclockwise circle are asymmetric as well.

3 - Study of Freight Generation Patterns in Medellin

Carlos Alberto Gonzalez-Calderon, Research Associate, Rensselaer Polytechnic Institute, 4 25th St., Apt. 5, Troy, NY, 12180, United States, gonzac8@rpi.edu

This paper analyses the freight generation patterns in Medellin, Colombia. A freight survey with a sample of 2,984 commercial establishments was conducted in 2012 to characterize the cargo movements and patterns in the city. This survey was complemented with another two questionnaires, one applied to 130 truck drivers at the urban area, and another one applied to 2,950 commercial vehicles. 10 carriers companies were interviewed to investigate logistics practices. Based on this, a second phase of the study was conducted with a service trip survey and freight parking study. Freight trip generation models were estimated to know how many trips are generated by TAZ in the city.

4 - Unconstraining Demand in Mobility Sharing Systems – Towards Undistorted Demand of Free-floating Car Sharing

Cornelius Hardt, Munich University of the Federal Armed Forces, Werner-Heisenberg-Weg 39, Neubiberg, 85577, Germany, cornelius.hardt@unibw.de

Mobility sharing system providers need reliable demand data to calibrate and optimize their systems on a daily basis. However, these data often suffer from incompleteness. Missing supply of vehicles usually results in missing observability and hence in underestimation of spatial-temporal demand. Although there are general techniques to overcome such shortcomings, no such methods are known to exist fitted for sharing systems. This work presents an approach to overcome these limitations by adapting unconstraining techniques to car sharing data and thereby considering constraining factors like temporal and spatial availability in order to reveal undistorted demand.

Tuesday, 9:00am - 10:30am

■ TA01

King's 1

Trade-offs in Prescriptive Applications of Decision Analysis

Sponsored: Decision Analysis

Sponsored Session

Chair: Jay Simon, American University, Kogod School of Business, Washington, DC, 20016, United States, jaysimon@american.edu

1 - A Markov Decision Tree Model to Evaluate Cost-effectiveness of Ovarian Cancer

Jiaru Bai, University of California, Irvine, jiarub@uci.edu, L Robin Keller

We present a way to build a Markov decision tree to model cancer progression and cost-effectiveness analysis for two or more cancer treatments. Olaparib, Platinum-based combinations, non-platinum agents, and bevacizumab-containing regimens are compared for the treatment of recurrent ovarian cancer using the Incremental Cost Effectiveness Ratio (ICER). We also propose several problems researchers can encounter in this kind of research and provide possible solutions.

2 - Real-time Multiple Attribute Taxi Assignment on Weighted Regions

Ali Esmaeeli, University of California, Irvine, Irvine, CA, United States, esmaeeli@uci.edu, L Robin Keller

In this paper we provide a model for the assigning problem in a taxi company from a decision modeling perspective. In our model, different regions of a map have different values for the taxi company. We calculate the desirability of the assignment using two attributes. These attributes are the average response time and the rate of accepted requests for each region. We show how we can calculate weights for regions and attributes in our model. Moreover, we define a value function and an algorithm which can be used to evaluate the value of an assignment in our model.

3 - The Self-sufficient Marine: Knapsacks and Trade-offs

Jay Simon, American University, jaysimon@american.edu, Aruna Apte, Eva D Regnier

The United States Marine Corps frequently conducts operations in austere environments with little infrastructure or logistical support. A squad of Marines must decide on a set of items to carry with them on a given mission. Some of these items are for sustainment purposes (e.g. food and water), and others are used to help carry out the mission more effectively. We model this decision by extending the knapsack problem in several ways. Of particular interest are the trade-offs that the squad must make, both between different mission-related items, and between duration and effectiveness.

4 - Multi-Criteria Preference Modeling in Design of Space Battle Management Systems

Eva D Regnier, Naval Postgraduate School, eregnier@nps.edu

The US Air Force is designing a command and control system for space battle management–in lay terms, making decisions about which space-based systems to use and how. These decisions are very high-stakes, and must be made under time pressure–sometimes in a matter of minutes. They require judgments that must be made by subject matter experts–such as the consequences of producing space debris–and high-level value and political judgements–such as the importance of attribution of events to the US. A MCDM "kernel" for such a system would provide a framework for making many of these judgments in advance, and generating trade- off weights and predictions in advance for a range of scenarios. In the context of an immediate decision point, the system would narrow the high-level decision-maker's focus on two or three best alternatives and the two or three key uncertainties and consequences that drive the decision to support faster, clearer decision making.

■ TA02

King's 2

Food Defense Modeling

Invited: Homeland Security and Disaster Management

Invited Session

Chair: Emma Hartnett, Risk Sciences International, TBD, Ottawa, ON, 0000, Canada, ehartnett@risksciences.com

1 - Towards a Safe and Resilient Food Supply

Amy Kircher, Food Protection and Defense Institute, akircher@umn.edu

Let's use big data to protect your lunch! The food and agriculture sector is a globally distributed and highly integrated system of systems. Complexity comes from the diversity of production, processing, and delivery systems from small companies to multinational food corporations. Unfortunately contamination events occur with unnerving frequency through natural, accidental, and intentional means. The Food Protection and Defense Institute Consortium have conducted research and technology development to improve our ability to combat food system disruptions. This session will highlight capabilities developed for predictive analytics and assessment of supply chains for vulnerabilities.

2 - Exploring Food Chain Vulnerabilities in Terms of Public Health Risk

Gregory Paoli, Risk Sciences International, 55 Metcalfe St., Suite 700, Ottawa, ON, K1P 6L5, Canada, gpaoli@risksciences.com, Emma Hartnett, Brittany Milton, Margaret Wilson

We have developed a web-based food processing vulnerability assessment tool for intentional attacks on food production systems. Based upon a stochastic simulation, the model tracks the levels of a suite of attack agents (e.g. B. anthracis, C. botulinum, and others) in a user-customized processing plant and determines the vulnerable points that should be considered for enhanced protection. The tool provides stakeholders with science-based quantitative information to inform decisions enhancing the resiliency of the supply chain, and minimizing the risks to the consumer. Results of the assessment of illustrative systems will be presented.

3 - Modeling Food Supply Chain Disruptions for Emergency Preparedness

Tejas Bhatt, Director, Institute of Food Technologists, 818 Connecticut Ave. NW Ste. 850, Washington, DC, 20006, United States, tbhatt@ift.org

The modern food supply chain is increasingly complex. A foodborne emergency, whether unintentional such as a food safety outbreak or intentional such as a food bioterrorism incident, needs a system of systems to react and respond to the crisis. Therefore, it is becoming imperative that modeling and simulation tools be developed to better understand primary, secondary and tertiary effects of interventions for emergency preparedness and response. Examples of such tools will be presented during this talk followed by a discussion of the challenges and opportunities facing the computational modeling community to better understand and analyze distribution dynamics of our food system.

4 - Modeling the Healthcare System Response and Surge Requirements During an Attack on the Food Supply

Emma Hartnett, Risk Sciences International, 55 Metcalfe St., Suite 700, Ottawa, ON, K1P 6L5, Canada, ehartnett@risksciences.com, Margaret Wilson, Kathleen Lysak, Donald Schaffner

We have developed a simulation-based online tool that enables the exploration of the public health system response, and surge capacity demands, under an attack on the food supply. Considering both treatment oriented and laboratory capacity, the discrete-event simulation considers the spatial and temporal aspects of an attack, and simulates the demand and ability to respond. Use of the tool allows the exploration of the impact of different responses to an incident, e.g. protocols addressing the emergency standard of care, or strategies such as the temporary care facilities. Results can inform the development of emergency preparedness plans, minimizing the impact of an attack on the food supply.

■ TA03

King's 3

The Value of Information

Sponsored: Behavioral Operations Management

Sponsored Session

Chair: Allen Miller, Air Force, 2950 Hobson Way, WPAFB, OH, 45433, United States, allen.miller@afit.edu

1 - Encouraging Information Sharing to Boost Seller Profits in a Name-your-own-price Auction

Yahong Chen, Beijing Institute of Technology, Beijing, China, yahonghap@126.com

In a name-your-own-price auction, buyers can learn a lot from bidding experiences shared by their peers. Such learning process reduces their uncertainty about bid price. By combining an information diffusion model and a belief-decision model, we explore the effects of bidders'information sharing on buyers'behaviors and the seller profits. Simulation results indicate that information sharing enables more buyers to join into auction, but its influence on the seller profits is nonlinear. The seller profits may reach its peak value when bidders' willingness-to-share is at a middle value. Moreover, the information fading coefficient has a significant effects on the seller profits.

2 - Sourcing Policy and Dissolution

Yi-Su Chen, Assistant Professor, University of Michigan-Dearborn, 19000 Hubbard Drive, FCS 184, Dearborn, MI, 48126, United States, yisuchen@umich.edu

Periodically, a manufacturer has to reconsider whether to modify decisions pertaining to extant strategic supplier relationships. This study uses a role-playing experiment with data collection from purchasing professionals, and examines how an option open to a manufacturer influences the likelihood of maintaining the status quo. We find that the influence of sourcing policy option varies, contingent on adding cost penalty, detecting quality defect, and involving in product development. Theoretical and managerial implications are discussed.

3 - Priorities and Feedback in Analyst Production Yields

John W Gardner, Brigham Young University, johnwgardner@byu.edu

Potential tensions between operational priorities of quality and speed remain important but understudied influences in production and operations management. In this paper we use laboratory experiments to examine the effects of operational priorities (quality vs. speed) and performance feedback on the production yields of repetitive data-input tasks. Such tasks are often necessary and critical inputs to data analytics and are also similar in nature to repetitive, independent manufacturing tasks. We study the specific task of inputting paper medical records into a mock electronic medical record system. In addition to examining production yields under different priorities and feedback availability, we compare learning curves of the time spent on correct inputs with time spent on reworked units and do so at various levels of task complexity. Our results inform production leaders regarding the effects of their decisions to emphasize quality or speed as well as how those choices influence yields, rework, and workers' experiences and behaviors given the presence or absence of timely performance feedback.

4 - The Influence of Education and Experience upon Contextual and Task Performance in Warehouse Operations.

Allen Miller, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States, allen.miller@afit.edu

We propose supply chain workers make observable, preventable errors while completing their assigned tasks in the shipping process. We believe worker-performance may be affected by an individual's knowledge of why and where they fit into a larger system–defined as mission knowledge. We investigate: How does mission knowledge affect a pick-and-pack worker's task performance? How do education and experiences impact mission knowledge and task performance? What factors mediate and moderate the relationship of mission knowledge and task performance? To discern these relationships, we conduct a controlled pick-and-pack experiment with supply workers in a simulated warehouse.

■ TA04

Queen's 4

Healthcare: Simulation and Optimization

Contributed Session

Chair: Farzad Zaerpour, University of Calgary-Haskayne School of Business, 3420 50th Street NW, # 118, Calgary, AB, T3A 2E1, Canada, fzaerpour@gmail.com

1 - Design of New Integrated Healthcare Facilities with Simulation

Jacqueline Griffin, Northeastern University, 360 Huntington Ave., 334 Snell Engineering Center, Boston, MA, 02115, United States, ja.griffin@neu.edu

We develop a simulation model to identify process improvements during the merging of three outpatient clinics at a major teaching hospital. The Orthopedics, Rheumatology and Radiology clinics currently operate independently, but are interconnected in terms of patient flow and scheduling. We utilize discrete event simulation techniques to assist in analysis of the design of systems and processes for the joint clinic which will be accompanied by construction of a new healthcare facility. We examine the impact of integrated patient flows on waiting time, length of stay, and system efficiency.

2 - Scheduling Coordinated Lab-clinics to Maximize the Service Level under Stochastic Testing Time

Farzad Zaerpour, PhD Candidate, Haskayne School of Business, University of Calgary, 1027 Northmount Dr, NW, # 4, Calgary, AB, T2L 0B6, Canada, farzad.zaerpour@haskayne.ucalgary.ca

In some outpatient clinics, it is desirable for patient testing to be scheduled just before the clinic appointment with the physician. If testing facilities are shared by several physicians, it becomes difficult to assure that testing is completed in time due to the variation in testing requirements across patients and types of clinics. To address this problem, we first develop a mixed-integer programming approach for scheduling physician clinics so that the likelihood of a patient not completing testing in time for the clinic appointment is minimized. Then a branch-and-price heuristic is proposed to solve practical problems. Numerical examples are presented to show the efficiency of this model.

3 - Referral Strategy, Incentive Scheme and Network Externalities in a Multisite Service System

Weixin Shang, Associate Professor, Lingnan University, Hong Kong, Hong Kong, shangwx@ln.edu.hk

Motivated by the practice at the public hospital system in Hong Kong, we analyze a multisite service system wherein a customer can accept service at his home station, or switch to another station under a switching cost, or reject the service under a rejection cost, observing the system workload. We show the optimal referral strategy follows some switching curves, and identify conditions under which referral is effective in reducing system cost. Providing subsidy can better align individual patient's routing decision with the system optimal one and hence reduce system cost, but full coordination cannot be achieved due to network externalities.

■ TA05

Queen's 5

Healthcare Analytics and Modeling

Invited: Global Health

Invited Session

Chair: Kelvin Yau, City University of Hong Kong, Kowloon, H.K., 0000, Hong Kong, mskyau@cityu.edu.hk

1 - Recent Trends in Sex Ratio at Birth in Hangzhou, China

Andy H. Lee, Curtin University, Perth, Australia, Andy.Lee@curtin.edu.au, Li Tang, Kelvin K. Yau, Liqian Qiu, Colin W. Binns

Higher than normal sex ratios at birth in China have been reported since the early 1980's. In this study, data were extracted from the Hangzhou Birth Information Database for all pregnant women who delivered live births in Hangzhou during 2005-2014. A total of 478,192 male and 430,852 female births were recorded, giving an overall sex ratio of 111.0. The sex ratio at birth was almost constant at around 110.7 during 2005-2008, followed by an increase to the peak at 113.1 in 2010 and then declined back to 109.6 in 2014. The sex ratio remained unbalanced for the past decade. However, further monitoring is needed to assess the long-term impacts from the recent termination of the one-child family policy in China.

2 - Semiparametric Frailty Modeling of Clustered Semi-competing Risks Data

Liming Xiang, Associate Professor, Nanyang Technological University, Singapore, 637371, Singapore, LMXiang@ntu.edu.sg, Mengjiao Peng

Semi-competing risks data arise in clinical studies where the time to the non-terminal event is subject to dependent censoring by the terminate event but not vice versa. Typically times to the two events are correlated. We seek to conduct marginal regressions and joint association analysis for clustered data with semi-competing risks. We propose a semiparametric modeling framework where a copula model is used for the joint distribution of the two event times and Cox PH regressions with a shared frailty are assumed for marginal distributions. A nonparametric ML estimation procedure is developed. Simulation results and real data analysis illustrate the performance of our method.

3 - An Empirical Study on No-show Behavior in Outpatient Clinics

Jingui Xie, School of Management University of Science and Technology of China, Hefei, China, xiej@ustc.edu.cn, Jiayi Liu, Kum-Khiong Yang, Zhichao Zheng

We study patients' no-show behavior in an outpatient appointment system for both new and follow-up patients with an explicit consideration of rescheduling. Previous studies either focused on appointment of new patients or treated rescheduling as new appointments. Most results revealed that the no-show probability increases significantly with waiting time. However, we show using clinical data that no-show is significantly affected by the rescheduling process and patients of different types respond to it in very different ways.

■ TA06

Queen's 6

Smart Manufacturing and Logistic Systems in Taiwan

Invited: Practice-Focused Operations

Invited Session

Chair: Cheng-Hung Wu, Associate Professor, National Taiwan University, Room 116 GuoChing Building, No.30, Sec. 3, Xinhai Rd.,Da'an Dist., Taipei City 106, Taiwan (R.O.C.), Taipei, 106, Taiwan, wuchn@ntu.edu.tw

1 - Smart Dispatching of Automated Material Handling Systems through Mobile Vehicle-to-Vehicle and Vehicle-to-Machine Communications

Shi-Chung Chang, National Taiwan University, scchangee@ntu.edu.tw, Yen-Shao Chen, Shi-Chung Chang

Smart decentralized control of automated material handling systems (AMHS) is crucial to facilitate effective production flows for productivity of large-scale or complex factory automation to effectively alleviate blocking and congestion. In this study, a cooperative mechanism exploiting mobile vehicle-to-vehicle (V2V) and vehicle-to-machine (V2M) communications is designed for smart AMHS dispatching. Compared with other commonly used dispatching heuristics, the proposed mechanism can significantly reduce blocking and congestion, reduce production cycle time, and increase the throughput in manufacturing systems.

2 - Order Batching and Picking Optimization for Automated Guided Vehicles

Vincent F. Yu, National Taiwan University of Science and Technology, Taipei, Taiwan, vincent@mail.ntust.edu.tw, A. A. N. Pewira Redi, Hsiu-I Ting

Order batching and order picking are critical activities in warehouse operation. During the development of a warehouse management system for a warehouse that employees smart automated guided vehicles (AGVs) to perform order picking, a control unit that optimally dispatches and routes AGVs is desired. Therefore, this study develops an optimization engine driven by an efficient and effective heuristic algorithm for the control unit. Computational study indicates that, comparing to simple rule-based dispatching, the heuristic algorithm constantly improves the on-time rate of orders, and shorten the average completion time of orders and total travel distance of AGVs.

3 - Green Product Design with Carbon Footprint Consideration in Decentralized Production Chains

I-Hsuan Hong, National Taiwan University, ihong@ntu.edu.tw, Jack C. P. Su

Primarily due to the rising level of environmental awareness, the reduction in the carbon emission incurred in the manufacturing process has attracted much attention. We consider a production chain consisting of one designer and two competing manufacturers, where the designer provides the product design and outsources the manufacturing work to two manufacturers. The manufacturers configure their own production chains after learning the information of the product design and the carbon rebate announced by the product designer. Two manufacturers compete for common key components resulting in a low carbon emission. Our model investigates how the competition for common components may affect the behaviors of the designer and two manufacturers.

4 - A New Strategy for DEA Computation

Wen-Chih Chen, National Chiao-Tugn University, wenchih@faculty.nctu.edu.tw

The implementation of Data Envelopment Analysis (DEA) relies on solving linear programs (LPs). The computation becomes significant when dealing with massive data sets. We propose a proactive strategy that tries to catch only the relevant data points, a small subset of the data, to determine the DEA scores. Our method is particularly independent of the scale and distribution of the data. The empirical studies show significant time saving of our strategy comparing to the benchmarks.

■ TA07

Kohala 1

Combinatorial Algorithms for Clustering, Image Segmentation and Data Mining

Invited Session

Chair: Dorit Hochbaum, University of California, IEOR Department, Berkeley, CA, United States, dhochbaum@berkeley.edu

1 - Combinatorial Algorithms for Clustering, Image Segmentation and Data Mining

Dorit Hochbaum, University of California, IEOR Department, Berkeley, CA, United States, dhochbaum@berkeley.edu

We present a model for clustering which combines two criteria: Given a collection of objects with pairwise similarity measure, the problem is to find a cluster that is as dissimilar as possible from the complement, while having as much similarity as possible within the cluster. The two objectives are combined either as a ratio or with linear weights. The ratio problem, and its linear weighted version, are solved by a combinatorial algorithm within the complexity of a single minimum s,t-cut algorithm. This problem (HNC) is closely related to the NP-hard problem of normalized cut that is often used in image segmentation and for which heuristic solutions are generated with the eigenvector technique (spectral method).

■ TA08

Kohala 2

OM/Marketing: Product Decisions with OM Considerations

Invited: Operations/Marketing Interface

Invited Session

Chair: Stephen Shum, City University of Hong Kong, Tat Chee Road, Kowloon Tong, 0000, Hong Kong, swhshum@cityu.edu.hk

1 - Reaping the Benefits of Bundling under High Production Costs

Will Ma, Operations Research Center, Massachusetts Institute of Technology, willma@mit.edu, David Simchi-Levi

It has long been known that selling different goods in a single bundle can significantly increase revenue, but that this is no longer the case if the goods have high production costs. We introduce a simple pricing scheme, called Pure Bundling with Disposal for Cost (PBDC), that captures the benefits of bundling under high costs, extracting all of the surplus in settings where previous simple mechanisms could not. We also prove a theoretical guarantee on the performance of PBDC that holds for arbitrary independent valuation distributions, by adopting and improving techniques from mechanism design literature. Finally, we perform extensive numerical experiments which support the efficacy of PBDC.

2 - The Impact of Consumer Quality Target on Product Line Design

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

In this paper, we study a firm's product line design when consumers care about not only the offered product quality but also the difference between the offered quality and their target quality level. In a market where consumers have heterogeneous quality targets, we find that targets have a significant impact on the product line offering strategy. In particular, both single product line strategy and full product line strategy can be optimal and when a full product line is offered, both the downward distortion of the low quality level and the upward distortion of the high quality level can be possible.

3 - Sensitivity Analysis on Responsive Pricing and Production under Imperfect Demand Updating

Geoffrey Chua, Nanyang Technological University, Singapore, gbachua@ntu.edu.sg

This paper studies three types of sensitivity analysis on firm's responsive pricing and responsive production strategies when the updated demand is still uncertain. First, under a bivariate normal forecast updating model, we demonstrate that comparative statics for both responsive strategies are similar to the classic pricing newsvendor with reduced uncertainty. Second, we show the performance of responsive pricing is insensitive, whereas the performance of responsive production is sensitive, to the respective first-stage decision. Third, we characterize performance sensitivity to parameter estimates for responsive pricing.

■ TA09

Kohala 3

Operations Management Contributions to Innovation & Entrepreneurship: Past, Present and the Road Ahead

Invited: Entrepreneurship and Innovation

Invited Session

Chair: Niyazi Taneri, Singapore University of Technology and Design, Singapore, 487372, Singapore, niyazitaneri@sutd.edu.sg

1 - Operations Management Contributions to Innovation & Entrepreneurship: Past, Present and the Road Ahead

Vish Krishnan, University of California-San Diego, krishnan@alum.mit.edu

Conventionally, OM has focused on steady-state operations in mature companies emphasizing waste elimination. This plenary talk will focus on the value OM can add to the domains of innovation and entrepreneurship, ranging from venture formation to scaling and growth of new ventures.

■ TA10

Kohala 4

Large-Scale Optimization II

Sponsored: Optimization

Sponsored Session

Chair: Damek Davis, University of California-Los Angeles, Los Angeles, CA, United States, damekdavis@gmail.com

1 - ARock: An Asynchronous Parallel Computing Framework

Wotao Yin, University of California, Los Angeles, wotaoyin@math.ucla.edu

Single-core performance stopped improving around 2005, but the number of cores in each computer continues to grow. Therefore, it is crucial to parallelize our algorithms. We propose ARock for finding the zero to a nonexpansive operator. In ARock, a set of cores update randomly selected variables in an asynchronous parallel fashion. As special cases, novel algorithms for linear systems, machine learning, distributed and decentralized optimization are introduced. We show that if the nonexpansive operator has a fixed point, then the sequence of points generated by ARock almost surely converges to a fixed point. Joint work with Zhimin Peng, Yangyang Xu, and Ming Yan.

2 - Stochastic Dual Ascent for Solving Linear Systems

Peter Richtarik, University of Edinburgh, peter.richtarik@ed.ac.uk

We develop a new randomized iterative algorithm—-stochastic dual ascent (SDA)—-for finding the projection of a given vector onto the solution space of a linear system. In each iteration of SDA, a dual variable is updated by a carefully chosen point in a subspace spanned by the columns of a random matrix drawn independently from a fixed distribution. We prove that linear convergence of the primal iterates, dual function values, primal function values and the duality gap under weak assumptions. Several existing randomized methods for linear systems arise as special cases of SDA, including randomized Kaczmarz, randomized Newton, randomized coordinate descent and Gaussian descent.

3 - Smart: the Stochastic Monotone Aggregated Root-finding Algorithm

Damek Davis, University of California-Los Angeles, damek@math.ucla.edu

We introduce the Stochastic Monotone Aggregated Root-finding (SMART) algorithm, a new randomized operator-splitting scheme for finding roots of finite sums of operators. These algorithms are similar to the growing class of incremental aggregated gradient algorithms, which minimize finite sums of functions; the difference is that we replace gradients of functions with black-boxes called operators. The operator point of view makes it easy to extend our algorithms to allow arbitrary sampling and updating of blocks of coordinates. In addition, to take advantage of parallelism, we allow asynchronous coordinate updates.

■ TA11

Kona 1

Business Applications

Contributed Session

Chair: Faryal Salman, SZABIST, 1-A/II 26th Street Ph V DHA Karachi, Karachi, 75500, Pakistan, faryal.salman@szabist.edu.pk

1 - How Do Start-Ups Leverage Big Data: Understanding Data-Driven Business Models

Darshan Desai, Berkeley College, New York, NY, 10017, United States, darshudesai@gmail.com

Large numbers of big data startup companies are emerging. Many more start-ups are aspiring to innovate their business models by leveraging increasingly larger amounts of available data. Academic research in the field of big data focused more on how large organizations with significantly larger resources and data can drive economic value on their strategic investment. In practice, increasing numbers of startups rely on data as an important resource, and these scholars paid very little attention to start-ups and the process through which they leverage big data. Therefore, this paper aims to explore how start-ups creates innovative business model and captures value from big data and analytics.

2 - Investigating Knowledge Sharing in Online Social Q & A Communities: The Perspective of Social-enabled IT Artifacts and Social Capital

Weiling Jiang, Huazhong University of Science and Technology, 1037 Luoyu Road, Hongshan District, Wuhan, 430074, China, M201473444@hust.edu.cn

Social Q&A communities take full advantage of collective wisdom by integrating the voluntary asking and sharing through social-enabled technology. Drawing on the social capital theory, we construct a model focus on the mechanism of how social-enabled IT artifacts (identity profiling, valuation mechanism, deep connecting, sub-community building) contribute to members' knowledge sharing intention through three dimensions of social capital (shared goals, social trust and commitment). Result indicates that IT artifacts are critical driver of social capital and the eventual sharing intention. Research contributes to the interaction design of social Q&A sites and practice community.

3 - Influences of Cultural Dimensions on Customer Satisfaction, Loyalty and Switching Behavior of Mobile Phones in Context of Pakistan

Faryal Salman, SZABIST, 1-A/II 26th Street Ph V DHA Karachi, Karachi, 75500, Pakistan, faryal.salman@szabist.edu.pk

Culture plays a key role in shaping up buying behavior. Hofstede (1980; 2001) has proposed five Cultural Dimensions that originate from cultural bearing of a society and it can used as a point of differentiation among cultures. These dimensions include: Power Distance (PD), Collectivism (COL) Individualism(IND); Uncertainty Avoidance (UA); Masculinity (MAS) Femininity (FEM) have significant influence on the way consumers buy and consume products/ services. In addition to this, these dimensions also influence the post consumption experiences such as customer satisfaction, loyalty and switching. To understand the cultural dimensions of a country has become very important for marketing academics and practitioners because of its significance in international business. Pakistan is a culturally diverse country where individuals have multilayered cultural identities due to their ethnic origins, regional dialects, religious associations. Furthermore, consumers in Pakistan have distinct preferences, lifestyles, habits and styles of judgments by virtue of their regional affiliations. Because of this cultural potpourri, international marketers cannot adopt the strategy of 'one-size fits all' while catering to Pakistani market. This also applies to various mobile phones service providers operating in Pakistan. They need to understand that customer satisfaction, loyalty and switching among mobile phone users is culturally sensitive. Working on this framework the current study explores the influence of Hofested's cultural dimensions on customer satisfaction, loyalty and switching in context of mobile phones users within Pakistan.

■ TA12

Kona 5

Sustainable Operations

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Xi Chen, University of Michigan - Dearborn, Industrial and Manufacturing Systems Engineering, Dearborn, MI, 48128, United States, xichenxi@umich.edu

1 - Competitive Industry's Response to Environmental Tax Incentives for Green Technology Adoption

Anton Ovchinnikov, Queen's School of Business, anton.ovchinnikov@queensu.ca

We consider operational aspects of how an industry composed of heterogeneous firms responds to an environmental tax by choosing production quantities and emissions-reducing technologies. We show the existence and uniqueness of the "market-only equilibrium" and demonstrate its many interesting properties. We then discuss the technology-and-market equilibria under different structural assumptions.

2 - The Role of Premium Sharing and Consulting Services in Green Sourcing

Xi Chen, University of Michigan - Dearborn, xichenxi@umich.edu

Certified sustainable products often times enjoy a significant green premium in the retail market. In this paper, we study a retailer's use of a sourcing contract as a tool of incentivizing suppliers to exert greening efforts which improves the chances of receiving certification, and in turn capturing the green premium. We also explore the rationale for retailer to involve in suppliers' greening efforts.

3 - Capacity Allocation for a Green Farm: Impact of Locally-aware Consumers

Niyazi Taneri, Singapore University of Technology and Design, niyazitaneri@sutd.edu.sg, Dong Li, Saif Benjaafar

Consumers are willing to pay a premium for green produce and some even more for locally sourced green produce. However, yields for green farming are typically lower than regular farming. Furthermore, 75% of farms in Alaska and over 50% of farms in Iowa are rented. We model the strategic interaction between a farm and a landowner. The farmer makes efforts to narrow the yield gap between organic and regular farming. We find that the optimal set of decisions are a function of factors such as the green premium, willingness to pay heterogeneity of consumers at the local market and the contract signed with the landowner. Interestingly, the presence of a green-aware group of local consumers may harm greenness.

4 - The Effect of Production and Consumption Emission Taxes under Demand Uncertainty

Jian Hu, University of Michigan - Dearborn, jianhu@umich.edu

We analyze the impact of taxes on emission abatement. Emission taxes have been a prevailing mechanism of being imposed on manufacturers. A present debate discusses an alternative - imposing emission taxes on consumption. We represent multi-objective Stackelberg's duopoly game models, facing demand uncertainty in market, in regard to production-specific and consumption-specific tax policies. A government decides both the tax policy and tax rate for trading off the profit of production and emission abatement, while manufacturers correspondingly consider the investment on green technology and adjusts the selling price and production quantity.

■ TA13

Kona 3

Uncertainty in Stochastic Simulation

Sponsored: Applied Probability

Sponsored Session

Chair: Xiaowei Zhang, Hong Kong University of Science and Technology, Clear Water Bay, Sai Kung, 00000, Hong Kong, xiaoweiz@ust.hk

1 - The Empirical Likelihood Approach to Input Uncertainty

Henry Lam, University of Michigan, khlam@umich.edu

We study the empirical likelihood machinery to quantify input uncertainty in stochastic simulation. This method converts the conventional task of output confidence interval construction into optimization over the input distributions with divergence constraints. We discuss statistical guarantees of our proposed method, and also computational algorithms via constrained stochastic approximation. We compare our proposed machinery with existing techniques and illustrate applications in simulation optimization.

2 - Robust Selection of the Best

Weiwei Fan, University of Science and Technology of China, wfan@ustc.edu.cn

Decision-makers often encounter the problem of selecting the best simulated alternative from a set of alternatives. However, the ambiguity may exist in the specification of input distribution(s). To address this problem, we propose a robust selection-of-the-best (RSB) framework, which embraces a group of possible distributions into an ambiguity set and selects the best alternative over their worst-case performances. In this paper, we design the two-stage and fully sequential RSB procedures, both of which contain two layers. Particularly, they identify the worst-case distribution (or estimate the worst-case performance) in the inner layer and select the best alternative in the outer.

3 - Calibrating Stochastic Simulation Models in the Presence of Model Inadequacy

Lu Zou, Hong Kong University of Science and Technology, lzou@ust.hk

A simulation model is often used as a proxy for the real system of interest for easier analysis in a decision-making process. However, no simulation model is totally representative of the reality. The impact of the model inadequacy on the prediction of system performance should be carefully assessed. We propose a new meta-modeling approach to simultaneously characterize both the simulation model and its model inadequacy. Our approach utilizes both simulation outputs and real data to predict system performance, and accounts for four types of uncertainty, i.e. unknown performance measure of the simulation model, simulation noise, unknown model inadequacy, and observation noise of the real system.

■ TA14

Kona 4

Adaptive Decision-Making for Health Systems

Sponsored: Health Applications

Sponsored Session

Chair: Anil Aswani, UC Berkeley, San Francisco, CA, United States, aaswani@berkeley.edu

1 - Data-driven Design of Piecewise Linear Incentives

Auyon Siddiq, UC Berkeley, Berkeley, CA, United States, auyon@berkeley.edu, Anil Aswani, Zuo-Jun Max Shen

Incentive programs found in healthcare systems often feature minimum viability thresholds and maximum payouts in order to reduce rents associated with outcome uncertainty and adverse selection, respectively. These types of incentives can be modeled using piecewise linear contracts under a principal-agent model. This work describes a two-stage approach to the design of piecewise linear incentives. The first stage consists of a novel approach to determining the type distribution for a group of agents based on outcome data resulting from a nominal incentive contract, and the second stage incorporates the estimated type distribution into the incentive design using integer programming.

2 - Clustering of Physically Inactive Women Based on Patterns of Baseline Activity Data: The MPED Trial

Mo Zhou, UC Berkeley, Berkeley, CA, United States, mzhou@berkeley.edu, Elena Flowers, Yoshimi Fukuoka, Philip Kaminsky, Ken Goldberg

Physical inactivity is associated with cardiovascular disease, Type II diabetes, obesity, and certain types of cancers. Baseline physical activity data (e.g., steps, metabolic equivalent of the task) were collected using a triaxial accelerometer from 215 physical inactive women who were enrolled in the mPED trial. The goal of this secondary data analysis is to cluster the subjects based on customized features of physical activity, such as frequency/length of moderate to vigorous intensity physical activity, consistency of physical activity pattern, time in day of exercise, etc. These findings can suggest healthy behaviors and be used to develop a personalized physical activity intervention.

3 - Scheduling Personalized Weight Loss Interventions using Predictive Analytics

Yonatan Mintz, UC Berkeley, ymintz@berkeley.edu, Anil Aswani, Yoshimi Fukuoka, Elena Flowers, Philip Kaminsky

A moderate amount of weight loss reduces cardiometabolic risks, such as lowering fasting plasm glucose and blood pressure. In this paper we develop an algorithm to personalize weight loss interventions and improve the efficacy of clinical trials targeted at overweight and obese individuals. We expand on a previously developed utility maximization model for patient behavior by utilizing integer programming and Bayesian prediction to evaluate the efficacy of various weight loss interventions and combine them into a cohort treatment. Our framework also allows for variations in the total number of clinical visits to be utilized, which we use to show potential cost savings while maintaining efficacy.

■ TA15

Kona 5

Health Policy/Public Health

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Banafsheh Behzad, Assistant Professor, California State University, Long Beach, College of Business Administration, Long Beach, CA, 90840, United States, banafsheh.behzad@csulb.edu

1 - Cost Effectiveness of Monitoring Strategies for Atrial Fibrillation Diagnosis after Stroke

Lauren E. Cipriano, University of Western Ontario, London, ON, Canada, lcipriano@ivey.uwo.ca, Vladimir Hachinski, Luciano A. Sposato

One-third to one-half of individuals with a recent stroke or TIA have atrial fibrillation (AF), approximately half of whom are undiagnosed. Individuals with AF and a history of stroke have an 8-12% annual risk of recurrent stroke; but this risk can be reduced with oral anticoagulation. We present a model to evaluate the effectiveness and cost-effectiveness of various cardiac monitoring technologies and technology sequences to identify undiagnosed AF after stroke. Routine outpatient monitoring for greater than 24-hours will reduce the number of recurrent strokes, improve quality-of-life, and is likely cost effective. Long-term monitoring is not cost effective for the diagnosis of AF.

2 - Impact of Mandated Outcome Thresholds on Transplant Wait Times, Patient Mortality, and Unused Organs

Mohammad Delasay, Carnegie Mellon University, Pittsburgh, PA, United States, delasays@andrew.cmu.edu

We develop a simplified model of a transplant center's waiting list in which patients arrive in one of two health states and their health deteriorates over time. Organs also become available and result in different survival outcomes depending on the health status of the transplanted patient. Using a queueing model where organs are allocated (or not) in a randomized manner to each class of patients, we first compute performance metrics of the system: wait list mortality, wait times, and fraction of unused organs. Next, we investigate allocation policies that maximize the number of transplants and satisfy the mandated survival outcome benchmarks.

3 - Seatbelt Usage: Is There an Association with Obesity?

Banafsheh Behzad, Assistant Professor, California State University, Long Beach, 1250 Bellflower Blvd., MS 850, CBA 440, Long Beach, CA, 90840-8501, United States, banafsheh.behzad@csulb.edu, Douglas M King, Sheldon H Jacobson

While primary seatbelt laws are designed to encourage vehicle passengers to wear seatbelts by allowing law enforcement officers to issue tickets when passengers do not wear seatbelts, discomfort may discourage obese individuals from wearing a seatbelt. The objective of this study is to assess the association between state-level obesity and seatbelt usage rates in the US. The results indicate that the magnitude of the statistical association between state obesity rates and state-level seatbelt usage is related to the existence of a primary seatbelt law, such that obesity has less impact on seatbelt usage in states where primary seatbelt laws are in effect.

■ TA16

Waikoloa 1

Global Supply Chains - Models, Benchmarks and Insights

Invited: Global Supply Chains

Invited Session

Chair: Ananth V Iyer, Susan Bulkeley Butler Chair, Purdue University, 100 S Grant Street, West Lafayette, IN, 47907, United States, aiyer@purdue.edu

1 - Understanding and Improving the Design of a Global Health Supply Chain

Gemma Berenguer, Purdue University, gemmabf@purdue.edu

We focus on data from USAID which provides all shipments across the supply chain in 2011-2012. We built statistical and mathematical programming models to understand the logic of the flows. We explore the impact of changes in mode mix, supply chain structure, lead times, and management of inventories, among other aspects. Our goal is to enable an understanding of the cost and service level impact on the operations of the supply chain.

2 - A Scenario Based Math Program for Planning for the Kumbh Mela: A Mass Gathering

Jyotirmoy Dalal, IIM Udaipur, jyotirmoy.dalal@iimu.ac.in

During Simhasth (Kumbh Mela), a religious mega-event, the influx of millions of visitors to the resource constrained Ujjain city (India), poses various managerial challenges to the authorities. We design a strategic network to ensure efficient pilgrim flow on the peak days, both in normal and emergency situations, while minimizing: (1) lead time of pilgrims for the "holy dip", and (2) disruption to Ujjain residents' lives, the two performance measures adopted from the "citizen scorecard". We develop a MIP model to decide the main and backup routes for the pilgrims for normal and emergency scenarios, respectively, as well as to evaluate any existing route plan with respect to the objective function.

3 - Optimal Contracts for Recycling and Refurbishment in the Reverse Supply Chain

Aditya Vedantam, SUNY Buffalo, Buffalo, NY, United States, adityave@buffalo.edu, Ananth Iyer

Managing the disposition of end-of-life electronics involving refurbishment and recycling is complicated by the varying condition of incoming units. We show how uncertainty in the reverse supply chain is managed by sharing the resale value between the product recovery facility and the customer. Data from a IT Asset retirement company is presented to support our findings.

4 - Operational Responses to a Demand Surge

Apurva Jain, University of Washington Seattle, apurva@uw.edu

We develop and analyze a model where a firm observes the evolution of a demand-surge over a short time-period. The firm's decisions about inventory, quality and delivery influence the evolution of the demand surge over short-term and have impact on the level of long-term demand it may experience. The firm must determine the time and quantity for ordering inventory to meet the surge and must choose between sources that differ in their quality-levels and delivery-times. We show how to analyze the model and optimize the timing and order-size decisions for the firm. We use these results to develop insights into the value of waiting to gather more information about the surge before acting.

■ TA17

Waikoloa 2

Galindo Session

Sponsored: Public Sector OR

Sponsored Session

Chair: Gina Maria Galindo Pacheco, Cheektowaga, NY, TBD, United States, ggalindo@uninorte.edu.co

1 - Disaster Donations Information Management System with Social Costs Considerations

Miguel A. Jaller-Martelo, University of California Davis, mjaller@ucdavis.edu, Jose Holguin-Veras, Johanna Amaya, Luk N. Van Wassenhove, Sogol Saremi

This presentation introduces a donations and information management system to mitigate the impacts of material convergence after disasters. The system is modeled as a multi-commodity flow problem based on empirical work to estimate the flow of donations, minimizing total social cost.

2 - Automated Tracking and Assessment of Measures of Performances and Effectiveness for Hadr Efforts

Hector J. Ortiz-Pena, CUBRC, Inc., 4455 Genesee St., Buffalo, NY, 14225, United States, hector.ortiz-pena@cubrc.org, Moises Sudit, John B Coles, Chad Poe, Katie McConky

This research has been focused on tracking and aggregating measures of performance and effectiveness on tasks during humanitarian assistance and disaster relief (HADR) efforts to provide decision makers an indicator on the readiness and execution state of the mission. Impact of conditions in the area of operation are applied to specific tasks and not to the overall mission since these may affect tasks differently within the context of the operation. Using this framework, readiness and execution assessments for a simulated HADR mission are monitored for tasks on surveillance and reconnaissance, distribution of supplies, and repair of vital lanes of transportation, during the relief effort.

3 - Improving Uban Transportation Safety by using Public Policies

Ruben Dario Yie Pinedo, Universidad del Norte, ryie@uninorte.edu.co

The transportation of weapons, fuel, explosives, and any king of war related commodities, is highly exposed to different kinds of danger. Obviously, enemy forces will try to acquire or destroy these types of goods in order to debilitate their rivals. Also, natural disasters and common delinquency could endanger in-transit cargo. Moreover, commodities as food, water, medicines, etc. are also in the scope of enemy forces. Our research focuses on creating safety routes in order to avoid confrontations by using moving and static patrols to accompany the cargoes.

4 - Access to Medical Services under an Emergency Setting with Dynamic Road Disrutpions

Gina M. Galindo, Universidad del Norte, ggalindo@uninorte.edu.co

Disasters typically cause disruptions to transportation networks. In most of the cases, such disruptions have a dynamic nature. For instance, flooded streets may become clear as water drains out; streets obstructed by debris might become accessible thanks to debris removal activities; or streets that are initially free, can become disrupted as the disaster evolves. These changes over the corresponding transportation network affect the development of evacuation efforts. In this research we address the problem of evacuating affected population with dynamic disruptions under disaster settings.

■ TA18

Waikoloa 3

Transportation Planning and Vehicle Routing

Contributed Session

Chair: Florian Paul, University of the Federal Armed Forces-Munich, Munich, SW, Germany, florian.paul@unibw.de

1 - Electric Vehicle Charging Station Locations under Range Uncertainty

Chungmok Lee, Assistant Professor, Hankuk University of Foreign Studies, 81 Oedae-ro, Mohyun-myun, Cheoin-gu, Yongin-si, 17053, Korea, Republic of, chungmok@hufs.ac.kr

In this talk, the electric vehicle charging station location problem under range uncertainty will be presented. The travel range of the electric vehicles can vary depending on the a variety of conditions the vehicles are operating on. We take into account the uncertainty of travel range of the electric vehicle in designing the charging locations, which results in a non-convex nonlinear integer programming problem. An exact solution algorithm based on the Benders decomposition approach incorporated with the column generation will be presented.

2 - A Multi-Objective Dynamic Vehicle Routing Problem with Time Window

Xingxing Cheng, Huazhong University of Science &Technology, Wuhan, China, xingxing_cheng@outlook.com

This paper presents a type of vehicle routing problem with multi-objective and time window(DVRPTW),which considers the demands arriving over time. The paper aims to make a trade-off between the operation cost and the service level,so the objectives of the proposed model are minimizing the total travel costs and the customers' waiting time.We propose an effective method for solving this problem and compare the performance of two strategies.

3 - Analytics for Smart Travel – From Raw GPS Data to Smart Urban Planning

Raya Horesh, IBM TJ Watson, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States, rhoresh@us.ibm.com

Individual traveller GPS data in urban area are essential for travel demand analysis and prediction that is required in urban transport systems planning and management. The main objective of this study is to show concepts and methodologies of using mobile location instruments for tracking individual travel behavior in urban space. We have developed algorithms that extract meaningful information for urban planning; such as detection of trips and stops, classification of trip purpose, detection of meaningful locations, computation of average speed of road segments and derivation of origin-destination matrix which is later used for public transportation route optimization.

4 - Intermodal Bike Routing. Assessing Munich's Bicycle Route Planner

Florian Paul, University of the Federal Armed Forces Munich, Munich, Germany, florian.paul@unibw.de

Navigation- and routing software for vehicles was primarily limited to cars so far. With the fast growing numbers of E-Bikes and Pedelecs in several European countries and the increase of online mapping tools and geo-information systems, this technological innovation can be seen now also in the context of cycling. The recently developed cycle route planner for the City of Munich provides a navigation and map service especially for the requirements of cyclists and can be combined with the use of public transport. The cycle route planner was evaluated with a data analysis of 130,000 route calculations, a customer survey of users and non-users and a field test of cycle trip recommendations.

Tuesday, 11:00am- 12:00pm

■ Plenary

Monarchy Ballroom

Contemporary Education for a World That Needs Innovative Products, Services and Systems

Invited Session

Chair: Catalina Stefanescu-Cuntze, European School of Management and Technology, Schlossplatz 1, Berlin, 10178, Germany, catalina.stefanescu-cuntze@esmt.org

1 - Contemporary Education for a World that Needs Innovative Products, Services and Systems

Thomas L. Magnanti, Massachusetts Institute of Technology, 32 Vassar Street, Cambridge, MA, 02139, United States, magnanti@mit.edu

Technology, design-driven innovation, and systems have always been vital to society's prosperity and well-being and will continue to be so in essentially all areas of importance to society. Education in these general arenas have evolved over hundreds of years, with the emergence within engineering and management of particular disciplinary and departmental structures and teaching paradigms. These include programs in industrial engineering, operations research, and (engineering or operations) management. Are these the best approaches in today's world? How should a contemporary technical-based university be structured? What degrees should it offer and how should it be delivering education? Using the development of the Singapore University of Technology and Design as a reference point, I will touch upon these issues in the context of the changing landscape of higher education.

Tuesday, 1:30pm - 3:00pm

■ TB01

King's 1

Decision Making and Design Engineering

Contributed Session

Chair: Lauren Culver, Stanford University, Stanford University, Stanford, CA, 94305, United States, lcculver@stanford.edu

1 - Development of Visual Design Element Guidelines for Consumer Products Based on User Characteristics

Wonil Hwang, Professor, Soongsil University, 369 Sangdo-Ro, Dongjak-Gu, Seoul, 06978, Korea, Republic of, wonil@ssu.ac.kr

This study aims to build a design guideline for effective visual display used for consumer products considering user characteristics; gender and age. Although a number of basic experiments identified the limits of human visual perception, the findings remain fragmented and unusable form. This study compiled a design cases along with tables aggregated from the experimental result on visual perception - brightness/contrast, useful field of view, color sensitivity. Since the provided data with case example suggests a feasible design space, it will save time for a product designer to find appropriate design alternatives.

2 - Tradeoffs Among U.S. National Interests and Ukraine's Energy Security

Lauren Culver, Stanford University, Stanford, CA, 94305, United States, lcculver@stanford.edu

Ukraine's energy security is in the United States' national interest, confronting U.S. policymakers with a decision of whether and how to intervene when there is a risk of demand for natural gas in Ukraine exceeding supply. Recent changes in Ukraine's political, energy, and financial systems as well as in global oil markets obscure the scale and urgency of shrewd intervention. My proposed decision analysis model reveals the tension between lowering the likelihood of a gas shortage and sending billions of dollars to an adversarial supplier. The model clarifies the holistic cost of U.S. policy in the face of unpredictable political actions in Ukraine and in Russia and uncertain changes in markets.

3 - Differences in Organizational Buyer Preferences towards Decision Criteria when Selecting Professional Service Providers

Mahmut Sonmez, Senior Lecturer in Management Science, University of Texas at San Antonio, College of Business, San Antonio, TX, 78249-0631, United States, mcyigms6@yahoo.com

Purchasing professional services has become an increasingly critical component of the modern business firm. In today's increasingly competitive business climate where professional services make up an expanding portion of the firm's expenditures, global firms can develop their learning curve and gain a competitive advantage through the correct selection of training service providers. This paper will solely focus on the decision criteria used for purchasing professional services for training in sales and negotiations and whether demographic differences such as company size, job title and industry alter the pre-qualifiers and final-stage differentiators in the selection process.

4 - Study on Program Pull Management Mechanism Based on Benefits Management

Zhichao Xu, Tianjin University, No. 92, Nankai District, Tianjin, China, Tianjin, China, xuxx1054@d.umn.edu

The aim of program management is to realize the maximum of synergetic benefits which commands the success criterion to shift from project realization to benefits realization to form a pull management mode. The paper established a management frame in which the benefits pull the business changes, and business changes pull the projects, as well as analyzed the path, methods and impact factors of the realization of program pull management mechanism. Finally, the program pull management mechanism was tested by Tianjin Railway Station Integrated Transport Hub Program.

■ TB02

King's 2

Homeland Security and Humanitarian Logistics

Invited: Homeland Security and Disaster Management

Invited Session

Chair: Julia Phillips, Deputy Director, Methodology, Argonne National Laboratory, 9700 S Cass Ave, Lemont, IL, 60439, United States, phillipsj@anl.gov

1 - Systems Thinking Assessment in Homeland Security Analysis

N. Peter Whitehead, Univeristy of Virginia, 1856 Clarendon Blvd, Arlington, VA, 22201-2914, United States, npwhitehead@mac.com, William Scherer, Casey Connor, Christopher Smith

Systems thinking as the basis for a problem solving methodology has been identified by the military as valuable means to improving national security. Identifying if systems thinking is embedded in an intelligence document, however, is a non-trivial problem. Typically it requires many years of expertise and the reading of reports multiple times. We present a methodology to streamline and improve this process of identifying if systems thinking is present in the analysis. Natural language processing techniques are applied to the theory of systems thinking to develop supervised and unsupervised methodologies for identifying and categorizing military reports.

2 - A Framework to Quantifying Risk to Critical Infrastructure Systems

Julia Phillips, Deputy Director, Methodology, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL, 60439, United States, phillipsj@anl.gov

The desire to understand the protection and resilience of national critical infrastructure and react to those findings is decades old. Initially focused on single assets, recent events, including the increasing impacts of climate change, emphasize the importance of the protection and resilience of systems of critical infrastructure. The first part of this discussion presents a proposed framework to help critical infrastructure system owners and operators evaluate protection and resilience postures of their systems. End products will include decision aiding to assist in the allocation of scarce resources. The proposed framework is designed to be actionable for specific infrastructure system owners, yet generic enough to collect and process information in a transparent, consistent, and repeatable way. The second part of the discussion will focus on current policy, legislative and cultural barriers that limit or slow the progress of increasing protection and resilience with an example focused on energy infrastructure. The tradeoffs between stakeholder often conflicting priorities and end goals lead to a complex landscape of national critical infrastructure protection and resilience.

3 - Access-to-medicines Supply Chain Design: A Stakeholder Framework

Nico Vandaele, Prof., KU Leuven, Naamsestraat 69, Leuven, 3000, Belgium, nico.vandaele@kuleuven.be

Many rigorous models have been developed to support the design of humanitarian supply chains. Supply chains supportive of Access-To-Medicines (ATM), like vaccine supply chains impose considerable additional challenges on this design process. We embed these models in a broader stakeholder based framework, which brings along a balanced set of Key Performance Indicators, against which the new design options and scenarios will be evaluated. Subsequently, a multi-criteria ranking method will reveal a shortlist of championing scenarios form which a final scenario will be chosen. We present a general stakeholder's framework for ATM supply chain design encapsulating a rigorous modelling approach.

■ TB03

King's 3

Teams and Networks

Invited: Business Strategy

Invited Session

Chair: Catherine De Fontenay, Associate Professor, Melbourne Business School, 200 Leicester Street, Carlton, 3053, Australia, c.de.fontenay@unimelb.edu.au

1 - Team Size, Lost Information, and the Career Prospects of Scientists

Catherine de Fontenay, Melbourne Business School, Carlton VIC, 3053, Australia, c.de.fontenay@unimelb.edu.au, Kwanghui Lim, Nicholas Snashall-Woodhams

Identifying high-quality workers can be challenging in teams. We show formally that `noisier' signals of quality due to teams can have a negative impact. Noisier signals lead to fewer promotions of juniors. High-ability junior workers are more likely to exit the firm, given worse promotion prospects. Noisier signals work in favor of senior incumbents, who are given a wider span of control. Using data from academic science, we show that when the size of scientific teams increased, there is evidence of fewer promotions, more power to senior scientists, and more exit. Thus any productivity gains to the firm from teams must be carefully weighed against their cost in terms of lost information.

2 - A Two-sided Matching Approach for Status-motivated Supply Relationships: Foal-sharing Contracts in the Thoroughbred Horse Industry

Darcy Kamal, Chapman University, kamal@chapman.edu

In our study we investigate how network status is leveraged against weaker buying partners in contract agreements which favor the supplying party. To disentangle the selection choice of contracting partners we use an assortative one-to-many two-sided matching model with Bayesian estimation, to test the relationship between the partner contracting decision and transaction performance. We analyze this problem empirically using a longitudinal dataset of transactions negotiated from 2007-2014 based on foal-sharing contracts between Thoroughbred stud farms and nurseries. We draw from our in-depth fieldwork to analyze productivity gains from these seemingly lopsided contracting decisions.

3 - The Dynamics of Products on Social Tagging Network: Insights for Demand Forecast and Positioning

Hyoryung Nam, University of Washington, Bothell, Bothell, WA, 7220, United States, hnam1@uw.edu

Products do not exist isolated, rather related to ideas, concepts, and beliefs. In this article, we infer ideas, concepts, and beliefs linked to a product over time by tracking the keywords associated with products by customers - "social tags" -and investigate whether the change in position of products on the network of such keywords can predict sales dynamics. Our findings suggest that marketing managers better understand a user community's perception of products and potentially influence product sales by taking into account the positioning of their products within social tagging networks.

■ TB04

Queen's 4

Issues in Health Care

Contributed Session

Chair: Yazan Alnsour, Denver, CO, 80220, United States, yazannsour@gmail.com

1 - Using Electronic Health Record Data to Predict Ophthalmology Patients' Examination Times

Michelle Rose Hribar, Informatics Researcher, Oregon Health & Science University, Portland, OR, United States, hribarm@ohsu.edu

Scheduling patients according to their exam times can improve clinic efficiency, but requires accurate timing predictions. Authors examined factors that affected patients' exam times at 4 ophthalmology clinics at OHSU. Correlation analysis was performed on 2 years of patient visit EHR data. New patients and eye dilation had the highest positive correlations with exam length across clinics, ranging from 0.22 to 0.47 ($p<0.01$) and from 0.14 and 0.27 ($p<0.01$) respectively. Correlation between mean length of a patient's previous exams and the length of a current exam varied from 0.08 to 0.22 ($p<0.01$). Using this information can help clinics schedule patients more effectively.

2 - Variability in Kidney Transplant Recipient and Provider Goals

Emily L. Tucker, PhD Student, Dept. of Industrial and Operations Engineering, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States, eltuck@umich.edu

Post-kidney transplant care is a partnership between recipients and healthcare providers, but their goals may not be aligned. We conducted a single-center cross-sectional study of 476 kidney transplant recipients and 72 healthcare providers to assess between- and within-group concordance regarding post-transplant goals. Generalizability of the recipient sample was assessed by comparison to demographic and transplant characteristics of all recipients who met study criteria. Identified areas of goal discordance may represent opportunities for discussion between providers and recipients, and we hypothesize that better goal alignment may increase satisfaction and improve outcomes.

3 - Utilizing Markov Chain Model to Study Long-Term Health Status of Patients with Ventilator in Home Care

Sy-Ming Guu, Chang Gung University, 259, Wen-Hwa 1st Road, Kwei-Shan, Taoyuan City, 33302, Taiwan, iesmguu@gmail.com

Taiwan's national healthcare program has established the Integrated Delivery System (IDS) for patients using ventilator since year 2000. The IDS treats patients using four status of care intensity, namely, by (1) intensive care unit (ICU), (2) respiratory care center (RCC), (3) respiratory ward (RW), and (4) home care (HC). In this primary study, we propose a Markov Chain model with five states consisting of ICU, Ward care (including RCC and RW), HC, Death, and Exit (leaving the institute). Based on the samples, we estimate the transition probabilities of the model. Through the analysis, we could estimate the long term probabilities of a HC patient turning death or exiting the institute respectively.

4 - Recommendation's and Functionality Business Models in Healthcare Mobile Market as Determinants of Consumers' Satisfaction

Yazan Alnsour, PhD candidate, University of Colorado, Denver, CO, 90220, United States, yazan.alnsour@ucdenver.edu

Many studies provide evidence that healthcare apps can play a larger role in the treatment and prevention of disease and improve health outcomes. Application developers increasingly encounter the issue of duplication of services and features among them. Developers are looking for means to differentiate themselves with variations in their business models. Researchers haven't yet investigated how the functionality business model would differentiate a mobile application in the digital marketplace. Our goal in this study is to demonstrate how the functionality business model would impact the consumer satisfaction, in the context of mobile health applications.

■ TB05

Queen's 5

Healthcare Management in Singapore

Invited: Global Health

Invited Session

Chair: Mabel C. Chou, National Univ. of Singapore, 15 Kent Ridge Drive, Singapore, 119245, Singapore, mabelchou@nus.edu.sg

1 - A Robust Optimization Model for Managing Elective Admission in a Public Hospital

Jin Qi, The Hong Kong University of Science and Technology, jinqi@ust.hk, Fanwen Meng, Meilin Zhang, James SK Ang, Singfat Chu

Hospital beds are a critical resource and the management of elective admissions by enforcing quotas could reduce incidents of shortfall. We propose a distributional robust optimization approach for managing elective admissions to determine these quotas. Based on an ambiguous set of probability distributions, we propose an optimized budget of variation approach that maximizes the level of uncertainty the admission system can withstand without violating the expected bed shortfall constraint. The proposed model is tested in simulations based on real hospital admission data.

2 - Bed Allocation to Reduce Overflow

Mabel C. Chou, National University of Singapore, Singapore, Singapore, mabelchou@nus.edu.sg, Jingui Xie, Marcus Teck Meng Ang, David D Yao

Hospital emergency department boarding time is a key performance indicator in many hospitals. In order to control the boarding time, some hospitals including the one under study in this paper may set a maximum boarding time (e.g. 6 hours) beyond which patients will be assigned to any available beds in the inpatient wards despite the medical specialties required. Such assignments may cause unnecessary travel time for the physicians. High overflow rates also have negative impact on patient outcomes and lead to more complicated bed allocation process. To address the overflow issue, we build an analytical model and propose two easy-to-compute bed allocation polices.

3 - Models for Hospital Inpatient Operations: A Data Driven Optimization Approach for Reducing ED Boarding Time

Shasha Han, National University of Singapore, Singapore, Singapore, shashahan@u.nus.edu, Shuangchi He, Hong Choon Oh

Prolonged boarding times in emergency departments are a crisis plaguing most public hospitals. To tackle the problem, we propose a data-driven optimization approach to managing patient bed assignments, based on examining a dataset from a public hospital in Singapore. Our model incorporates practical features conventionally absent from the queueing control framework. We show that it is able to greatly reduce the mean boarding time as well as the percentage of patients waiting longer than a given target, with a slightly increased overflow fraction. Also, it helps to resolve the time-of-day congestion of boarding times, which results from routine discharge procedures in hospitals.

■ TB06

Queen's 6

Production Control and Optimization

Invited: Practice-Focused Operations

Invited Session

Chair: Kuo-Hao Chang, National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu, Taiwan 30013, R.O.C, Hsinchu, 300, Taiwan, chang@mx.nthu.edu.tw

1 - An Efficient Method for Probability-based Simulation Optimization

Kuo-Hao Chang, National Tsing Hua University, chang@mx.nthu.edu.tw

Many real-world optimization problems involving profound randomness can be cast into the framework of simulation optimization. When the objective functions is probability-based, however, it is difficult to decide on whether one solution is superior to the other due to small difference among solutions and it requires tremendous simulation observations to make correct decisions regarding the move of the algorithm. We propose an efficient approach that incorporates importance sampling s and a newly-developed search strategy to solve the problem. Numerical Studies show that the proposed method is promising and is worth further investigation.

2 - Dynamic Production Control with Real Time Equipment Health Considerations
Cheng-Hung Wu, National Taiwan University, wuchn@ntu.edu.tw

This research studies dynamic production scheduling problems under real-time equipment health considerations. With the emerging of the "Internet of Things (IoT)" concept, equipment can now collect and share health information with other equipment through industry internet. However, it remains unclear how equipment health information can be fully used to improve productivity. In this research, a dynamic production scheduling algorithm is proposed to demonstrate the effectiveness of proactive production control that responds before machine failures.

3 - Data-driven Parameter Optimization for Manufacturing Process by Applying Response Surface: A Case Study of PVC Pipe Extrusion Manufacturing
Yin Jing Tien, Data Analytics Technology and Applications Research Institute, Institute for Information Industry, Taiwan, R.O.C., garytien@iii.org.tw, Grace Lin

In plastic industry, plastic extrusion is the most common manufacturing technology. To obtain the optimum process parameters, there are many design-based approaches have been developed. However, doing experiments sometimes may be difficult and take lots of time. Here we purpose a model free approach by using a lot of historical data to construct an empirical response surface with corresponding parameters. The main idea is to let the previous good experience can be reserved and for use through analysis of historical data. For PVC pipe extrusion case study, we used data of one year, to find a better parameter to reduce the weight of the product, and then to reduce the cost of raw materials.

4 - Solving Product Mix Problem in Production Ramp-up in Semiconductor Industry using Quantile-based Simulation Optimization
Kuo-Hao Chang, Associate Professor, chang@mx.nthu.edu.tw

In semiconductor industry, many companies often implement engineering lots, which refers to the lots that have higher priority in the manufacturing process, for process improvement and/or product development needs, which however may disrupt the smoothness of the manufacturing process and delay the delivery time of normal lots. We propose a decision model to characterize this arduous tradeoff and apply an efficient simulation optimization method to generate the optimal product mix in semiconductor manufacturing. An extensive numerical study shows that the solution method has satisfactory performance and is able to find the nearly optimal solution in reasonable computing time. An empirical study conducted in collaboration with a semiconductor company in Taiwan further validates the viability of this research in practical settings.

■ TB07

Kohala 1

Prescriptive Analytics in Retailing

Invited Session

Chair: Felipe Caro, UCLA, Anderson School of Management, Los Angeles, CA, 1, United States, felipe.caro@anderson.ucla.edu

1 - Prescriptive Analytics in Retailing
Felipe Caro, UCLA, Anderson School of Management, Los Angeles, CA, United States, felipe.caro@anderson.ucla.edu

The use of analytics has become ubiquitous in modern retailing. The growth of online retailers such as Amazon and brick-and-mortar retailers like Zara is greatly explained by their successful implementation of data-driven processes. We will present a general framework to approach business analytics initiatives in practice. We then apply the framework to several examples in the retail industry with an emphasis on controlled field experiments to measure impact.

■ TB08

Kohala 2

OM/Marketing: Innovative Strategies

Invited: Operations/Marketing Interface

Invited Session

Chair: Tingliang Huang, tingliang.huang@bc.edu

1 - Salesforce Contracting under Supply Uncertainty
Tinglong Dai, Carey Business School, Johns Hopkins University, dai@jhu.edu

We consider a scenario in which a firm hires a salesperson to market a product with uncertainty in both demand and supply. We show that, among other results, when it is difficult to infer marketing effort from observing the sales outcome, it may be in the best interests of the firm to contract with the salesperson before the inventory information becomes available.

2 - A Theoretical Analysis of the Lean Startups in Product Development
Steve Onesun Yoo, School of Management, UCL, o.yoo@ucl.ac.uk

An early stage entrepreneurial firm with a new product concept must maximize the chance of successful product launch. To avoid developing an unwanted product, practitioners suggest a lean approach to development, i.e., a firm should iteratively launch an unfinished product to learn what the consumers want and to alter the final product goal whenever necessary. We formalize this approach via the Bayesian learning framework, and investigate the optimal development strategy.

3 - Managing Quality and Product Returns in Competitive Markets
Tingliang Huang, Carroll School of Management, Boston College, tingliang.huang@bc.edu

An early stage entrepreneurial firm with a new product concept must maximize the chance of successful product launch. To avoid developing an unwanted product, practitioners suggest a lean approach to development, i.e., a firm should iteratively launch an unfinished product to learn what the consumers want and to alter the final product goal whenever necessary. We formalize this approach via the Bayesian learning framework, and investigate the optimal development strategy.

■ TB09

Kohala 3

Editors' Panel on Entrepreneurship & Innovation

Invited: Entrepreneurship and Innovation

Invited Session

Chair: Niyazi Taneri, Singapore University of Technology and Design, 8 Somapah Rd, Singapore, 487372, Singapore, niyazitaneri@sutd.edu.sg

1 - Editors' Panel on Entrepreneurship & Innovation
Niyazi Taneri, Singapore University of Technology and Design, 20 Dover Drive, Singapore, 138682, Singapore, niyazitaneri@sutd.edu.sg

This panel will discuss current and emerging topics in Innovation & Entrepreneurship.

2 - Editor, Academy of Management Journal
Jason Shaw, Hong Kong Polytechnic University, jason.shaw@polyu.edu.hk

3 - Associate Editor, Management Science
Vish Krishnan, University of California-San Diego, krishnan@alum.mit.edu

4 - Associate Editor, Strategic Entrepreneurship Journal
Sharon Alvarez, University of Denver, Sharon.Alvarez@du.edu

■ TB10

Kohala 4

Optimization in Reliability and Maintenance Management

Sponsored: Optimization

Sponsored Session

Chair: Xiaoyan Zhu, University of Chinese Academy of Sciences, Athens, OH, United States, xzhu5@ucas.ac.cn

1 - Condition-based Maintenance using the Inverse Gaussian Degradation Model
Zhisheng Ye, Department of Industrial and Systems Engineering, National University of Singapore, yez@nus.edu.sg

This study considers an optimal condition-based replacement policy with optimal inspection interval when the degradation conforms to an inverse Gaussian process with random effects. The distribution of the random effects is updated when more degradation observations are available. The observed degradation level together with the unit's age are used for the replacement decision. The structure of the optimal replacement policy is investigated in depth. We prove that the monotone control limit policy is optimal. We also provide numerical studies to validate our results and conduct sensitivity analysis of the model parameters on the optimal policy.

2 - Burn-in Optimization for Products Exhibiting Two Phase Degradation Patterns

Tao Yuan, Associate Professor, Ohio University, Athens, OH, United States, yuan@ohio.edu

Motivated by the two-phase degradation phenomena observed on light displays, this presentation discusses a Bayesian approach for planning degradation-based burn-in test for products exhibiting two-phase degradation patterns. The primary focus of the degradation-based burn-in test considered in this study is to eliminate the initial rapid degradation phase. A hierarchical Bayesian bi-exponential model is used to feature the two-phase degradation of the burn-in population. Two planning criteria in terms of mission reliability and total cost are introduced. A practical example using plasma display panels' degradation data is employed to illustrate the proposed methodology.

3 - Optimization of K-type Component Assignment in System Reliability Design

Xiaoyan Zhu, School of Economics and Management, University of Chinese Academy of Sciences, xzhu5@ucas.ac.cn

It proposes an importance measure based heuristic method for multi-type component assignment problems with the objective of maximizing system reliability. Birnbaum importance (BI) is applied to measure the importance of a position in a system. By comparing BI values of all unassigned positions, the most important position is determined. The most important position is then assigned the corresponding type of component with the highest reliability. Case studies that consider both small and large example systems are used to evaluate accuracy and computational efficiency of the proposed method.

4 - Categorical Characteristics of Recent Serious Network Failures in Japan

Masato Uchida, Chiba Institute of Technology, 2-17-1 Tsudanuma, Narashino, Chiba, 275-0016, Japan, masato.uchida@ieee.org

Due to significant environmental changes in the telecommunications market, network failures affect socioeconomic activities more than ever before. In this presentation, we investigate statistical characteristics of duration and number of users affected for serious network failures, which are defined as network failures that last for more than two hours and affect more than 30,000 users, that occurred in Japan during Japanese fiscal years 2008-2014 (April 2008 to March 2015). In the analysis, we classify network failures into categories according to services (Fixed/Mobile/Upper Layer), carriers (Major (NTT, KDDI, SoftBank)/Others) and causes (Equipment/Others).

■ TB11

Kona 1

Business Applications in Various Industries

Contributed Session

Chair: Kirk Karwan, Furman University, Furman University, Greenville, SC, 29613, United States, kirk.karwan@furman.edu

1 - Examing the Effect of Owned Social Media Marketing in Tourism

YenChun Chou, National Chengchi University, No 64 Sec 2 Zhinan RD, Taipei, 11605, Taiwan, yenchun@nccu.edu.tw

While social media represents a two-way communication, few have examined firm's behavior in the social interactions. Our study focuses on a firm's marketing efforts on Facebook brand page, and evaluates the effect on sales. We further explore whether a firm can moderate such effect by promoting different types of products.

2 - Agricultural Economic Effects of Infrastructure Modernization on the Upper Mississippi River

Tun-Hsiang Edward Yu, Associate Professor, University of Tennessee, 2621 Morgan Circle, 314A Morgan Hall, Knoxville, TN, 37996, United States, tyu1@utk.edu

The Mississippi River is currently the primary carrier of grain and oilseeds in the United States. Entities in the grain and oilseeds sector argue that the aging and deteriorating lock and dam system on the upper Mississippi River has unfavorably influenced the competitiveness of U.S. grain in the international market. This paper estimates the net changes in economic welfare of U.S. grain and oilseeds sector before and after the modernization of lock and dam system on the River. A price-endogenous, spatial equilibrium, quadratic programming model based on the second welfare theorem is applied for the optimization. The changes of mode use resulting from system modernization will also be examined.

3 - Significant Roles of Key Elements of Communities of Innovation in Promoting Youth Employment and Entrepreneurship

Joo Won Lee, Seoul National University, Seoul, Korea, Republic of, joowonlee9732@snu.ac.kr

The Innovation Age requires the youth to prepare to be a successful member of Community of Innovation (COI). Key elements of COI include intrinsic motivation, leadership, ownership, dynamic expertise, and etc. Because many professions will start consisting of COIs, lack of the appropriate abilities and skills will leave the youth ill prepared to be employed. Furthermore, because youth start-ups can play a significant role in solving youth unemployment, schooling must teach the above mentioned attributes to the youth who attempt to start their own companies. Using hiring attributes of Google as evidence, I conclude that the youth must learn elements of COI within schools and classrooms.

4 - Improving the Numbers: Does Success in Major Sports Affect College Admission Statistics?

Kirk Karwan, Professor, Furman University, 3300 Poinsett Highway, Dept of Business & Accounting, Greenville, SC, 29613, United States, kirk.karwan@furman.edu

Universities, especially in today's climate, are concerned with the number and quality of students who apply and enroll. This study replicates an earlier paper by Pope and Pope that evaluated the effects of intercollegiate athletic success on the number and quality of university admissions applications. Data from 323 Division I institutions and covering the years 1999-2013 were used to test the effects of athletic success.

■ TB12

Kona 2

Risk Analysis

Contributed Session

Chair: Shaonan Tian, San Jose State University, San Jose State University, San Jose, CA, 95192, United States, shaonan.tian@sjsu.edu

1 - Research on Procurement Strategy under Supply Disruption Risk and Multi-Source Supplier

Laura Lv, Huazhong University of Technology, Wuhan, China, 1601017350@qq.com

In this paper, multi-source supplier refers to two suppliers, which a stable supplier and another to have the risk of interruption. In addition, except the two suppliers, this paper considers the spot market,so the manufacturer has three procurement modes. What is more, we consider there are general parts and the core parts, different parts have different strategy .when the ending time of interruption is random, with minimal cost, to seek the optimal procurement strategy.

2 - Modelling Operational Risk using Skew T-copulas and Bayesian Inference

Betty Johanna Garzon Rozo, PhD candidate in Management Science, University of Edinburgh, 29 Buccleuch Place, Room 3.02, Edinburgh, EH8 9JS, United Kingdom, s1154454@sms.ed.ac.uk

Operational risk losses are heavy tailed, asymmetric and extremely dependent. We propose a new methodology to assess, in a multivariate way, the asymmetry and extreme dependence between severities and to calculate the capital for operational risk. This methodology applies for the first time the multivariate skew t-copula; and the Bayesian inference theory to estimate the skew t-copula parameters. This paper analyzes a new operational loss data set, SAS® Operational Risk Global Data. Our approach substantially outperforms symmetric elliptical copulas, demonstrating that the skew t-copula provides a more efficient allocation of capital charges up to 56% smaller than the standard Basel model.

3 - Financial Ratios and Bankruptcy Predictions

Shaonan Tian, Assistant Professor, San Jose State University, One Washington Square, San Jose, CA, 95192, United States, shaonan.tian@sjsu.edu

We introduce a popular variable selection method, adaptive-LASSO to forecast bankruptcy events for the international market using Compustat Global database. Our empirical study shows that for Japan market, three predictor variables, including Retained Earning/Total Asset, Total Debt/Total Asset and Current Liability/Sales are selected by adaptive-LASSO method. The model using those three financial ratios alone demonstrates strong predictability in forecasting corporate default. For Japan market, the model with adaptive-LASSO selected variables shows superior out-of-sample predictive power over the Altman's Z-score model.

■ TB13

Kona 3

Methods in Data Mining and Machine Learning

Contributed Session

Chair: Erik Rolland, University of California, University of California, Merced, CA, 95340, United States, erolland@ucmerced.edu

1 - Automated Defect Classification on Fail Bit Maps in Dram Wafers using a Matrix Factorization Method

Youngseon Jeong, Chonnam National University, Gwangju, 61186, Korea, Republic of, youngseonjeong@gmail.com

This research proposes the automated classification model based on a novel matrix factorization approach, called regularized singular value decomposition (RSVD). The proposed RSVD decomposes binarized image data into several eigen-images to extract features that can provide the characteristics of the specific patterns on data. By using the extracted features, k-nearest neighbor (k-NN) classifier is employed to classify defect patterns into each class. The proposed approach is tested on real-life dynamic random access memory (DRAM) wafer data and promising results have been obtained for the automatic classification of specific patterns on image data.

2 - A Network-Based Framework for Conversation Modeling in Text Mining

Onur Seref, Associate Professor, Virginia Tech, Pamplin Hall, Suite 1007, Virginia Tech, 880 West Campus Drive, Blacksburg, VA, 24061, United States, seref@vt.edu

In this talk, we present a network-based framework to identify conversational phrases in different classes of text data using prevalence scores of n-gram structures and their connections. We use network clustering methods to create sub-graphs of connected n-grams, where different paths in these sub-graphs trace sequences of words that form conversational phrases with richer contextual meaning. We use sequence alignment methods to identify variations of these phrases. We apply the proposed framework to study a collection of discussion posts from the automotive industry, and compare its effectiveness to standard methods such as LDA.

3 - A Deep Learning Journey using Open Source Platforms – Singa Versus H2O

Selina Sy Ng, Senior Engineer, Data Analytics, ASTRI, Hong Kong Science Park, Shatin, Hong Kong, Hong Kong, selinang@astri.org

SINGA and H2O, two open source distributed machine learning/deep learning platforms, compared their performances using MLP on the MNIST dataset for hand written digits recognition. However, both teams claimed they performed better and neither could repeat the results reported by the other. We independently studied their performances on a single computer and a four-node cluster, considering both training time and test accuracies. We checked the difference in accuracy with a paired t-test. Our study showed that H2O generated stable and accurate performance. SINGA could be trained more efficiently in a short time but the accuracy could deviate a lot from the expected if training details were changed.

4 - Assessing the Credibility of Online Information at Scale

Erik Rolland, Professor of Management, University of California, School of Engineering, 5200 N. Lake Rd, Merced, CA, 95340, United States, erolland@ucmerced.edu

In this research, we aim to produce new insights into scalable ways to assess the scientific credibility of information sources on the Internet. We use topic modeling, sentiment analyses, and social network analyses to to produce new insights and identify the most prevalent and contentious hypotheses debated by influential sources of information on climate change, and provide explanation of how hypotheses are supported or contradicted by the available scientific evidence. We then propose methods of analyzing propagation of trust in such reference networks.

■ TB14

Kona 4

Predictive Analytics for Health Services Delivery

Sponsored: Health Applications

Sponsored Session

Chair: Ozgur M Araz, University of Nebreska, 1240 R Street P.O. Box 880491, Lincoln, NE, 68588-0491, United States, oaraz2@unl.edu

1 - Telehealth Delivery and Reimbursements for Mental Health Services in the United States

Fernando Wilson, University of Nebraska Medical Center, fernando.wilson@unmc.edu

A large literature has demonstrated the efficacy of telehealth technologies in treating mental health, and most states now allow reimbursement for telehealth delivery of services. However, it is unclear whether mental health providers are responding to recent policy developments in telehealth by increasing use of telehealth technologies to deliver services. Our study characterizes telehealth-related claims of services for mental health and substance abuse using the largest private claims database in the United States from 2009 to 2013.

2 - Evaluating the Impact of Diagnostic Biomarkers on the Cost-effective Efficiency Frontier of Alternative Lung Cancer Screening Strategies

Iakovos Toumazis, Stanford University, iakovost@stanford.edu, Ayca Erdogan, Sylvia Plevritis

We investigate the benefits and costs of various screening strategies for lung cancer when computerized tomography is combined with a hypothetical diagnostic biomarker test using a data driven microsimulation model. The model simulates individuals' lung cancer progression in the presence and absence of a biomarker test under different screening strategies, which vary in terms of start age, stop age and frequency of screening. We identify the cost-effective frontier and show that adding a biomarker test may potentially increase the health benefit and decrease the total cost of screening under specific screening strategies. A sensitivity analysis is conducted on the test's accuracy and cost.

3 - Predictive Modeling of Hospital Admissions from the Emergency Department

Ozgur Araz, University of Nebraska Lincoln, oaraz2@unl.edu

In this paper, we are investigating the predictive factors of hospital admissions from the emergency department (ED) in order to inform resource capacity planning for the ED boarding process during influenza season as well as off season. We used ED visits data over 5 years (2010-2014) from a major hospital in Omaha Metro area and performed our analyses using several predictive models, e.g., logistics regression, artificial neural network and decision tree models. The predictive accuracy of the models are evaluated.

4 - Private Payer Reimbursements to Primary Care Providers for Healthcare Services using Telehealth

Jim P Stimpson, CUNY Graduate School of Public Health and Health Policy, New York, NY, United States, Jim.Stimpson@sph.cuny.edu, Fernando A Wilson

Telehealth services offer a promising avenue to expand service delivery for primary care providers and decrease economic barriers to accessing primary care, particularly for patients who find travel difficult, institutionalized patients, and patients that live in medically underserved areas. We discuss recent trends in telehealth policymaking impacting health care, and present results on telehealth billings, reimbursements and charges for primary care providers using the largest private claims database in the United States.

■ TB15

Kona 5

Legal Applications of Decision Analysis

Invited: Decision Analysis

Invited Session

Chair: John N Celona, President, Decision Analysis Associates LLC, 505 Vista Ave, San Carlos, CA, 94070, United States, jcelona@decisionaa.com

1 - Applying Decision Analysisto IP Litigation

Michael Pierantozzi, Hewlett Packard Enterprise, pierantozzi@yahoo.com

IP licensing and litigation requires close collaboration of technical experts, attorneys, and businesspeople to create and execute monetization strategies and defend against liability. This talk illustrates how decision analysis has been applied to create value and avoid risk.

2 - Winning at Litigation through Decision Analysis

John N Celona, Decision Analysis Associates LLC, jcelona@decisionaa.com

Overview of applying decision analysis to creating and executing winning strategies in litigation or disputes.

■ TB16

Waikoloa 1

Global Sourcing and Supply Networks

Invited: Global Supply Chains

Invited Session

Chair: Nikolay Osadchiy, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30322, United States, nikolay.osadchiy@emory.edu

1 - International Tax Arbitrage Via Decentralized Supply Chain Structures

Masha Shunko, Assistant Professor, University of Washington, Seattle, WA, United States, mshunko@uw.edu, Hung Tuan Do, Andy A Tsay

Delegating decisions and shifting risk to divisions located in low-tax jurisdictions allows multinational firms to obtain tax benefits. Yet decentralization adds operational inefficiencies and costs. To capture this tradeoff we model three commonly-used distribution structures (Commissionaire, Limited-Risk Distributor, and Fully-Fledged Distributor), analyze pricing and incentive strategies within each structure, and provide guidance on choosing from among these structures.

2 - Global Supply Chain Sourcing: A Life Cycle Analysis and Benchmark Results

Morris A Cohen, University of Pennsylvania, cohen@wharton.upenn.edu, Shiliang Cui

Many manufacturing firms are engaged in re-structuring their global supply chain sourcing strategy. For decades, a dominant strategy has been to outsource to low cost suppliers. This has led to the transfer of manufacturing jobs and development activities out of developed countries, and into low labor cost countries. This trend is being challenged by re-shoring manufacturing back to the U.S. or Europe, or by near-shoring manufacturing to Mexico or Eastern Europe. We introduce a stochastic model of global sourcing that incorporates a full product life cycle perspective. We derive optimal global sourcing strategies and review the results of a recent benchmark study that motivated the model.

3 - A Model of the Supply Chain Network Interactions and Risk Propagation

John R Birge, University of Chicago, John.Birge@ChicagoBooth.edu, Jing Wu

Disruptions to suppliers and customers can have significant effects on a firm's operational performance. The nature of these connections can lead to the proliferation and accumulation of shocks or to their dissipation depending on the structure of the network of connections. We present an equilibrium model of these connections which explains observations of varying effects of centrality depending on a firms upstream or downstream supply chain location.

4 - Systematic Risk and Mass Layoffs in US Manufacturing

Nikolay Osadchiy, Emory University, nikolay.osadchiy@emory.edu, Sridhar Seshadri, Peeyush Taori, Suresh Dasari

We study the role of systematic risk in jobs relocation decisions of manufacturers. Using the mass layoffs and employment data in the U.S. manufacturing sector we explore the view voiced by a number of manufacturers that in addition to cheap labor, systematic risk is also an important input in their production decisions.

■ TB17

Waikoloa 2

Homeland Security and Force Agility

Sponsored: Public Sector OR

Sponsored Session

Chair: Paul B Kantor, Rutgers University (Emeritus), 123, Madison, WI, 123, United States, paul.kantor@rutgers.edu

1 - Border Security as a Two Person Game with Incomplete Information

Paul B Kantor, Rutgers University (Emeritus), paul.kantor@rutgers.edu

Abstract not available.

2 - A Budgeted Maximum Multiple Coverage Model for Cybersecurity Planning and Management

Laura Albert McLay, University of Wisconsin-Madison, laura@engr.wisc.edu

We study how to identify strategies for securing cyber-infrastructure. In this paper, we propose an optimization framework that prioritizes the investment in security mitigation to maximize the coverage for vulnerabilities. A maximum multiple coverage problems are formulated, with the considerations of random coverage failure and multi-choice restrictions. We design approximation algorithms with guaranteed performance ratios for our problems.

3 - Border Security

Vladimir Menkov, Rutgers, vmenkov@gmail.com

Abstract not available.

4 - Simulating Dynamic Traffic Scheduling on the Upper Mississippi River

Kevin D Sweeney, Assistant Professor of Supply Chain Management, Sam Houston State University, Box 2056, Huntsville, TX, 77341, United States, ksweeney@shsu.edu

This research implements new scheduling mechanisms derived from the dynamic job shop literature within a simulation model of the Upper Mississippi River (UMR). Modeling the locks and dams of a congested segment of the UMR as work stations, we investigate if the implementation of alternative scheduling rules, such as the total work-content of jobs in queues (WINQ), reduces average wait times compared to shortest processing time (SPT) or first-in first-out (FIFO) scheduling rules. The results indicate preferred scheduling policies on the UMR and provide a robustness test for previous results on dynamic job shop scheduling rules using actual operational data.

■ TB18

Waikoloa 3

Various Methods in Business Applications

Contributed Session

Chair: Penghao Cui, YT, ab, United States, pacpos.phcui@gmail.com

1 - Using Two Functional Areas Strategies as a Joint Improvement Strategy

Marvin Gonzalez, College of Charleston, 6 Liberty Street, Charleston, SC, 29424, United States, gonzalezm@cofc.edu

The success of any product depends essentially on the response of this product or service to the customer expectations. The organizations that accurately respond to consumer needs take a crucial market leadership in an environment characterized by high competitiveness, resulting from high flexibility of products and processes. There are many different ways to understand and translate the customer expectations to the organizations' requirements, QFD is one of them. If this technique is adequately used, a strategy of improvement based on QFD can be arisen, using marketing and manufacturing strategies at the same time.

2 - Using Automated Algorithm Configuration to Accelerate the Optimization of Decentralized Energy Systems Modeled as Large-Scale, Two-Stage Stochastic Programs

Hannes Schwarz, Karlsruhe Institute of Technology (KIT), Hertzstraße 16, Karlsruhe, 76187, Germany, hannes.schwarz@kit.edu

The optimization of decentralized energy systems is an important practical problem that can be modeled as stochastic programs and solved via their large-scale, deterministic equivalent formulations. Unfortunately, using this approach, even when leveraging a high degree of parallelism on HPC systems, finding close-to-optimal solutions still require several weeks to months of computation. In this work, we demonstrate how this computational effort can be reduced substantially by using an effective sequential model-based algorithm configuration (SMAC) procedure, for a well-known example of a residential quarter with photovoltaic systems and storages, modeled as a two-stage stochastic MIP.

3 - Blockage and Starvation Control Policies of Two-machine One-Buffer Transfer Line Based on Analytical Model

Penghao Cui, Performance Analysis Center of Production and Operations Systems (PacPos), Northwestern Polytechnical University, Xi'an Shaanxi, China, pacpos.phcui@gmail.com

This paper presents two buffer control policies, restart policy and sleeping policy, for two-machine one-buffer transfer line to reduce stoppage frequency and cost due to blockage and starvation. We model transfer line's in-out-transition behavior of basic state space, only in-(or out-) transition behavior of controlled state space, and switch between two state spaces, respectively, using Markov process. We give exact analytical solutions and further evaluate the effect of different policies on the system performance.

4 - An Memetic Algorithm Based on a Tabu Search for the Antibandwidth Maximization Problem

Shengnan Shu, Huazhong University of Science and Technology, Wuhan, China, 1051125617@qq.com

The antibandwidth maximization problem is to label the vertices of a graph with distinct integers such that the minimum difference between labels of adjacent vertices is maximized. It is one of the NP-complete problems. In this paper, we reduce the AMP to a series of k-AMP, followed by proposing a special tabu search procedure with two evaluate functions and a memetic algorithm which uses a TEA crossover operator for the general graphs of k-AMP. Our extensive experimentation with 240 instances of 7 known optimum sets and 3 unknown optimum sets shows that the proposed algorithms outperforms existing methods, and have proved the optimum solutions of an unknown optimum set.

Tuesday, 3:30pm - 5:00pm

■ TC01

King's 1

Optimization, Decision Making and Applications

Contributed Session

Chair: Monique Guignard-Spielberg, University of Pennsylvania, University of Pennsylvania, Philadelphia, PA, 19104-6340, United States, guignard_monique@yahoo.fr

1 - Advanced Excel Optimisation Modelling using OpenSolver and SolverStudio

Andrew J. Mason, University of Auckland, Dept of Engineering Science, Private Bag 92019, Auckland, New Zealand, a.mason@auckland.ac.nz

OpenSolver and SolverStudio are freely available tools that are widely used for optimisation modelling in Excel. OpenSolver (http://opensolver.org) extends Excel's optimisation capabilities by adding access to open source solvers such as COIN-OR's CBC and BONMIN. SolverStudio (http://solverstudio.org) takes a different approach in that it allows users to build and solve models within Excel using modern modelling languages such as PuLP, AMPL, GAMS, Julia/JUMP and CMPL. We introduce these tools and demonstrate recent advances in their capabilities. Several case studies are also presented.

2 - Commonalities in Genetic Signatures and Signaling Pathways in Neurological Disorders: Further Results

Nicole Ortiz, UPRM, Calle 65 Infanteria 32 N, Lajas, PR, 00667, United States, nicole.ortiz1@upr.edu

Finding similarities in genetic behavior among different illnesses can lead to extrapolate knowledge among their respective biological processes. This project aims to compare Alzheimer's Disease and Parkinson s Disease to help characterize both ailments through their genetic similarities. To achieve this, both of their potential genetic signaling paths are constructed through a series of optimization procedures: a filtering stage to detect differentially expressed genes through multiple criteria optimization and a structuring stage to find the most correlated path among the said genes through network optimization. The results and their biological relevance are discussed.

3 - Measuring Green Performance of Suppliers via Simulation-based Multi-criteria Decision Analysis

Kazim Sari, Associate Professor and Chair, Beykent University, Ayazaga Campus, Istanbul, 34396, Turkey, kazims@beykent.edu.tr

We propose a novel multi-criteria decision framework for measuring green performance of suppliers. In our decision framework, Monte Carlo simulation analysis is combined with AHP (Analytical Hierarchy Process) and VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje) methodologies under fuzzy environment. While AHP is used to obtain relative weights of evaluation criteria obtained from extensive review of literature, VIKOR is used to generate rankings of suppliers. By adding Monte Carlo simulation into the analysis, it is offered a new way of dealing with uncertainties results from incomplete and/or vague information related with the decision situation.

4 - An Adaptive Convex Hull Heuristic for Differentiable N Onlinear 0-1 Integer Programming Problems

Monique Guignard-Spielberg, Professor, University of Pennsylvania, 500 Jmhh-Opim Department, Wharton School, University of Pennsylvania, Philadelphia, PA, 19104-6340, United States, guignard_monique@yahoo.fr

The Convex Hull Heuristic is a fast heuristic for general 0-1 nonlinear integer programming problems with linear constraints and a differentiable objective function. It can be run as a single start (S-S) or multi-start (M-S) heuristic. The starting point(s) can often be adapted to the problem type. Computational results, including integrality or optimality gaps when available, will be presented for QKPs (0-1 quadratic knapsack problems) as (S-S), and for QAPs, GQAPs, E-kQKPs (QKPs with a cardinality constraint) and CDAPs (crossdock door assignment problems) as (M-S).

■ TC02

King's 2

Aviation Applications

Contributed Session

Chair: Kenneth Kuhn, RAND Corporation, RAND Corporation, Santa Monica, CA, 90407, United States, kkuhn@rand.org

1 - A Study on the Low Cost Carriers in South Korean: Past, Present and Future.

Jiseon Lee, KAIST, 291 Daehak-ro, Yuseong-gu, Daejeon, Korea, Republic of, easysun85@kaist.ac.kr

In 2005, Hansung Airlines became the first Low Cost Carrier (LCC) in South Korea and operated until 2008 when it decided to suspend the flight operation due to the rising of oil prices and the unfavorable exchange rates. Currently there are five LCCs in South Korea. These LCCs have been changing the airline industry in South Korea and make up over 50% of the domestic flights and 10% of international flights of the market share in the country. The purpose of this paper is to look back these past 10 year on the airline industry as a result of LCCs and how it has changed the government policies, safety regulations, and the growth process for the airline industry. We also address the recent trends and future outlook.

2 - Airborne Recovery of the Emergency Communication Network in Disaster Response

Recep Berk Ozgur, Turkish Air Force Academy, Yesilyurt, Istanbul, 34149, Turkey, 1418ozgur@harbiyeli.hho.edu.tr

Maintenance of the cellular communication systems which are disrupted by a natural disaster, has a vital importance for response operations of the emergency teams in the first 72 hours. In this study, the role of unmanned aerial vehicles (UAVs) is examined in the airborne recovery of the cellular communication network. A mixed integer linear programming model has been formulated to determine loitering locations of the relay UAVS to maximize the coverage of emergency response teams subject to be continuously connected with each other and also to the center. Finally, results obtained by the proposed model have been demonstrated for various randomly generated disaster damage scenarios.

3 - IMC-PID Controller Design for Turbine Control Loop Based on Closed-Loop Identification

Li Xiao-feng, The Instrument and Power Plant Control Department,, Guangzhou, 510080, China, 13660239839@139.com

This paper proposes a closed-loop identification method for the design of a robust PID controller of the turbine control loop in the boiler-turbine coordinated control system. The process model is firstly identified. In the identification procedure, set-point change tests are adopted to calculate the model based on process inputs and outputs in control loops. The process frequency-response matrix is estimated, and then a transform function matrix is obtained by least square method. The robust PID controller of the turbine control loop is designed by using the internal model control (IMC) method based on the obtained model. It is shown that the IMC-PID controller maintains the robust performance and minimizes the effects of the external disturbance in power system or the internal disturbances in the power plant.

4 - Identifying Comparable Days in Air Traffic Flow Management Data

Kenneth Kuhn, RAND Corporation, 1776 Main Street, Santa Monica, CA, 90407, United States, kkuhn@rand.org

This study defines a methodology for identifying days during which similar collections of air traffic flow management initiatives were implemented. This is a step in a larger project to analyze the past use of initiatives and develop a recommendation engine for traffic managers. Advisories issued by the FAA's Air Traffic Control System Command Center are processed to yield feature data. An example feature is plan time, the difference between when an advisory first mention an initiative and when the initiative goes into effect. Market basket and cluster analysis are applied to the features. There is more structure in the initiative data than in previously analyzed weather and air traffic data.

■ TC03

King's 3

Behavioral Operations and Marketing

Contributed Session

Chair: Darshan Desai, Berkeley College, New York, NY, 10017, United States, darshudesai@gmail.com

1 - Prediction of Social Network User's Behavior Preference

Peng Zhu, Nanjing University of Science and Technology, 200 Xiaolingwei Street, Nanjing, 210094, China, p.zhu@outlook.com

Analysis and prediction of user behavior has become a significant means to enhance the user experience in social networks. However, due to features of social networks, the limitations of user's time and energy, the social relationships of most social users are incomplete and sparse, it restricts the coverage and accuracy of user behavioral prediction. In response to these problems, this paper extracts user potential social relationship, and by making use of user preference information, it designs effective user preference consistency algorithm. Meanwhile, it proposes a visualizer evaluation method, which also can evaluate the performance of prediction algorithm from micro level.

2 - Modeling and Optimization of Peer-to-peer Lending Processes

Ying Shi, Lecturer, Zhengjiang University of Finance & Economics, Xueyuan Street No.18,Xiasha Higher Education Park, Hangzhou, 310018, China, angelashi@zufe.edu.cn

In China, peer-to-peer lending has launched a new way of financing for small companies in recent years, yet asymmetric information has restricted seriously the development of peer-to-peer lending. By utilizing Markov stochastic process, firstly, we construct the expected profit equations for the platforms, guarantee companies, borrowers, and lenders. Then, we build a multi-objective non-linear programming model of maximizing the profits for the participants, and obtain the optimal lending amounts and some other decision. Finally, we present some numerical examples to verify the effectiveness of the addressed model. The paper is of significance to optimize financial resource allocation.

3 - The Effect of Unavailable Compromise Option on Consumer Preference

Qing Yao, University of Science and Technology Beijing, Dongling School of Economics and Management, Beijing, 100083, China, yao@ustb.edu.cn

How information about unavailable products influence consumer's preference for remaining options represents a meaningful arena in both theory and practice. We examine how unavailability of compromise option influences preference on the remaining options. Based on three studies involving contexts where products are generally judged by two attributes, price and quality, we show that unavailability of compromise option advocates for the increased preference for the option excelling in price. Moreover, when experts ratings of the product quality aiming to reduce the ambiguity of quality trade-offs are provided, the asymmetric influence of unavailable compromise set on other options is attenuated. Alternatively, when presenting the quality information as ranges rather than specific values, the increased ambiguity of quality trade-offs in turn enhance the share of the cheaper option. The findings are consistent with the explanations from conflict-reducing and easy trade-offs heuristics.

4 - Predicting Customers' Response to Marketing Actions: Leveraging Power of Clumpiness

Darshan Desai, Berkeley College, New York, NY, 10017, United States, darshudesai@gmail.com

It seems intuitive that firms can be more profitable if they can predict the most profitable customers and invest disproportionately in them. However, effectiveness of such initiatives largely depends on a firm's ability to accurately predict the customers' lifetime value (CLV). Scholars have proposed many advanced techniques, however, the recency/frequency/monetary value (RFM) segmentation framework remains a CLV mainstay. Recent research has demonstrated the deficiency in RFM and extended the framework to include clumpiness. We build on this recent research and explore if the clumpiness is the missing link between the firms' marketing actions and its CLV and competitive performance.

■ TC04

Queen's 4

Game Theory

Contributed Session

Chair: Konstantinos Kollias, Google, Belmont, CA, 94002, United States, kostas.c.kollias@gmail.com

1 - An Extension of Quantal Response Equilibrium and Determination of Perfect Equilibrium

Chuangyin Dang, Professor, City University of Hong Kong, Dept of Systems Eng & Eng Mgmt, 83 Tat Chee Avenue, Kowloon, Hong Kong, mecdang@cityu.edu.hk

As a strict refinement of Nash equilibrium, the concept of perfect equilibrium was formulated and extensively studied in the literature. To determine perfect equilibrium, this paper extends the quantal response equilibrium to a perturbed game. As a result of this extension, a smooth path is constructed for determining perfect equilibrium. The path starts from an arbitrary totally mixed strategy profile and leads to perfect equilibrium. Examples further confirm the effectiveness of the path.

2 - An Extension of Nash's Continuous Mapping and a Simplicial Path-following Method for Approximating Perfect Equilibria

Yabin Sun, Phd Student, City University of Hong Kong, Nam Shan Office-705, 83 Tat Chee Avenue, Kowloon, Hong Kong, yabinsun-c@my.cityu.edu.hk

As a strict refinement of Nash equilibrium, perfect equilibrium plays an important role in the development of game theory and its applications. To compute a perfect equilibrium, we extend Nash's continuous mapping to a perturbed game. As a result of this extension and an application of a triangulation with continuous refinement of grid size, we develop a simplicial path-following method for approximating perfect equilibria. The method starts from an arbitrary totally mixed strategy profile and leads to a perfect equilibrium at a limit. Numerical results further show that the method is effective and efficient.

3 - A Quantal Response Equilibrium from Nash Mapping and Approximation of Perfect Equilibrium

Yin Chen, City University of Hong Kong, 702B, SR3, 22 Cornwall Str., KLT, Hong Kong, yinchen4-c@my.cityu.edu.hk

Based on Nash's mapping, a class of quantal response equilibrium is formulated for finite n-person games in normal form. To determine a perfect equilibrium, we extend this quantal response equilibrium to a perturbed game. As a result of this extension, we develop a smooth path-following method for approximating aperfect equilibrium. The method follows a smooth path that starts from an arbitrary totally mixed strategy profile and leads to a perfect equilibrium. Numerical examples further demonstrate the effectiveness of the approach.

4 - Dynamic Game theory for Analysis and Selection of Partners in Public Private Partnerships

Mohammad Rajabi, University of Edinburgh, 29 Buccleuch Place, Lothian, Edinburgh, EH8 9JS, United Kingdom, m.rajabi@sms.ed.ac.uk

Nowadays, delivering public services through Public-Private Partnerships (PPPs) has become a standard approach. In this paper, we propose a Game Theory based modelling and analysis framework to assist the public sector in deciding to which private sector partner to award a PPP contract. The proposed framework provides both the theoretic foundation and the thinking logic for the public sector to negotiate with the private sector. The proposed model is based on a non-cooperative dynamic game with complete information. The dynamic nature of this model makes it highly suitable for real life situations involving negotiation over contractual terms.

5 - Optimal Cost-sharing in General Resource Selection Games

Konstantinos Kollias, Research Scientist, Google, 1945 Charleston Rd, Mountain View, CA, 94043, United States, kostas.c.kollias@gmail.com

Resource selection games provide a model for a diverse collection of applications where a set of resources is matched to a set of demands. Examples include routing in traffic and in telecommunication networks, acquisition of services or goods with demand-dependent prices, etc. Demands are often submitted by selfish players and congestion on the resources results in negative externalities for their users. We consider a policy maker that can set a priori rules to minimize the induced inefficiencies. We explore the space of such rules abstracted as cost-sharing methods. We prescribe desirable properties that the method should possess and characterize the optimal one, in this natural design space.

■ TC05

Queen's 5

Operations Management in Healthcare

Invited: Global Health

Invited Session

Chair: Kin Keung Lai, Professor, City University of Hong Kong, Tat Chee Ave, Kowloon, 0000, Hong Kong, mskklai@cityu.edu.hk

1 - Matching Supply and Demand of Medical Service Considering Expectation: A Two Stage Method

Xi Chen, Xidian University, Xi'an, China, xchen@xidian.edu.cn, Liu Zhao, Jing Han, Juan Wang

A two-stage matching method is proposed to assign patients to doctors. Matching suitable patient and doctor to form a pair will facilitate the effectiveness of medical service and improve the satisfaction degree of patient. In the first stage, the grouping rules are proposed to balance the workload among the doctors. Then, a multi-objective optimization model is established to maximize the similarity degree between the expectations of patients. In the second stage, another optimization model is constructed to maximize the satisfaction degree of the patients to the doctors. Finally, a practical example is used to demonstrate the feasibility and effectiveness of the proposed method.

2 - An Insight on Age Variation of Health Care in China: An Application of Meta-analysis

Jian Chai, Xidian University, Xi'an, China, chaijian0376@126.com, Limin Xing, Kin Keung Lai, Quanying Lu, Shouyang Wang

Due to previous studies drew various conclusions on the effect of healthcare insurance in China, we apply meta-analysis to the problem. For 31 related papers, we first conduct a conditional Dirichlet-based Bayesian semi-parametric model, deeming healthcare possesses little probability reducing medical expense. Then, with age group as moderators to make meta-regression analysis, we conclude it reduces medical spending by 11.94% for the non-old group, while helpless for the old ones, even positive to some extent. In light of the aging population and increasing medical expense in China, we finally propose "public hospital, public welfare" and"prevent disease before" for the medical reform.

3 - Bi-level Multi-objective Hospital Outpatient Physician Allocation Model under Uncertainty

Xiaoyang Zhou, Shaanxi Normal Univeristy, Xian, China, x.y.zhou@foxmail.com

Due to the hospital's highly specialized nature, technological and human resources constraints, a large amount of patients cannot receive the proper treatments on time. Since the first part of the treatment process is physician allocation, therefore, it is necessary to study the allocation problem of hospital physician.

4 - Innovation Docking Paths and Network Diffusion Mechanism of Mobile-health Service Based on Small-world Networks

Jing Han, Shaanxi Normal University, Xi'an, China, hanjing@snnu.edu.cn, Shunxin Ye, Bin Li, Kin Keung Lai

This paper aims to describe the self-organizational evolutionary paths in the process of knowledge diffusion and innovation paths docking between hospitals and patients to analyze the mobile health service in the framework of small-world networks theory. The results show that the dynamic docking paths building with networks structure matching would optimize knowledge diffusion and customers' need expression based on the small-world networks, in which process the organizations-across docking paths among multiple agents and networks diffusion mechanism play much significant roles, so that the quality and efficiency of m-health service would be promoted.

■ TC06

Queen's 6

Data Analytic and Industry Innovation

Invited: Practice-Focused Operations

Invited Session

Chair: Grace Lin, Data Analytics Technology and Applications Research Institute, Institute for Information Industry, Taiwan, R.O.C., 5F., No.133, Sec. 4, Minsheng E. Rd., Songshan Dist., Taipei City 105, Taiwan (R.O.C.), Institute for Information Ind

1 - Itinerary Planning in Smart Tourism Taiwan

Tsung-Lin Wu, Data Analytics Technology and Applications Research Institute, Institute for Information Industry, Taiwan, R.O.C., tlwu@iii.org.tw

In the rapidly growing and evolving global tourism industry, the prevalence of mobile devices places higher demands on last-minute itinerary planning. Promising itinerary plans have to take into account the aspects including (1) tourists' preferences and wish lists, (2) social media contents, (3) information of scenery, stores, and events, such as their locations and open hours, and (4) traffic time information. In this work we propose heuristic algorithms to fulfill these requirements and give recommended itineraries in few seconds, which are implemented in our tourist service, Smart Tourism Taiwan.

2 - Nighttime Sleep Quality Assessment for Eldercare Based on Ambient Sensor Environment

Yi-Chong Zeng, Data Analytics Technology and Applications Research Institute, Institute for Information Industry, Taiwan, R.O.C., yichongzeng@iii.org.tw

Getting enough sleep has become an important issue for the elderly. Besides sleep duration, sleep status is also an index to assess elder's sleep quality. Lack of sleep is one of factors to result in elders getting hurt in daily living. Recently, wearable device with sleep status estimation has become famous, which estimates three types of sleep statuses, including, awake, light sleep, and restful sleep. However, in some situation people feel uncomfortable to wear device, such as the elder with dementia. In this work, we employ ambient sensors deployed in the experimental environment to detect people activity as well as to assess sleep quality.

3 - Integrating Product Information from Heterogeneous Data Sources

Arthur Wu, Data Analytics Technology and Applications Research Institute, Institute for Information Industry, Taiwan, R.O.C., arthurwu@iii.org.tw

Given that millions of products are sold, reviewed, and discussed on the internet, social media and shopping websites are important sources to collect sales information and user opinion. However, products are sold and discussed by merchants and users using different product names on different websites. Furthermore, such data is mostly not well structured and often contains missing or wrong values. Integrating product information from these heterogeneous data sources is a huge challenge. In this study, we introduce a framework for matching different information referring to the same real-world product. This framework consists of three steps: feature extraction, similarity estimation, and classification. The results of this study provide a basis for further analysis and applications.

4 - UBI Data Lake and Analytics Applications for Insurance Industry

Wei-Ting Chen, Data Analytics Technology and Applications Research Institute, Institute for Information Industry, Taiwan, R.O.C., weitingchen@iii.org.tw

With Big Data Analytics, Internet of Things, and Cloud Computing, many insurance companies around the world market a type of insurance called UBI (Usage-based Insurance). In UBI, insurance prices are dynamic and depend on data from devices in vehicles. However, risk of driving relied on not only drivers' behaviors but external environment. For this reason, this study aims to build a data lake which links to vehicles and Open Data.

■ TC07

Kohala 1

Simulation

Contributed Session

Chair: Peter McGlaughlin, mcglghl2@illinois.edu

1 - Liear Cmbination of the Variance of the Sample Mean with Minimal Mean Square Error

Mingchang Chih, Assistant Professr, Feng Chia University, Taitung, Taiwan, mcchih@fcu.edu.tw

We introduce the idea of considering the correlation structure of the simulation output data in the design of a variance estimator. Specifically, we use the correlations of two adjacent non-overlapping batch means to detect the correlation structure of the data. Once the bias term is negligible, we apply linear combinations of batch means estimators based on different batch sizes, and then we choose the linear combination weights by omitting the bias vector. We also evaluate our idea with Monte Carlo experiments. In our study, we aim to develop a linear-combination algorithm for estimating the variance of the sample mean for steady-state simulations.

2 - Modelling Customer Portfolio Value using Lifetime Value and a Markov-Based Model

Alejandro Francisco Mac Cawley, Assistant Profeessor, Pontificia Universidad Catolica de Chile, Vicuna Mackenna 4860, Santiago, 7820436, Chile, amac@ing.puc.cl

We present a model of the customer portfolio value for a retail company. To achieve the valuation of the customer portfolio we first characterize three clusters of customers, according to the profit they generate along their lifetime in the company. We determined the customer groups as: marginal, medium and principal. We also determine a Markov-based model that portraits the probabilities that a given customer will move from any]group to a different group and the probability that a customer from a group will depart or a new customer arrive. With this information, we are able to simulate and forecast the customer portfolio value along time and determine the effect of changes in the underlying variables.

3 - A Simulation Study on the Optimal Initial Vehicle Deployment for Electric Scooter Sharing Systems

Silvia Merdikawati, Master Student, NTUST, No.43, Keelung Rd., Sec.4, Daan Dist., Taipei City 10607, Taiwan (R.O.C.), Taipei, 10607, Taiwan, silvia_merdika@yahoo.com

Electric Scooter Sharing Systems (ESSS) are environmental friendly transportation alternatives that offer extra benefits to existing bicycle share customers. This study investigates the optimal initial vehicle deployment for a fully automated ESSS implemented in a city with the highest density of universities in Taiwan. With limited empirical demand and usage information, we simulated the critical demand parameters (trip rates, trip lengths and trip durations) and supply parameters (number of e-scooter and charging dock, recharge protocol) to determine the optimal number of e-scooter under different potential demand situations to gain important insights before full field deployment.

4 - Discretization Error in Reflected Fractional Brownian Motion

Peter McGlaughlin, University of Illinois, Urbana-Champaign, Urbana, IL, United States, mcglghl2@illinois.edu

The long range dependence and self-similarity properties of fractional Brownian motion make it an attractive model for traffic in many data transfer networks. A reflected fractional Brownian motion (rfBm) appears in the storage process of such a network. In this talk, we focus on the simulation of rfBm using an Euler discretization scheme and we show that the strong discretization error is of order nH-1, where n is the number of points and the Hurst parameter H in (0,1).

■ TC08

Kohala 2

Empirical Marketing Studies

Contributed Session

Chair: Kadiampatti N. Rajendran, University of Northern Iowa, University of Northern Iowa, Cedar Falls, IA, 50614-0126, United States, raj.rajendran@uni.edu

1 - An Experimental Study of Cultural Differences, Consumer Needs, and Consumer Satisfaction

Mei-Wen Chao, Assistant Professor, Kao Yuan University, 1821 Jhongshan Road, Lujhu District, Kaohsiung City, 82151, Taiwan, t80149@cc.kyu.edu.tw

Once the company gets into global marketplace, the global marketing plan is often the most difficult part to complete for any business because of the social and cultural differences involved. This paper aims to help the service industry can better understand the viewpoint customers use to fulfill their satisfaction by evaluating the needs toward store quality attributes and create a guideline about how to vary examination and improvement of the service quality between Taiwanese and American cultures.

2 - An Empirical Research on Consumer's Price Acceptance in Japan

Yoshiyuki Okuse, Senshu University, 2-1-1 Higashi Mita, Tama-ward, Kawasaki City Kanagawa Pref, 214-8580, Japan, okuse@senshu-u.jp

The purpose of this research is to identify the variability of consumer's price acceptance by situations. For this purpose, multi-level analysis was conducted to the data which was collected from internet survey on Japanese consumer's price acceptance for eating at fast food shops.

3 - Experience Infusion

Mathew Chylinski, Univeristy of New South Wales, South Wing 3rd Floor, Quadrangle Bldg., Sydney, Australia, m.chylinski@unsw.edu.au

The paper investigates a framework based on compensatory process experience, where positive experiences compensate for negative ones, in the context of online retailing. We analyze data obtained from an elaborate experiment on experience regulation by testing a panel dynamic system of equations using a Bayesian (MCMC) approach. This approach allows us to capture the simultaneous interaction between different activities and experiences over time. We find that infusion of an intrinsically enjoyable but unrelated activity such as gameplay with a principal-agent conjoint task improves the overall experience of the decision task, and increases the accuracy of the decision making.

4 - Discovering Attributes of a Higher Education Institution that Matter to Students using the Kano Method

Kadiampatti N Rajendran, Associate Professor, University of Northern Iowa, 342 Curris Business Building, Cedar Falls, IA, 50614-0126, United States, raj.rajendran@uni.edu

In the present study, we are applying the Kano method to evaluate the nature of various attributes of an institution of higher learning, which may be a first in its own right. Our findings suggest that there are 'attractive' attributes (i.e. capable of producing 'customer delight') among academic, institutional, and student-life related domains. We suggest broadening the interpretation of attribute categories Professor Kano developed (Kano et al. 1984) by utilizing the indices of satisfaction and dissatisfaction. An interesting aspect highlighted by the study is how best to utilize the findings of Kano studies, particularly in the context of recruiting students to higher education institutions.

■ TC09

Kohala 3

Open Problems on Open Innovation

Invited: Entrepreneurship and Innovation

Invited Session

Chair: Shigemi Yoneyama, Gakushuin University, 1-5-1 Mejiro,, Toshima-ku,, Tokyo, 171-8588, Japan, shigemi.yoneyama@gakushuin.ac.jp

1 - The Interaction Between Inbound and Outbound Process of Open Innovation and Its Effect on Innovation Performance

Isamu Yamauchi, Meiji Gakuin University, Tokyo, Japan, ism.yamauchi@gmail.com, Shigemi Yoneyama

Using original survey data on Japanese companies at project level, we will investigate a relationship between inbound and outbound process of open innovation. Outbound activities can increase the inbound flow of outside knowledge which would accelerate discovery of new use and exploitation of inside knowledge. The survey results show that outbound activities not only have a direct positive effect on innovation performance per se but also enhance an effect of inbound activities, which suggests a synergistic effect of two processes. Moreover, we will introduce the survey result that the magnitude of such interactive effect varies depending on the timing and scope of exposure of inside knowledge.

2 - What is Nidec's Research, Acquisition and Development (RAD) Strategy for Open Innovation?

Seiji Manabe, Yokohama National University, Yokohama, Japan, manabe-seiji@nifty.com

This paper show how Nidec, a Japanese motor manufacturer, seeks to achieve balance between its own technology development from basic research and technology introduction by acquisition. Since the company's founding as a late-comer in 1973, Nidec has researched motor technology at its basic research division and, at the same time, acquired 46 motor-related companies over the past 31 years to obtain external technologies. As a result, Nidec grew to be the world's No.1 motor company. Compared to Cisco's A&D Strategy, we will discuss the practice and the logic of Nidec's RAD (Research, Acquisition and Development) strategy.

3 - Sourcing External Technology and New Product Market

Masayo Kani, Associate Professor, Tezukayama University, 7-1-1 Tezukayama, Nara, Nara, 631-8501, Japan, mkani@tezukayama-u.ac.jp, Kazuyuki Motohashi

This paper provides empirical analyses to comprehensively understand combining external technology into new product development by using a survey data on Japanese firms. In the first analysis, we explore factors that determine whether firms incorporate external technology or not and which strategies such as collaboration and licensing in are selected. Our finding is that the amount of accumulated knowledge in the focal field is associated with the choice of strategy. The second analysis shows the effects of sourcing external technology on the market of the new product by controlling covariates used in the first analysis.

4 - Patent, Secrecy and Firm Performance: Implication for Open and Closed Strategy

Koichiro Onishi, Osaka Institute of Technology, onishi@ip.oit.ac.jp, Yoichiro Nishimura

This paper investigates the effect of patenting, secrecy and disclosure of inventions on firm performance. Our data includes the number of patentable inventions, patents and secrecy measuring companies' alternative strategy for IP. We introduce these strategic variables into a production function. To cope with endogenous problem for firm strategy, we use government subsidies for patenting as instruments. We find that while patented inventions enhance companies' productivity, strategic secrecy is effective for SMEs. An implication of our work is that closed IP strategy is still significant for SMEs to appropriate their innovation.

■ TC10

Kohala 4

Large-scale Semidefinite Programs

Sponsored: Optimization

Sponsored Session

Chair: Javad Lavaei, UC Berkeley, Berkeley, California, CA, 94720, United States, lavaei@berkeley.edu

1 - Moment/sum-of-squares Hierarchy for Complex Polynomial Optimization

Cedric Josz, University of Paris VI, cedric.josz@gmail.com, Daniel K Molzahn

We consider the problem of finding the global optimum of a real-valued complex polynomial on a compact set defined by real-valued complex polynomial inequalities. It reduces to solving a sequence of complex semidefinite programming relaxations that grow tighter and tighter thanks to D'Angelo's and Putinar's Positivstellenstatz discovered in 2008. In other words, the Lasserre hierarchy may be transposed to complex numbers. We discuss a method for exploiting sparsity which enables the complex hierarchy to solve problems with several thousand complex variables.

2 - Low-rank Solutions of Sparse Linear Matrix Inequalities

Ramtin Madani, University of California, Berkeley, Berkeley, CA, United States, ramtin.madani@berkeley.edu, Ghazal Fazelnia, Somayeh Sojoudi, Javad Lavaei

This work is concerned with the problem of finding a low-rank solution of an arbitrary sparse linear matrix inequality (LMI). To this end, we map the sparsity of the LMI problem into a graph. We develop a theory relating the rank of the minimum-rank solution of the LMI problem to the sparsity of its underlying graph. Furthermore, we propose three graph-theoretic convex programs to obtain a low-rank solution. Two of these problems need a tree decomposition of the sparsity graph. The third one does not rely on any computationally-expensive graph analysis. The results are applied to the problems of minimum-rank matrix completion, conic relaxation for polynomial optimization, and affine rank minimization.

3 - Penalized Semidefinite Programming Relaxation for Polynominal Optimization Problems

Javad Lavaei, UC Berkeley, Berkeley, CA, United States, lavaei@berkeley.edu, Morteza Ashraphijuo, Ramtin Madani

NP-hardness of combinatorial optimization and several other problems is due to the complexity of finding the inverse of a set of polynomial equations. In this talk, we show that the inverse of an arbitrary polynomial system is equal to the argmin of some semidefinite program (SDP) at the neighborhood of any given nominal point. We then prove that there is a finite set of SDPs, whose argmins all together establish the inverse of the polynomial system globally. Using this result, we develop a series of penalized SDPs to find near-global solutions of every arbitrary polynomial optimization problem.

4 - Large-Scale Graphical Lasso Problems

Somayeh Sojoudi, University of California-Berkeley, 1543 Delaware Street, Berkeley, CA, 94703, United States, sojoudi@berkeley.edu

Sparse inverse covariance estimation from a small number of samples is an important problem with a wide variety of applications. Graphical lasso is a popular technique for addressing this problem. This technique relies on solving a computationally-expensive semidefinite program (SDP). We derive sufficient conditions under which the solution of this large-scale SDP has a simple formula. We test these conditions on electrical circuits and functional MRI data. This talk develops new insights into regularized SDP problems.

■ TC11

Kona 1

Reliability

Contributed Session

Chair: Minjae Park, Hongik University, Hongik University, Seoul, 121791, Korea, Republic of, mjpark@hongik.ac.kr

1 - A Bayesian Approach to Degradation Based Burn-in Optimization

Suk Joo Bae, Associate Professor, Hanyang University, 705-2 Engineering center(main bldg),, 17 Haengdang-dong, Seongdong-gu, Seoul, 133-791, Korea, Republic of, sjbae@hanyang.ac.kr

In this article, we propose a Bayesian approach for a degradation-based burn-in test for products exhibiting two-phase degradation patterns. A hierarchical Bayesian bi-exponential model is used, and mission reliability and total cost are used as planning criteria. The proposed burn-in approach is built within the hierarchical Bayesian framework to account for unit-to-unit variability within the burn-in population, and uncertainty concerning the model parameters. A practical example using PDP degradation data was used to illustrate the proposed methodology.

3 - An Ideal Way of Obtaining an Optimal Inspection Permutation for a System with Components Connected in Series

Honest Chipoyera, University of the Witwatersrand, 1 Jorrisen Street, Braamfontein, Johannesburg, South Africa, honest.chipoyera@wits.ac.za

The problem of an inspection permutation/strategy (first discussed by Zuckerman (1989) and reviewed by Qiu (1991)) is revisted. A way of determining an optimal inspection strategy in an easier fashion is proferred and Mathematica is used to showcase how the method works.

4 - Optimal Maintenance Strategy for Systems with Repair Time Threshold

Minjae Park, Professor, Hongik University, 72-1 Sangsu-Dong, Mapo-Gu, Seoul, 121791, Korea, Republic of, mjpark@hongik.ac.kr

This paper extends the basic age replacement policy for a repairable product by considering the minimal repair and the replacement simultaneously on each failure of the product. We consider a situation where a repair time threshold is pre-set and either minimal repair or replacement is performed depending on whether or not the repair time exceeds the threshold when the product failure occurs. The product failures are modeled under the nonhomogeneous Poisson process with a known intensity function. By assuming a cost model under such an extended age replacement policy, we study the optimal choice of the pre-determined replacement age by minimizing the expected cost rate.

2 - Truthfulness of a Proportional Sharing Mechanism in Resource Exchange

Qi Qi, Assistant Professor, Hong Kong University of Science & Technology, Hong Kong University of, Science and Technology, Kowloon, Hong Kong, kaylaqi@ust.hk

We consider the popular proportional sharing mechanism and discuss the incentives and opportunities of an agent to lie for personal gains. The main result is a proof that an agent manipulating the proportional sharing mechanism by misreportingits resource amount will not benefit its utility eventually. This result establishes a strategic stability property of the resource exchange protocol. We further illustrate and confirm the result via network examples.

■ TC12

Kona 2

Scheduling

Contributed Session

Chair: Nima Zaerpour, California State University-San Marcos, San Marcos, CA, 98, United States, nzaerpour@csusm.edu

1 - Strategic Scheduling of Pavement Rehabilitation Interventions

Jackeline Murillo-Hoyos, Graduate Student, Purdue University, Lyles School of Civil Engineering, 550 Stadium Mall Drive, Office 2155, West Lafayette, IN, 47906, United States, jmurill@purdue.edu

Infrastructure agencies seek to apply appropriate rehabilitation treatments at the right time. A schedule refers to the set of triggers or pre-treatment levels of infrastructure condition over life cycle, and an optimal schedule is one that maximizes life-cycle utility in terms of benefits (infrastructure longevity and condition as well as agency and user costs). To obtain an optimal schedule, the approach uses a sequentially decomposed optimization framework to address the mixed-discrete nature of the problem. The paper ends with a case study that uses cost and performance data from in-service highway pavements and assesses the performance of the framework in obtaining the optimal schedule.

2 - Mix Response Flexibility and Sequencing in Process Industries

Shellyanne Wilson, The University of the West Indies, St. Augustine, Trinidad and Tobago, shellyanne.wilson@sta.uwi.edu

Mix flexibility remains critical to a company's manufacturing system, as it is needed to manufacture expanding product ranges on shared manufacturing resources. The measurement of the response dimension provides an insight into the ease of changing between products in a company's product mix; and has primarily focused on the time element of product changeovers. Despite the allure of finding a standard measure for this flexibility type, there still remains no universal measure. This research paper, via a case study, presents a mix response flexibility measure that can be used to inform the production planning process to determine time-efficient product sequences in process industries.

3 - Scenarios in Strategic Planning: Preventing Bias, or Biasing the Process?

Diana Shrimpton, Defence Science and Technology Group, Melbourne, Australia, diana.shrimpton@dsto.defence.gov.au

Qualitative scenario analysis provides strategic context for Defence decision making, underpinning detailed quantitative analysis, modeling and simulation. The use of scenarios is said to add rigour to strategic planning by reducing the cognitive biases that can prejudice thinking about the future. However insights from the field of psychology reveal that the process of generating scenarios may itself introduce biases. A case study from Australian Defence is used to illustrate and critique the theory, highlighting the relevance of strategic level assumptions for operational analysis, and resulting in a number of practical recommendations for users of scenario-based planning.

4 - A Next Generation Container Port

Nima Zaerpour, Assistant Professor of Operations Management, California State University, San Marcos, CA, United States, nzaerpour@csusm.edu

Containerized transportation is an essential part of the intermodal freight transport. Practitioners are always searching for innovations to achieve higher efficiency. We propose a next generation high-density container tower system to increase the footprint utilization in order to achieve high throughput within a given land profile. For such systems, the use of footprint is much smaller than for conventional container ports. We answer the following questions: <ol> What is the cost of a next generation port? What is the performance of a next generation port of a given storage capacity? We compare our proposed next generation port with the real data obtained from a conventional container terminal.

■ TC13

Kona 3

Environment, Energy and Natural Resources

Contributed Session

Chair: Krystel Castillo, University of Texas-San Antonio, University of Texas-San Antonio, San Antonio, TX, 78249, United States, Krystel.Castillo@utsa.edu

1 - Climate Policy Measure Index

Julian Dieler, Junior Economist, Ifo Institute, Poschingerstrasse 5, Munich, 81679, Germany, dieler@ifo.de

This study introduces a new climate policy index, the Climate Policy Measure Index (CPMI), which enables the analysis of the stringency and effectiveness of the climate policy in the OECD countries. The CPMI provides cross-country comparisons of the stringency of climate policy as well as the comparison of the development over time (1991-2012). The major contribution to the existing indices in this field is the entirely data-driven aggregation of the several sub-indicators to one composite indicator. Thereby the CPMI provides a high degree of objectivity and transparency.

2 - Integrating Sustainability Concerns in the Indian Agricultural Sector

Ashish Dwivedi, Lecturer, University of Hull, Business School, University of Hull, Cottingham Road, Hull, HU6 7RX, United Kingdom, a.dwivedi@hull.ac.uk

India has a population of 1.2 billion approximately, and has recently witnessed high economic growth rates. The retail sector in India is estimated to be worth US$ 450 billion, is one of the top five retail markets, and is expected to grow to US$ 660 billion. At a global level, it is recognised that any long-term progress on the 'Sustainable development' agenda will require the active participation of the government, businesses and civil society in India. This paper reports on a two-year cross-sectional study on how global logistics and supply chains of international businesses which have global operations can integrate sustainability concerns within the Indian agricultural supply chain.

3 - Analysis of Public Response Behavior under Air Pollution Warning Issuance in Beijing

fangping wang, Beijing Normal University, Room 1009,Wing B, No.12 Xueyuannan Rd, Beijing, China, fangpingwang@mail.bnu.edu.cn

We conducted a survey in Beijing which focus on the public response under air pollution warning issuance. Including air pollution awareness, health influenced perception, warning responding, and responding investment. Age, education and income which were objective factors, air quality index cognition and health influenced perception which were subjective factors showed strong correlation with responding under warning issuance. Individual response on air pollution warning depended largely on warning issuance and his opinion on health influenced perception. Respondents suffered serious health harm were more ungrudging to respond, though they exhibited lower response investment.

4 - A Robust Optimization Model for Biofuel Supply Chain Planning Incorporating Biomass Quality Uncertainties

Krystel K. Castillo-Villar, GreenStar Endowed Assistant Professor in Energy, University of Texas-San Antonio, One UTSA Circle, Mechanical Engineering, San Antonio, TX, 78249, United States, Krystel.Castillo@utsa.edu

We study the design of a second-generation feedstock supply chain network, which includes strategic (biorefinery location) and tactical (logistics) decisions. We include different uncertain parameters such as supply, moisture and ash content. The forecasting of biomass quality parameters (i.e., moisture and ash contents) is challenging. A robust optimization model is proposed for the problem and a hybrid algorithm based on a metaheuristic and inner approximation is used to solve it. The results from the robust model are compared with the results from an equivalent two-stage stochastic model. Finally, preliminary results from a case study in the state of Tennessee are presented and discussed.

■ TC14

Kona 4

Healthcare Scheduling

Sponsored: Health Applications

Sponsored Session

Chair: Burhaneddin Sandikci, University of Chicago, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States, burhan@chicagobooth.edu

1 - Stochastic Next Day Operating Room Scheduling: Modeling and Heuristics

Enis Kayis, Ozyegin University, Istanbul, 34794, Turkey, enis.kayis@ozyegin.edu.tr, Refik Gullu, Taghi Khaniyev

We consider the daily scheduling problem of a single operating room with uncertain surgery durations. Our aim is to find the optimum sequence and scheduled starting times of the surgeries to minimize weighted sum of expected patient waiting times and operating room idle times. We provide analytical characterization and numerical performance of promising heuristics.

2 - Elective Patient Admission under Multiple Ressource Constraints

Christiane Barz, Technical University Berlin, Christiane.barz@tu-berlin.de, Kumar Rajaram

We consider a patient admission problem to a hospital with multiple resource constraints (e.g. OR and beds) and a stochastic evolution of patient care requirements. Emergency patients arrive randomly and have to be accepted at the hospital. Elective patients, however, can be accepted, postponed or even rejected. We formulate the control process as a Markov Decision Process to maximize expected contribution net of overbooking costs, develop bounds using approximate dynamic programming and use them to construct heuristics. We test our methods on data from the RonaldReagan UCLA Medical Center and nd that our intuitive newsvendor-based heuristic performs well across all scenarios.

3 - Myopic Scheduling of Jobs with Decaying Value with Applications in Patient Scheduling

Neal Master, Stanford Univerity, nmaster@stanford.edu, Carri Chan, Nicholas Bambos

In healthcare settings, delays in receiving treatment can result in worse outcomes for patients. We introduce a clearing model in which the reward generated by completing service for an individual job decays over time. Because computing an optimal policy for such a model is computationally intractable, we focus on a number of myopic heuristics. We provide performance guarantees for each heuristic and use simulation to gain further insight into patient scheduling problems.

■ TC15

Kona 5

Supply Chain and Finance

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Xuan Zhao, Wilfrid Laurier University, Ontario, Canada N2L 3C5, Waterloo, AB, 210000, Canada, xzhao@wlu.ca

1 - Lehman Sisters: Female Bank Executives and Risk-taking
Wendy Wu, Wilfrid Laurier University, wwu@wlu.ca, Cindy Truong

This paper studies the impact of female executives on risk-taking of US banks. With a sample of US banks from 2002 to 2010, we find consistent evidence that female executives decrease the risk-taking of banks. We also find that a more balanced gender ratio results in a greater impact on bank risk taking. The results are robust to alternative specifications of riskiness and instrument variable approach. However, when we only use part of the sample period surrounding the financial crises, the results do not hold. This suggests that empirical studies using short sample period surrounding the financial crises should be interpreted with care.

2 - Strategic Risk Management for Supply Chains
Xuan Zhao, Wilfrid Laurier University, xzhao@wlu.ca, Shanshan Ma, We Xing

This paper studies two risk management strategies related to spot market to mitigate firms' exposure to demand uncertainty, namely, operational hedging and financial hedging. We find that The supplier charges a lower contract price when selling to operational hedger(s), which hurt the supplier. The operational hedger may not benefit from the lower contract price when competing with a financial hedger. By committing to opt out of the spot trading, the financial hedger benefit from competing with an operational hedger, who is forced to reduce his production. As a result, both incline to commit to financial hedging, which may lead to the Prisoner's Dilemma.

3 - Strategic Risk Management
Vladimir Dvoracek, University of Fraser Valley, School of Business and Department of Economics, Abbotsford, BC, V2S 7M8, Canada, vlad.dvoracek@ufv.ca

We characterize the order submission strategy of an investor who has a regular income stream and faces both fixed and endogenous costs of transferring these funds to an interest bearing asset. The investor submits his order to a dealer who offers price improvement based on the future value of the investor's business. In choosing trading frequency and order size, the investor faces a trade-off: more frequent trading yields better prices but incurs greater fixed trading costs. We analyze how the primitives of the economy and investor characteristics affect outcomes. An increase in income increases order size, order frequency, and price improvement.

4 - Financing Suppliers in Assembly Systems: Buyers vs. Banks
Shiming Deng, Professor, Huazhong University of Science and Technology, Wuhan, 430074, China, dengsm@gmail.com

We consider a stylized assembly supply chain consisting of multiple make-to-stock component suppliers and one make-to-order assembler facing uncertain demand. Before demand is realized, the assembler, as a leader, decides the purchasing prices for each components, and then the component suppliers, as followers, simultaneously choose their production quantities. The suppliers have limited initial capital and may borrow loans from either banks (bank financing) or the assembler (buyer financing). We characterize the equilibrium solutions of each fi nancing strategy and compare their performance from various prospectives. Many useful managerial insights are discussed.

■ TC16

Waikoloa 1

Supply Chain Management: I

Contributed Session

Chair: Jie Zhang, Guangdong University of Finance and Economics, Guangdong University of Finance and Economics, Guangzhou, 510000, China, jiezh@alumni.ust.hk

1 - Flexibility Design of Unbalanced Supply Chains Via Extended Probabilistic Expanders
Yong Liang, Assistant Professor, Tsinghua University, Beijing, 100084, China, liangyong@sem.tsinghua.edu.cn

One way to study supply chain flexibility is to find a sparse structure to perform almost as well as the full flexibility structure. Many sparse structures are designed in the literature for balanced and symmetrical systems, but there are not much for unbalanced systems. In this paper, we propose a class of sparse structures called extended probabilistic expanders for the flexibility design of unbalanced and symmetrical networks. An efficient randomized algorithm is presented to construct an extended probabilistic expanders. We also prove that for a mildly unbalanced system, our structure is the asymptotically sparsest design regardless of a constant multiplier.

2 - The Impact of Supply Chain System and Learning on the Sustainable Performance: Empirical Evidence from China
Zhiduan Xu, Professor, Xiamen University, 422 Siming South Road, School of Management, Xiamen, 361005, China, zhiduanx@xmu.edu.cn

It's unclear how the inherent characteristics of supply chain(SC) may affect the sustainable performance. This study generates insights into the nature of supply chain system, which consists of function, structure, and context. By analyzing data of 264 firms in China by survey method,we form a structural equation model showing that SC system could directly and indirectly enhance the three dimensions of sustainability of SC, i.e., economic, social, and environment performance. Furthermore, the result shows that SC learning is a catalyst for SC system and could affect the sustainable performance of SC positively.

3 - An Empirical Examination of Translating Supply Chain Strategies Into Improved Firm Performance
Chun Yip Leung, Research Assistant Professor, Chinese University of Hong Kong, Chinese University of Hong Kong, Chak Cheung Street, Shatin, Hong Kong, jerrelleung@baf.cuhk.edu.hk

In the current service driven economy it is impetus to choose and implement the right supply chain strategy. However, the literature on supply chain strategy is still underexplored and often come to inconclusive results. We propose a model based on the Resource Based View and posit that firms not only need to choose the right supply chain strategy, but also need to utilize the correct supply chain practices, resources, according to the respective supply chain strategy. Subsequently, firms can build capabilities, operational performance, from the resources and eventually lead into financial benefits. We investigated our proposed model by using data collected from 171 manufacturing firms in China.

4 - Contract Choice for Combating Deceptive Counterfeits
Jie Zhang, Guangdong University of Finance and Economics, 21 Luntou Road, Haizhu District, Guangzhou, 510000, China, jiezh@alumni.ust.hk

Deceptive counterfeits differ from non-deceptive ones in that they are sold as authentic products so that consumers may buy counterfeits unknowingly. When a distribution channel has been penetrated with deceptive counterfeits, a brand name company may rely on different contract types with downstream retailers, to restrict their incentive of selling counterfeits as well as to improve the channel's profit. In this paper, we consider several contract types and analyze the optimal parameters for each one to combat counterfeits. Then, we compare all the outcomes to find the most effective one.

■ TC17

Waikoloa 2

Revenue/Yield Management

Contributed Session

Chair: Sajad Modaresi, Duke University, Fuqua School of Business, Duke University, Fuqua School of Business, Durham, NC, 27705, United States, modaresi.sajjad@gmail.com

1 - Assortment Optimization under a General Discrete Choice Model: A Tight Analysis of Revenue Ordered Assortments
Gerardo Berbeglia, The University of Melbourne, 200 Leicester Street, Melbourne, 3053, Australia, g.berbeglia@mbs.edu

A simple and natural strategy for the assortment problem in revenue management is to select the best assortment out of all those that are constructed by fixing a threshold revenue r and then choosing all products with revenue at least r. This is known as the revenue-ordered assortments strategy. We provide a precise analysis of how well revenue-ordered assortments approximate the optimum revenue under a very general discrete choice model. Our analysis of revenue-ordered assortments match and unify known results for certain models, and improves the best known results for others. An appealing feature of our analysis is that it is simple and yet it is best possible even for specific models within the class.

2 - 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

We present a dynamic pricing model in a setting where customers can be incentivized to purchase multiple units. Three different pricing schemes, including two nonlinear ones, are considered. The dynamic linear pricing (DLP) model charges a uniform price that depends on the time-to-go and the remaining capacity. The dynamic package pricing (DPP) model allows complete freedom in pricing different package sizes. We also study dynamic block pricing (DBP) as an intermediate scheme where prices are linear within each block, where the block can be either fixed or flexible. Interestingly, due to customer choice behavior and the value of block flexibility, DBP performs nearly as well as DPP.

3 - Optimizing Cross Selling Strategy in B2B E-Commerce

Santanu Sinha, Data Scientist, Hewlett Packard Enterprise, CVR, 66/2, 7th Floor, Bagmane Tech Park, Bangalore, 560093, India, santanu.sinha@hpe.com

Designing an effective cross selling strategy for key customers in a B2B environment is a major challenge in Hi-Tech Industry. A recommendation system has been designed to solve this problem. The solution segments the customers and products based on several dimensions. Then it suggests personalized recommendations for each customer based on Apriori and Collaborative Filtering algorithms. It also provides optimal pricing strategy for the customized offers considering price elasticity, margin, and conversion rate. The above model has been designed, developed, and being tested for an internal business unit within Hewlett Packard Enterprise - with a potential of significant impact on revenue.

4 - A Dynamic Clustering Approach to Data-Driven Assortment Personalization

Sajad Modaresi, Duke University, 101 Mayfield Cir., Durham, NC, 27705, United States, sajad.modaresi@duke.edu

A retailer faces heterogeneous customers with unknown product preferences. The retailer can personalize the assortment offering based on the customers' profile information. This may be computationally intensive given the abundance of customer and product attribute data. At the same time, customers with different profiles may have similar preferences for products. Thus, the retailer can benefit from aggregating information among customers with similar preferences. We propose a dynamic clustering approach that adaptively adjusts customer segments and personalizes the assortment offering to maximize cumulative revenue.

■ TC18

Waikoloa 3

Vehicle Routing

Contributed Session

Chair: Jesus Munuzuri, University of Seville, University of Seville, Seville, 41092, Spain, munuzuri@us.es

1 - A Firefly Algorithm for the Heterogeneous Fixed Fleet VRP

Stella Sofianopoulou, Professor, University of Piraeus, 80 Karaoli & Dimitriou Street, Piraeus, 18534, Greece, sofianop@unipi.gr

Vehicle routing problem (VRP) is a key factor of logistics distribution. This article is presenting a hybrid firefly algorithm for optimizing the routing of heterogeneous fixed fleet of vehicles in logistics distribution systems. The principles and key steps of the proposed firefly algorithm are introduced in detail. Experimental results of solving the heterogeneous fixed fleet vehicle routing problem are tested based on benchmark datasets. Moreover the algorithm is compared with other algorithms solving similar problems in order to prove the effectiveness of the proposed hybrid firefly algorithm.

2 - Location and Selective Routing Problem with Pricing for the Collection of Used Products

Necati Aras, Professor, Bogazici University, Industrial Engineering Department, Bebek, Istanbul, 34342, Turkey, arasn@boun.edu.tr

We consider a firm that locates collection centers (CCs) for used products (cores) to be collected from dealers. Collection is performed by vehicles that start and end their routes at the same CC. The firm's objective is to maximize its profit by determining the locations of the CCs, the acquisition price offered for each core, the number of vehicles allocated to each opened CC and the route of each vehicle. The profit results from cost savings associated with using cores in remanufacturing. We develop a mixed-integer linear programming formulation, which is an extension of the classical location-routing problem. We also devise a tabu search heuristic for solving large instances.

3 - Optimization of Recyclable Waste Collection using Real-time Information

Jesus Munuzuri, Associate Professor, University of Seville, CM Descubrimientos, Seville, 41092, Spain, munuzuri@us.es

This work focuses on the collection of recyclable glass bins, with the peculiarity that they are equipped with a sensor that provides daily fill level data to the control center. Using this additional real time information we propose a collection policy that minimizes overall route costs in the long run, combining cost evaluation with VRP operators. We applied this policy to a case study and compared it with the collection of only those bins above a fixed replenishment level. We performed several simulations of the two policies, and the results show our proposed policy achieves better results in terms of covered demand and better utilization of resources.

4 - A Heuristic for Rail Transportation of Hazardous Materials with Due Dates

Ginger Yi Ke, Assistant Professor, Memorial University of Newfoundland, Faculty of Business Administration, Memorial University of Newfoundland, St. John's, NL, A1B 3X5, Canada, gke@mun.ca

This paper studies the routing and scheduling of rail shipments of hazardous materials with due dates. In particular, we minimize the weighted sum of earliness and tardiness for each demand plus the holding cost at each yard, while forcing a risk threshold on each service leg at any time instant. A mixed-integer programming model and a heuristic-based solution method are proposed for preparing the shipment plan. Numerical experiments are conducted to provide managerial insights.

Wednesday, 9:00am - 10:30am

■ WA01

King's 1

Mining and Machine Learning in Business Applications

Contributed Session

Chair: Xiaodong Lin, Rutgers University, Rutgers University, Piscataway, NJ, 08854, United States, lin@business.rutgers.edu

1 - The Business Analytics Toolbox

Mia L Stephens, Academic Ambassador, SAS Institute Inc, PO Box 290, York Harbor, ME, 03911, United States, mia.stephens@jmp.com

The modern world is defined, in part, by the volumes of data produced daily. A challenge is using this data to guiding decision-making and strategy. We present techniques for developing predictive models with JMP Pro statistical software. We use a case study to illustrate data preparation, demonstrate interactive visualization techniques, and discuss the importance of validation and validation statistics to gauge model accuracy. Then, we present several modeling techniques: logistic regression, classification trees, neural networks, Lasso, Elastic Net, and Ridge regression. Finally, we interactively reduce models, and discuss methods for model visualization, comparison and selection.

2 - Labor Demand Forecasting for Enterprise Services

Kranthi Sowjanya Adatrao, Analytics Consultant, Hewlett Packard Enterprise, HP Prime, No 66/2, Wing A, Bagmane TechPark, Bangalore, 560093, India, adatrao.sowjanya@hpe.com

To remain viable in a value-based business environment correctly predicting Labor Demand on time is the key to the success of services business. Over the last few quarters it has been observed that as much ~one third of Labor Demand is not met on time. The biggest challenge is the lack of a mechanism to predict prospective demand. This results is service delivery delay, increased hiring cost and unsatisfied customers. We have built an analytical solution for this problem which is a one stop solution to arrive at a future demand, even when the sale is getting pursued. Potential Business Impact of ~ (Three fold) $XXX M assuming10% decrease in avg. delay of 90 days in meeting demand on time.

3 - Making the Most of Intelligence: Data Mining for Data Mining for Customer

Corey Travis, Graduate student in Business Informatics, Western Kentucky University, Bowling Green, KY, United States, corey.travis483@topper.wku.edu

This research focuses on customer loyalty. We use RFM measure (Recency of last purchase, Frequency of purchase within a given period of time and Monetary Value of all purchases) for that purpose. We not only focus on numerical data, but we add the textual data to our model. I use predictive modeling techniques to build the model, then, I group the customers' perception based on their textual feedback. I utilize unsupervised machine learning algorithms to cluster this data; and finally, compare the logistic regression model using numerical data only plus textual data. The best results between the two models will be reported accordingly using ROC charts (SAS EM).

4 - Fraud Detection in Mobile Advertising

Xiaodong Lin, Associate Professor, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08854, United States, lin@business.rutgers.edu

Various types of mobile fraud, including click and payment fraud, have become prevalent in the mobile advertising industry. Building effective fraud detection techniques is therefore critical for online advertising business. In this paper, we apply semi-supervised techniques to large scale datasets with user login, app download, and purchase records to identify fraudulent payment activities. Specifically, we generate fine-grained spatial, device, and temporal login features to solve a highly unbalanced classification problem. These results are promising for fraud detection in other mobile domains and can also be adapted to identify evolving fraudulent activities.

■ WA03

King's 3

Inventory and Supply Chain Management

Contributed Session

Chair: Santanu Sinha, Hewlett Packard Enterprise, Hewlett Packard Enterprise, Bangalore, 560093, India, santanu.sinha@hpe.com

1 - A Heuristic for Setting Inventory Levels of Premium Wines in a Small Export-Oriented Winery

Sergio Maturana, Professor, Pontificia Universidad Catolica de Chile, Dept Industrial and Systems Engineering, Vicuna Mackenna 4860, Santiago, MACUL, Chile, smaturan@ing.puc.cl

We present a two stage heuristic for setting the stock levels of premium wines using an (s-1,s) policy, which was developed to support a small export-oriented Chilean winery. We assume that orders arrive according to independent Poisson processes, inventory levels of bottled and labeled wines are reviewed continuously, a postponement strategy is used for the labeling process, and there is only one labeling machine. The heuristic attempts to minimize the sum of the steady-state expected values of the WIP, overage, and underage costs per unit time. We provide some numerical examples and analyze the accuracy of the proposed heuristic.

2 - Distribution-free Ordering and Pricing Newsvendor Problem with Quantity Discount and Resource Constraint

Wensi Zhang, Beijing Institute of Technology, No. 5 Zhongguancun South Street, Haidian, Beijing, 100081, China, zhangwensi@bit.edu.cn

This paper investigates the distribution-free multi-product ordering and pricing newsvendor problem with supplier provides all unit quantity discounts. The objective of this problem is to find the optimal ordering quantities and selling prices to maximize expected profit under a resource constraint. We establish a mixed integer non-linear programming (MINLP) model to formulate this problem, and then develop a distribution-free approach under the max-min criterion and Lagrangian-based heuristic to handle the unknown demand distribution and constraint, respectively. Numerical results show the robustness and effectiveness of the approach and algorithms.

3 - The Newsvendor Problem under Price-Sensitive Stochastic Demand and Purchase Price Uncertainty

Xiangling Hu, Seidman College of Business, L. William Seidman Center 3115, Grand Rapids, MI, 49504, United States, hux@gvsu.edu

This paper studies a newsvendor's joint procurement planning and pricing problem in which it faces fluctuating procurement prices and price-sensitive stochastic demand. It has a particular time period before the commencement of the selling season to make the purchase and a short selling season, and the firm makes "time-flexible" purchases (Li and Kouvelis 1999) from one of the multiple alternative suppliers that differ in their price processes to manage its procurement risk. We develop a reality-adaptable solution algorithm, which quickly decreases the computational complexity when there exist multiple alternative suppliers and the procurement planning period is long. We then extend our solution algorithm to consider the downside risk minimization in multiple-alternative-supplier case. Through extensive numerical analysis, we demonstrate the profound impact of increasing the potential supplier base can have on the firm's profit and the risk exposure, together with the effect of these parameters on the purchasing decisions. We further examine the purchasing time and the expected profit distributions through simulations.

4 - Optimizing Safety Stock Allocation in a Multi-Echelon Inventory under Budget Constraint: A 'Revenue At Risk' Model

Santanu Sinha, Data Scientist, Hewlett Packard Enterprise, CVR, 66/2, 5th Floor, Bagmane Tech Park, Bangalore, 560093, India, santanu.sinha@hpe.com

How to optimize a multi-echelon inventory with multi-products under service level and budget constraints at each stage - so that the total 'revenue at risk' is the minimum?

Traditional algorithms, when applied to solve this with a large product portfolio, failed to provide an optimal solution. Hence, an efficient heuristic has been developed to generate a near-optimal solution. The above algorithm has been designed, developed, and implemented in a Decision Support System for an internal business unit within Hewlett Packard Enterprise. Post-deployment, a 5-10% improvement in overall service-level has been observed along with a significant impact on revenue under strict business constraints.

■ WA04

Queen's 4

Supply Chain Optimization

Contributed Session

Chair: Javier Rubio-Herrero, Rutgers University, Rutgers University, Edison, NJ, 08837, United States, javier.rubioherrero@rutgers.edu

1 - Optimization Model for Integrated Design of Assembly Sequence and Supply Chain Structure

Changmuk Kang, Soongsil University, Hyungnam 301, 369 Sangdo-ro, Seoul, 156-743, Korea, Republic of, changmuk.kang@ssu.ac.kr

Supply chain design has been widely studied in the operations management field. Surprisingly, however, there is few practical model for designing its structure. This study develops an optimization model that determines assembly and transportation sequences together with suppliers who are in charge of assembly operations. The model constrains transportation flows between suppliers by sequence of their operations. The objective is minimizing costs for manufacturing, transportation and holding inventories. A solution of the model provides a comprehensive look for total supply chain cost.

2 - Supply Chain Coordination Model Based on Credit Option and Price Discount Strategy

Hua Zhou, Huazhong University of Science & Technology, Wuhan, China, 1169143497@qq.com

This paper concentrates on the strategies of credit option and price discount policy in a single manufacturer multi-buyer supply chain. This research aims at minimizing the total cost of the supplier and obtains the feasible variable range of credit option and discount respectively, then analyses whether credit option is superior to discount strategy or conversely for the sake of the supplier from the quantitative point of view.

3 - Optimal Building Strategies of Charging Network in Supply Chain Analysis

Tian Wang, Huazhong University of Science and Technology, School of Management, Hongshan Distrct, Wuhan, 430074, China, wangtian3261@gmail.com

Consumers' willingness to pay for electric vehicles is severely limited by the driving range. The expansion of charging network is a way to alleviate this situation. This paper focuses on finding which party, the manufacturer or the dealership, is more suitable to extend charging network for a larger market adoption rate. We investigate two business models (M-Building and D-Building) where M-Building and D-Building represent that the builder is the manufacturer and the dealership respectively. We study the optimal prices and building strategies. We also analyze the preferences of the manufacturer and the dealership on the choices between M-Building and D-Building.

4 - Price-Setting Newsvendor Optimal Policies with Mean-Variance Criteria

Javier Rubio-Herrero, Rutgers University, 100 Rockafeller Rd, Piscataway, NJ, 08854, United States, javier.rubioherrero@rutgers.edu

We introduce a price-setting newsvendor problem where the retailer uses a mean-variance criterion to maximize his profit. The demand is price-dependent and may take two functional forms, namely, additive or multiplicative. We consider both risk-averse and risk-seeking cases and, by performing sequential optimization, we analyze the conditions under which the uniqueness of the optimal solution is guaranteed. These conditions are introduced in economic terms via the lost sales rate elasticity.

■ WA05

Queen's 5

On Healthcare Issues

Invited: Global Health

Invited Session

Chair: Fang Liu, Nanyang Business School, 50 Nanyang Avenue, Singapore, 2052, Singapore, Liu_Fang@ntu.edu.sg

1 - Incentivizing Less-than-fully-qualified Providers for Early Diagnosis of Tuberculosis in India

Sarang Deo, Indian School of Business, sarang_deo@isb.edu

A major driver of TB epidemic in India is delay in diagnosis by less-than-fully-qualified providers (LTFQs), who are typically the first point of contact for patients. This work is motivated by pilots funded by international donors to provide monetary incentives to LTFQs to induce earlier diagnosis. We develop a game-theoretic model to design the optimal incentive contracts and calibrate them using realistic parameter estimates obtained from primary and secondary data.

2 - Optimal Mobile Health Clinic Service Delivery Aimed at Minimizing Social Healthcare Costs

Fang Liu, Nanyang Technological University, liu_fang@ntu.edu.sg

People living in certain remote communities often have little access to medical care due to natural and social constraints such as the poor infrastructure and a lack of health insurance. Some governments and organizations have set up mobile health clinics in rural communities to help populations who are hard to reach to medical care. We find the optimal delivery policy for the mobile health clinics (MHC), and characterize the optimal delivery policy. We show that MHC reduces the system's cost, and increases people's quality adjusted life years. However, MHC may result in more patients visiting the regular hospital in some periods, which may affect the operations at the regular hospital.

3 - Application of a Simulation Optimization Framework for the Dynamic Deployment of Ambulances in the Singapore Emergency Medical Services

Lam Shao Wei Sean, Singapore Health Services, Singapore, Singapore, lam.shao.wei@singhealth.com.sg

The effective deployment of ambulances remains a cornerstone for delivering care to patients with acute time-sensitive conditions. A dynamic ambulance deployment system allows ambulances to be repositioned in anticipation of where demand will occur, and to compensate for poor areal coverage. A simulation optimization framework based on the approximate dynamic programming (ADP) approach can provide explicit consideration of the dynamic and stochastic nature of the rapidly evolving system states to improve deployment decisions, yet retaining computational feasibility. Such an approach is proposed to derive improved ambulance reallocation plans for Singapore's EMS system.

■ WA06

Queen's 6

E-Business and Commerce

Contributed Session

Chair: Kris Johnson Ferreira, Harvard Business School, Morgan Hall 492, Boston, MA, 02163, United States, kferreira@hbs.edu

1 - Drivers and Demand Benefits of Retail Consumer Return Policies

Guangzhi Shang, Assistant Professor, Florida State University, Department of Marketing, College of Business, Tallahassee, FL, 32306, United States, gshang@fsu.edu

We study the empirical validity of several theoretically plausible return policy drivers. We also quantify the demand benefits of offering a return policy, contributing to the empirical consumer returns literature.

2 - Impacts of Logistics Information on Sales: Evidence from Taobao

Huan Zheng, Shanghai Jiao Tong University, Management Science Department,, 535 Fa Hua Zhen Rd, Shanghai, China, zhenghuan@sjtu.edu.cn

Using data on from China's largest online marketplace platform, we examine how online sales are affected by three different information sources for logistics services: online word of mouth (WOM) about logistics performance, self-proclaimed logistics services, and expected delivery time. We use an instrumental variable method to address the endogeneity issue between sales and WOM. Our findings indicate that, ceteris paribus, consumers consider both delivery time and WOM about logistics performance but not sellers' self-proclaimed logistics services when they make purchase decisions. The effects of logistics services on sales are asymmetric for large sellers and small sellers.

3 - The Effect of Social Media Momentum on Brand Competition and Purchase Decisions

Jingwen Zhao, University of Hawaii at Manoa, 909 University Ave., Apt. 205, Honolulu, HI, 96826, United States, jingwenz@hawaii.edu

Online social network has become an increasingly influential tool for people to follow fashion trend and develop personal brands. In this paper, we leverage the largest fashion social network to investigate (1) how social network momentum affects purchase decisions, (2) whether the momentum of national brands substitutes or complements that of personal brands, and (3) how the substitution or complement effect is related to purchase decisions. Our main findings suggest that user-generated brand awareness and recognition affect brand competition and purchase decisions, which further our understanding of the impact of social media on user behaviors and provide managerial implications.

4 - Choosing as Assortment Rotation Strategy to Boost Sales

Kris Johnson Ferreira, Harvard Business School, Morgan Hall 492, Boston, MA, 02163, United States, kferreira@hbs.edu

By offering products sequentially as opposed to simultaneously, fashion retailers can introduce uncertainty in consumer choice that affects purchase decisions. For example, a consumer must decide whether to purchase an item before seeing similar items offered later in the season. We develop a consumer choice model and finite-horizon stochastic dynamic program to study when this uncertainty is advantageous for a retailer. We show that if consumers are myopic, the retailer maximizes revenue by offering products sequentially. However, if consumers are strategic, there exist conditions under which either offering products sequentially or simultaneously is optimal.

■ WA07

Kohala 1

Simulation and Optimization

Contributed Session

Chair: Parag Gandhi, University of Pittsburgh, University of Pittsburgh, Pittsburgh, PA, 15217, United States, pag62@pitt.edu

1 - Fully Sequential Procedure for Feasibility Determination without the Tolerance Level

Chuljin Park, Assistant Professor, Hanyang University, Engineering Center 706-2, Hanyang University, Seoul, 133-791, Korea, Republic of, parkcj@hanyang.ac.kr

We consider the problem of determining the feasibility of systems when a performance measure in a stochastic constraint needs to be evaluated via simulation. We develop two new procedures that use an existing feasibility determination procedure iteratively as their sub-routine. Our procedures return the set of strictly feasible systems with guaranteed correct decision probability while not requiring users to set tolerance levels.

2 - Simulation Optimization of National Grain Reserve Policies

Leyuan Shi, University of Wisconsin-Madison, 1513 University Ave., ME3250, Madison, WI, 53706, United States, leyuan@engr.wisc.edu

National grain reserve plays an important role in responding to the disaster and unbalance of supply and demand in many countries through release grain to market by auctioning. In this study, we develop an agent-based simulation model of national grain market with detail descriptions of different agents including national grain reserve, grain trading enterprises and grain processing enterprises. Based on the model, we compared two different auction policies (periodic release policy and price peg policy) with the ultimate goal of maximize social welfare via a simulation optimization method.

3 - Packing Tori in a Cuboid

Makoto Namiki, Toho University, 2-2-1 Miyama, Funabashi, 274-8510, Japan, namiki@is.sci.toho-u.ac.jp

Torus is a 3D object looking like a swim ring, a donut or a bagel. We consider the problem of packing tori in a cuboid, that is the problem for finding maximum number of tori stacked in bounded cuboid in 3D. Application of this problem is to pack tires in the container. For this problem, we first examine how two tori contact with each other by solving a certain nonlinear optimization problem. Then we give some packing strategies in heuristic scheme by using the optimal solutions. Graphical simulations for this problem and computational experiments will be also given in our presentation.

4 - Model to Predict Bidding Dynamics at Indian Premier League Players Auction

Parag Gandhi, University of Pittsburgh, 2715 Murray Avenue, Apartment 308, Pittsburgh, PA, 15217, United States, pag62@pitt.edu

In Indian Premier League, annual player auction is the most followed way of acquiring a player by teams. In the auction players' names are presented in a predetermined order for interested teams to bid against one another. The study focuses on developing a prediction model to construct a dynamic biding strategy for shaping an optimal team. In this winning contribution and maximum bid price of a player are predicted using his past performances and brand value. These factors categorize the importance of players and formulate the team's initial bidding strategy. The Model revises this strategy after every bid, based on remaining budget, remaining players in the auction and probable bids of opposing teams.

■ WA08

Kohala 2

Electric Markets

Contributed Session

Chair: Christoph Weissbart, Munich, Germany, weissbart@ifo.de

1 - Allocation of Renewable Curtailment: Redispatching Electricity Generation and Demand During Distribution Grid Congestion

Hans Schermeyer, Research Associate & PhD Student, Karlsruhe Institute of Technology (KIT), Hertzstr 16, Building 06.33, Karlsruhe, 76187, Germany, hans.schermeyer@kit.edu

The increase of electricity from renewable energy sources leads to more grid congestions and resulting curtailment of renewables in Germany and worldwide. In this work we model a 110kV distribution grid and occurring congestion events caused by renewable electricity feed-in. The grid load is calculated applying an AC load flow algorithm. To compute the necessary time series of generation and demand we develop an agent-based simulation model to represent the central European energy-only market disregarding grid constraints. We introduce PTDF-based strategies to resolve occurring congestion varying in their geographical resolution and the available flexibility options to change net load.

2 - Electric Transmission Expansion Considering Property Value Impact on Routing

Juan Andrade, PhD. Student, University of Texas at Austin, 4405 Avenue A, Apt. 11, Austin, TX, 78751, United States, jandraderam@utexas.edu

The development of utility scale renewable generation requires new transmission infrastructure, whose proximity to urban areas produces social opposition. This opposition can be quantified as a social cost produced in property value reduction by transmission proximity to population. It is presented a MILP formulation that minimizes costs for generation, and investment and social impact for transmission considering an electrical and a routing networks. This formulation is suitable for real size applications by decomposing the problem for each network, and by reducing the routing network size by triangulating the routing surface considering only significant terrain information.

3 - Time Dependent Optimal Load Shedding in Active Power Distribution Grids using Demand Side Flexibility

Manuel Ruppert, Research assistant, Karlsruhe Institute of Technology, Hertzstrasse 16, Karlsruhe, 76187, Germany, manuel.ruppert@kit.edu

Driven by increasing decentralized generation, distribution grids are transforming towards active grids with increasing diffusion of ICT. This leads to new possibilities for load shedding strategies, enhancing today's rotating drop schemes without consideration of microspatial impact and backup capacities. In our approach, we present a nonlinear, time-dependent formulation for optimal load shedding, incorporating individual utility functions in order to minimize utility loss of residential demand and critical infrastructures. We demonstrate our approach using a medium voltage benchmark grid and show that loss of utility can be decreased in comparison to traditional approaches.

4 - Optimal Geographic Distribution of Electricity Generation in a Carbon-Constrained Europe

Christoph Weissbart, Ifo Institute, Poschingerstr 5, Munich, Germany, weissbart@ifo.de

We use the EU-REGEN model to explain the cost-optimal capacity investment and electricity generation in a carbon-constrained European power market until 2050. Results show that onshore wind power will be the most crucial generation technology with the geographic distribution of its capacities being driven by resource quality and not by a geographic balancing effect. Gas power will be the major conventional generation technology for backing-up wind power. A phase out of coal power proves to be not economically optimal due to CCS entering the market. Finally, non-cooperation among the targeted decarbonization path disturbs the cost-minimal distribution of capacity and generation significantly.

■ WA09

Kohala 3

Human Behavior in Innovation and Project Management

Invited: Entrepreneurship and Innovation

Invited Session

Chair: Yaozhong Wu, NUS Business School, NUS Business School, Singapore, 119245, Singapore, bizwyz@nus.edu.sg

1 - Collective Choice in Dynamic Contribution Games

George Georgiadis, Northwestern University, Kellogg School of Management, g-georgiadis@kellogg.northwestern.edu

Two heterogeneous agents exert effort over time to complete a project and collectively decide its scope. A larger scope requires greater cumulative effort and delivers higher benefits upon completion. To study the scope under collective choice, we derive the agents' preferences over scopes. The efficient agent prefers a smaller scope, and preferences are time-inconsistent: as the project progresses, the efficient agent's preferred scope shrinks, whereas the inefficient agent's preferred scope expands. In equilibrium without commitment, the efficient agent obtains his ideal scope with either agent as dictator and under unanimity. In this sense, the efficient agent always has real authority.

2 - Incentivizing Competing Project Managers for Product Evaluation

Niyazi Taneri, Singapore University of Technology and Design, niyazitaneri@sutd.edu.sg

We study the effects of signal quality, effort cost and resource allocation under moral hazard and adverse selection concerns in an R&D organization with project managers competing for limited internal resources. We conduct laboratory experiments where human-subjects take on the role of the firm and face automated project managers.

3 - Decision Making in Project Management: A Behavioral Study

Yaozhong Wu, NUS Business School, bizwyz@nus.edu.sg, Xiaoyang Long, Javad Nasiry

We study how managers make sequential decisions under uncertainty in projects of multiple stages. Our experiments show that people deviate from rational predictions. We propose a bounded rationality model to investigate behavioral regularities in our setting.

■ WA10

Kohala 4

Optimization & Statistics/Machine Learning

Sponsored: Optimization

Sponsored Session

Chair: Gah-Yi Vahn, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, gvahn@london.edu

1 - Consistent Custering using an L1 Fusion Penalty

Peter Radchenko, University of Southern California, radchenk@marshall.usc.edu, Gourab Mukherjee

We study the large sample behavior of a convex clustering framework, which minimizes the sample within cluster sum of squares under an L1 fusion constraint on the cluster centroids. Our analysis is based on a novel representation of the sample clustering procedure as a sequence of cluster splits, each determined by a maximization problem. We use this representation to provide a simple and intuitive formulation for the population clustering procedure, and demonstrate that the sample procedure consistently estimates its population analog. Based on the new perspectives gained from the asymptotic investigation, we propose a key post-processing modification of the original clustering approach.

2 - Inverse Optimization with Noisy Data and Applications to Predictive Modeling for Health Care

Anil Aswani, UC Berkeley, aaswani@berkeley.edu, Auyon Siddiq, Zuo-Jun Max Shen, Philip Kaminsky, Yonatan Mintz, Yoshimi Fukuoka, Yoshimi Fukuoka

We present a novel approach to solving problems where noisy measurements of minimizers to a parametric optimization problem are observed and then used to estimate unknown parameters of the optimization problem. Though some approaches have been developed, these require no noise in measured data and no modeling mismatch. In this talk, we present an approach for the case where the parametric optimization problem is convex, and show this approach is risk consistent (provides best possible predictions) or estimation consistent (estimates true parameters) under appropriate conditions. Applications of this approach to predictive modeling in healthcare systems are briefly outlined.

3 - Performance-based Regularization in Data-driven Portfolio Optimization
Gah-Yi Vahn, London Business School, gvahn@london.edu

We investigate performance-based regularization (PBR), on the portfolio optimization problem. The idea is to constrain the sample variances of the estimated quantities in the problem; for portfolio optimization they are the portfolio risk and return. The goal of PBR is to steer the solution towards one associated with less estimation error in the performance.

■ WA11

Kona 1

Quality Management

Contributed Session

Chair: Mehmet Turkoz, Rutgers University, Rutgers University, Piscataway, NJ, 08854, United States, turkoz@scarletmail.rutgers.edu

1 - Variable Selection Based MEWMA for High Dimensional Multistage Processes
Myong K Jeong, Rutgers University, 96 Frelinghuysen Road, CoRE Building, Room 204, Piscataway, NJ, 08854, United States, mjeong@rci.rutgers.edu

Statistical monitoring of high-dimensional processes is crucial in industry to ensure the quality of a process output. However, few statistical process monitoring (SPC) approaches for monitoring and controlling quality in high-dimensional multistage processes have been studied. In this paper, we investigate a deviance residual-based MEWMA control chart with a variable selection procedure. Proposed method outperforms the existing multivariate SPC charts in terms of out-of-control average run length for the detection of process mean shift.

2 - Variable Stage Independent Double Sampling Plan Having Desired Operating Characteristics Indexed by Quality Loss
Ryosuke Tomohiro, Okayama University, Kita-Ku, Tushima-Naka 3-1-1, Okayama city, 700-8530, Japan, pykk0a7i@s.okayama-u.ac.jp

Recently, the concept of quality loss proposed by Taguchi has been accepted as the new evaluation measure of quality. In this study, variable stage-independent double sampling plan (VSIDSP) having desired operating characteristics (OC) indexed by quality loss is newly considered. The proposed VSIDSP has the feature that the decision in the 2nd-stage sampling inspection is independent with the observations in the 1st-stage sampling inspection. Further, by considering the average sampling number, design procedure for the VSIDSP having desired OC is constructed. Through some numerical examples, the effectivity of the proposed VSIDSP is verified from the view point of the average sampling number.

3 - Reliability Analysis for Multi-component System Subject to Multiple Dependent Competing Failure Process and Interactions
Xiaogang Li, Beihang University, Beijing, China, lxg@buaa.edu.cn

This paper presents an algorithm for reliability analysis of multi-component degraded system which subject to two kinds of dependent structure.This paper offer a unique perspective on modeling component interdependencies and system reliability by making use of components degradation information and system structure function.This article innovatively introduces the proportional hazards model (PHM) to describe effect of the environmental stresses and degradation interactions from other components.In conclude, this proposed algorithm evaluates the reliability in the perspective of system, and consider the interactions among components with failure of physics theory.

4 - Nonparametric Fault Variable Identification in High Dimensional Processes
Mehmet Turkoz, PhD Student, Rutgers University, 16 Rachel Terrace, Piscataway, NJ, 08854, United States, turkoz@scarletmail.rutgers.edu

Identifying the changed variables in statistical process control (SPC) is an important research issue. If the underlying distribution of the process is not known, nonparametric methods are more efficient for identification of changed variables. In this paper, we propose a new nonparametric fault identification approach in a high-dimensional processes.

■ WA12

Kona 2

Strategic Planning and Management

Contributed Session

Chair: Moshe Kress, Naval Postgraduate School, Naval Postgraduate School, Monterey, CA, 93943, United States, mkress@nps.edu

1 - An Investigation of Post Initial Public Offerings Returns Drift
Nilofar Varzgani, Ph.D. Candidate, Management Science, Rutgers Business School, 113 Harrison Avenue, Apt 204, Harrison, NJ, 07029, United States, nilofarv@scarletmail.rutgers.edu

We analyze IPO returns after the first day, 4 weeks and 90 days time period to determine the existence of a momentum drift. Existing literature provides evidence that IPOs are underpriced or at least have a positively skewed distribution with an invisible negative tail, highly attributable to underwriter price support. Therefore, we expect a price-earnings momentum right after the IPO up till the lock up period. We test the model on a sample of IPOs from 1985 to 2014. We devise a new algorithmic approach to detect the outliers which we call The Dynamic Rule Based Anomaly Detection and predict an average time period after which the stock starts trading on it's fundamentals.

2 - Owner-Financed Bootstrapping as a Nascent Phenomenon: How Young Entrepreneurs Finance Themselves
Thomas Zehren, PhD Candidate and Assistant Lecturer, Technical University of Dortmund, Vogelpothsweg 87, Dortmund, 44227, Germany, Thomas.Zehren@udo.edu

Financial bootstrapping describes a burgeoning technique used by entrepreneurs to avoid relying on external financing. To date, initial research has developed measures for identifying different types of bootstrappers. Building upon resource dependence theory, this study is the first to shed light on the most relevant type, the owner-financed bootstrapper. Based on 3,017 respective bootstrappers drawn from a representative sample of 150,397 completed interviews, findings reveal human capital as a key determinant. Moreover, strong moderating effects answer the currently most discussed research question: Owner-financed bootstrapping is a clear deliberate and not a provoked choice.

3 - Estimating the Crisis Information Coverage Model in the Internet Communities
Jiuchang Wei, Professor, University of Science and Technology of China, 96 Jinzhai Rd, Hefei, 230026, China, weijc@ustc.edu.cn

This study uses the ratio of public be covered or informed by crisis messages to measure the impact of the crisis information communication process. We construct a complete information communication model which is composed of three stages: crisis information release, crisis information diffusion, and crisis information receiving. Basing on the model construction, effects of some important factors and variables in the model are studied, which include the crisis information release quantity, crisis information release mode, crisis information diffusion speed, crisis information obsolescence speed.

4 - When is Information Sufficient for Action?
Moshe Kress, Professor, Naval Postgraduate School, 1411 Cunningham Road, OR Department, Monterey, CA, 93943, United States, mkress@nps.edu

We analyze a variant of the whereabouts search problem, in which a searcher looks for a target hiding in one of n possible locations. Unlike in the classic version, our searcher does not pursue the target by actively moving from one location to the next. Instead, the searcher receives a stream of intelligence about the location of the target. At any time, the searcher can engage the location he thinks contains the target or wait for more intelligence. The searcher incurs costs when he engages the wrong location, or waits for too long for more information. We formulate the searcher's decision as an optimal stopping problem and establish conditions for optimally executing this search-and-interdict mission.

■ WA13

Kona 3

Network Optimization II

Contributed Session

Chair: Vladimir Boginski, University of Florida, University of Florida, Shalimar, FL, 32579, United States, boginski@reef.ufl.edu

1 - Degree-Constrained Minimum Spanning Tree Problem with Uncertain Edge Weights

Xin Gao, North China Electric Power Universtiy, No.2 Beinong Road, Beijing, 102206, China, gaoxin@ncepu.edu.cn

Uncertainty theory has shown great advantages in solving many nondeterministic problems, one of which is the degree-constrained minimum spanning tree (DCMST) problem in uncertain networks. Based on different comparison principles of uncertain variables, three types of DCMST models are proposed here: uncertain expected DCMST, uncertain α—DCMST and uncertain most DCMST. We also discover an equivalence relation between the uncertain-DCMST of an uncertain network and the DCMST of the corresponding deterministic network. Finally, a related genetic algorithm is proposed here to solve the three models, and some numerical examples are provided to illustrate its effectiveness.

2 - Multicommodity Network Design with Congestion

Navneet Vidyarthi, Concordia University, John Molson School of Business, Department of Decision Sciences and MIS, Montreal, QC, H3G 1M8, Canada, navneet.vidyarthi@gmail.com

The problem we study seeks to simultaneously establish capacitated links on a network and route multiple commodities between their respective origin and destination nodes so as to minimize the sum of the fixed cost of establishing the links, the transportation cost for all commodities, and the delay cost due to congestion on the capacitated links. We present a nonlinear integer programming formulation of the model, followed by two alternate cutting plane based solutions approaches: one based on Generalized Benders decomposition and the other using simple transformation of the nonlinear objective function and piecewise linear approximation.

3 - Identifying Critical Nodes in Interdependent Networks with Cascading Failures

Vladimir Boginski, University of Florida, 1350 N. Poquito Road, Shalimar, FL, 32579, United States, boginski@reef.ufl.edu

We consider the problems of identifying "critical" nodes in coupled interdependent networks, that is, a subset of nodes whose deletion causes the maximum network fragmentation (as quantfii ed by an appropriate metric) in the presence of cascading failures. Theoretical and computational aspects of these problems are discussed.

■ WA14

Kona 4

Healthcare Analytics

Sponsored: Health Applications

Sponsored Session

Chair: Tinglong Dai, Johns Hopkins University, Baltimore, MD, 21202, United States, dai@jhu.edu

Co-Chair: Haijing Hao, University of Massachusetts Boston, Boston, MA, 02125, United States, Haijing.Hao@umb.edu

1 - Vendor Strategies in Health Information Technology Adoption

Yunfeng Shi, Assistant Professor, Pennsylvania State University, 504 Ford Building, University Park, PA, 16802, United States, yus16@psu.edu, Veronica Fuentes

This study uses a longitudinal design to analyze secondary data from The Healthcare Information and Management Systems Society (HIMSS) Database and the Area Resource File (ARF), including 4900 Acute Care hospitals in the U.S. between 2005 and 2009. A fixed-effects multinomial logit model is used to evaluate the effect of three environmental factors (munificence, dynamism, and complexity) on strategy selection. A discrete-time hazard model is used to examine the relationship between vendor strategies and time needed to reach level 4 adoption defined by HIMSS. Robustness checks and model fitness tests are conducted. The average time needed for a hospital to reach level 4 is 3.2 years.

2 - Analysis of a New Class of Liver Allocation Policies

Zachary Ngai Hang Leung, City University of Hong Kong, znhleung@cityu.edu.hk, Mustafa Akan, James Markmann, Sridhar R. Tayur, Heidi Yeh

The purpose of the study is to propose alternative MELD scores for liver transplant candidates with hepatocellular carcinoma (HCC), in order to achieve a more equitable allocation of livers between HCC and non-HCC candidates. We build a disease model for the dynamic health states of liver transplant candidates on the waiting list, where the transition probabilities between health states are estimated from SRTR data. We create a new open source discrete-event computer simulation model for the US liver allocation system which we validate using SRTR data.

3 - Clinical Ambiguity and Conflicts of Interest in Interventional Cardiology Decision-making

Tinglong Dai, Johns Hopkins University, dai@jhu.edu, Xiaofang Wang, Chao-Wei Hwang

Cardiovascular disease is the leading cause of death in the United States, and coronary artery disease (CAD) is the major underlying culprit. Percutaneous coronary intervention (PCI) has proven to be beneficial to patients with acute coronary syndrome, yet its benefit to stable CAD patients is more nuanced. Indeed, unnecessary PCI procedures for stable CAD patients have contributed to wasteful health spending and, in certain cases, patient harm. In this paper, we model both clinical ambiguity and conflicts of interest in interventional cardiology decision-making.

4 - What Are Patients Complaining? A Text Mining Approach To Online Doctor Reviews by International Comparison

Haijing Hao, University of Massachusetts Boston, Haijing.Hao@umb.edu, Kunpeng Zhang, Weiguang Wang, Guodong Gao

We examine hundred thousands of textual reviews from two large online doctor review websites in the U.S. and China by using cutting edge text mining method to explore what are the similarity and difference for online doctor reviews cross cultural and country.

■ WA15

Kona 5

MSOM / Energy Sustainability

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Owen Wu, Indiana University, 1309 E. 10th Street, Bloomington, IN, 47405, United States, owenwu@indiana.edu

1 - Optimal Unit Commitment with Demand Response and Economic Wind Curtailment

Wanshan Zhu, Tsinghua University, Beijing, China, zhuws@tsinghua.edu.cn

This paper studies the integration of wind power in electricity networks by combining economic wind curtailment (EWC) and demand response (DR) for the daily unit commitment problem. We develop a stochastic dynamic programming model the problem where EWC and DR provide upward and downward load control. Numerical analysis focuses on answering the question of a possible synergy between DR and EWC. Finally interactions between DR and EWC in different or same time frames is proposed and illustrated in a case study based on data from RTE (Rseau de Transport dElectricit). A sensitivity analysis over the wind forecast error is also studied to assess the impact of wind unpredictability.

2 - Service Region Design for Urban Electric Vehicle Sharing Systems

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

We consider the service region design problem for electric vehicle sharing systems. We then develop a model that incorporates both customer adoption behavior and fleet operations under spatially-imbalanced and time-varying travel patterns. To address the uncertainty in adoption patterns, we employ a distributionally-robust optimization framework. Applying this approach to the case of Car2Go's service in San Diego, CA, with real operations data, we address a number of planning questions.

3 - Energy Efficiency Contracting in Supply Chains under Asymmetric Bargaining Power

Sam Aflaki, HEC Paris, aflaki@hec.fr, Ali Shantia, Andrea Masini

In a supply chain consisting of a buyer and a supplier, this study analyses the effect of relative bargaining power and technology uncertainty on the supplier's decision to invest in energy efficiency (EE) measures. We analyse price commitment and shared investment contracts and compare the two mechanisms in their ability to boost EE investment when the buyer's high bargaining power in addition to high technology uncertainty prevent the supplier from investing in EE.

4 - Coordinating Energy Efficiency and Demand Response
Owen Wu, Indiana University, Bloomington, IN, United States, owenwu@indiana.edu, Eric Webb, Kyle Cattani

Traditionally, energy demand-side management techniques, such as energy efficiency and demand response, are each evaluated in isolation. In this paper, we examine the interactions between long-term energy efficiency upgrades and daily demand response at an industrial firm. We find that energy efficiency and demand response act as substitutes, and the long-studied energy efficiency gap between firm-optimal and societal-optimal levels of energy efficiency is smaller when demand response is considered. We suggest three approaches to reducing the energy efficiency gap, including an original suggestion that relies upon the interactions between energy efficiency and demand response.

■ WA16

Waikoloa 1

Supply Chain Management: II

Contributed Session

Chair: Chia-Wei Kuo, National Taiwan University, National Taiwan University, Taipei, 106, Taiwan, cwkuo@ntu.edu.tw

1 - Debt Financing and Capacity Investment
Qiaohai (Joice) Hu, City University of Hong Kong, AC-1, Room 7605, Dept of management Science, Kowloon, Hong Kong, joice.hu@gmail.com

We study a supply chain composed of a supplier and a buyer. The supplier has to commit to building up capacity for the buyer before demand uncertainty has been resolved. After uncertainty has been resolved, the parties engage in a bargaining game to decide whether or not to trade and at what price. We show that the supplier can use debt fi nancing to improve its bargaining position and therefore build a higher capacity level than if it were purely equity- financed. Surprisingly, the supplier's debt financing may also bene fit the buyer and encourage the buyer to invest in value enhancement, resulting in a Pareto improvement.

2 - Exploring the Relationship Between Eprocurement Technologyusage and Supply Chain Integration and its Effect on Performance
Gioconda Quesada, COFC, 1808 Coatbridge Road, Mount Pleasant, SC, 29466, United States, quesadag@cofc.edu

With the advancements on eprocurement technologies, there is a belief that the implementation of these initiatives will bring higher benefits not only to a firm but to the supply chain. However, just having the ebusiness capability does not traduce to significant supply chain performance improvements but it does support supply chain integration (SCI) efforts [1]. Supply chain integration (SCI) must involve not only external integration but also internal integration [2], and many empirical studies fail to add this important component to the measurement of SCI [3],[4]. In this study, we show empirical evidence of the effect of eprocurement technology usage on performance.

3 - Evaluation of the Robustness of Supply Capacity of Green Supplier using Taguchi Method
Yuan Feng Wen, Associate Professor, National Kaoshiung Marine University, #142 Haijhuan Road, Nanzih District, Kaoshiung, 81157, Taiwan, ywen@mail.nkmu.edu.tw

The purpose of this study is to evaluate the robustness of supply capacity of green supplier by applying Taguchi method. An effective and efficient supplier selection and evaluation should be capable of reducing costs and raising customer-service levels, and should be capable of enhancing the robustness of the supply capacity. In this study, the robustness of supply capacity of green supplier under various uncertain environments is studied using the simulation method. The signal- to-noise (S/N) ratio for each criterion is calculated to indicate the robustness of supply capacity performance. This S/N ratio is used to determine an overall supply capacity evaluation among various suppliers.

4 - Oem's Selling Channels and Supply Chain Performance
Chia-Wei Kuo, Associate Professor, National Taiwan University, 85 Sec 4, Roosevelt Rd, Taipei, 106, Taiwan, cwkuo@ntu.edu.tw

We consider the OEM providing a selling channel to improve the distribution efficiency for the developing market. Inspired by Galanz, a China-based microwave oven OEM, that launched its own brand microwave oven in China around 1996, we model when an OEM will offer an OEM selling channel for the brand buyers, how OEM should incentivize the brand buyers to allow for this selling channel, and how such move will enhance accessibility under different brand pricing reactions.

■ WA17

Waikoloa 2

Applications of OR in the Public Sector

Sponsored: Public Sector OR

Sponsored Session

Chair: Gerald W Evans, University of Louisville, TBD, The Villages, FL, TBD, United States, gwevan01@louisville.edu

1 - Facilitating Technology Transfer in Offsite Construction Between India and the UK: Drivers and Challenges
Aman Gupta, Embry-Riddle Aeronautical University-Worldwide, 10733 Copper Ridge Dr., Louisville, KY, 40241, United States, guptaa7@erau.edu, Mohammed Arif

The increasing demand for affordable housing in developing countries such as India which mainly uses traditional construction technologies begs the need of technologies that are efficient, low cost, and at the same time high quality. Technologies used by developed nations can meet that need if the transfer could be accomplished efficiently. The purpose of this research is to present findings of a survey and follow-up interviews of senior managers from UK and India to explore the drivers and challenges to facilitate technology transfer in offsite construction between the two countries.

2 - Applications of OR in Healthcare
Kenneth Musselman, Regenstrief Center for Healthcare Engineering, Purdue University, kmusselm@purdue.edu

For decades, healthcare systems have been plagued with process inefficiencies, unnecessary duplications, substandard patient engagement, and gross misuses of resources. This has resulted in billions of dollars of unnecessary waste and poor quality indicators year after year. The healthcare industry, faced with increasing pressures, has begun to embrace the use of engineering and management principles to help transform its systems of care. This presentation provides examples of how Operations Research is impacting various healthcare systems and how it is, in particular, reshaping the healthcare delivery experience.

3 - Multiple Objectives in the Public Sector
Gerald William Evans, University of Louisville (retired), gwevan01@louisville.edu

Analysis of multiple objectives in public sector applications of OR is especially important. This presentation will review the reasons for this importance and provide a taxonomy for the various methodologies. In addition, published applications involving multiple objectives will be reviewed, and areas for further research will be presented.

4 - Financial Network with Electronic Transaction and Social Responsible Investing
Ke Ke, Central Washington University, 2400 S. 240th st., Des Moines, WA, 98198, United States, kekegrace@yahoo.com

Internet has transformed the economic landscape for financial decision-making. We develop a framework for the modeling, analysis, and computation of solutions to multitiered financial network problems with electronic transactions in which both the sources of financial funds and the intermediaries are multicriteria decision-makers seeking not only to maximize their net revenues but also to minimize risk. Furthermore, the intermediaries are assumed to be socially responsible companies, who want to maximize their social responsibility levels. We make explicit the behavior of the various decision-makers, including the consumers at the demand markets for the financial products.

■ WA18

Waikoloa 3

Price Management and Systems Design

Contributed Session

Chair: Riyaz Sikora, University of Texas-Arlington, University of Texas-Arlington, Arlington, TX, 76019, United States, rsikora@uta.edu

1 - Optimal Pricing Strategy for Two-stage Introduction of Product-service Bundling
Zichen Zhang, Northeastern University, Shenyang, China, zczhang2013@hotmail.com

An analytical framework is established to study the two-stage introduction and pricing strategy when product-service bundling and individual sale are introduced into a monopoly market sequentially. By comparing bundling-first case and individual-sale-first case, the optimal pricing strategies for both pure bundling and partial mixed bundling are given. The experimental analysis shows that there exists both pure strategy and mixed strategy for the optimal prices in the two-stage introduction of product-service bundling.

2 - Optimal Pricing for Electric Scooter Sharing System by Matching Fleet Classes with Customer Categories

Ririh Rahma Ratinghayu, Research Assistant, National Taiwan University of Science and Technology, No. 43, Section 4, Keelung Rd., Taipei City, 106, Taiwan, ririhrahma@yahoo.com

While Electric Scooter Sharing Systems (ESSS) offer benefit of easy and longer-range of travel to existing bicycle share customers, battery life limitation can diminish customer experience. This study aims to design a pricing mechanism to optimize revenue of an ESSS through matching customer categories segregated by trip distance with vehicle categorized by the battery level. By employing heuristic methods to determine price and simulation to evaluate the mechanism, we found that it's not always profitable to serve long-distance customer category by preventing other categories from using fully-charged fleet depend on across-categories demand distribution and stations' relative proximity.

3 - Platform Investment Strategy on Reducing Transaction Cost

Shanshan Zhang, Lecturer, Foshan University, 18 Jiangwan 1st Rd, Foshan, 528000, China, sscheung@foxmail.com

A two-sided platform connecting two types of users provides a bridge for the transactions between them. Users are willing to make transactions on the platform only when their transaction cost reduction compared to direct trading is larger than the price charged by the platform. Transaction cost reduction depends on the platform's investment. This paper deals with the investment problem of a platform on reducing transaction costs of two-sided users. It is found that a platform should never choose the investment way that the maximal transaction costs of two user sides are reduced by the same amount.

4 - Using Reinforcement Learning for Supply Chain Management

Riyaz Sikora, Associate Professor, University of Texas-Arlington, PO Box 19437, Arlington, TX, 76019, United States, rsikora@uta.edu

Supply chain is recognized as complex adaptive system requiring dynamic and flexible reactions against the changes of environment for its effective management. In this paper we present the design, implementation and evaluation of an intelligent agent for supply chain management. We use concepts from reinforcement and other learning paradigms to design our agent. We use the Trading Agent Competition (TAC SCM) as the basis for designing a simulation system to test our agent and compare its performance with two agents that are based on some of the top performing agents from past competitions. Our results show that our agent has the best competitive performance under different demand distributions.

Wednesday, 11:00am - 12:30pm

■ WB01

King's 1

Multicriteria Decision Making

Contributed Session

Chair: Juliane Mueller, Lawrence Berkeley National Lab, Berkeley, CA, 94702, United States, juliane.mueller2901@gmail.com

1 - Multi-Criteria Decision Making for Real Estate Selection - An MCDM Problem Structuring Framework and Real Estate Decision Support Model

Dominique Tiesmeier, Alliance Manchester Business School, Booth St. W, Manchester, M15 6PB, United Kingdom, dominique.tiesmeier@postgrad.mbs.ac.uk

This paper presents a novel problem structuring framework that was adopted to identify relevant decision problem parameters for luxury real estate selection. In conjunction with real estate professionals and prospective homebuyers, it was identified that decision complexity results from a large number of correlated and dependent criteria, the differences in decision makers' preferences and the scarcity of available information in the industry. It is shown how a modified Evidential Reasoning (ER) rule can address this Multi-criteria Decision Making (MDCM) problem and consequently provide homebuyers with robust decision support.

2 - A Fuzzy-DEA-Game Model Applied to Obtain Production Strategies under Uncertainty

Fernando Augusto Silva Marins, Full Professor, UNESP, Av. Ariberto Pereira da Cunha, 333, Guaratingueta, 12516001, Brazil, fmarins@feg.unesp.br

This paper deploys a new Fuzzy-DEA-Game (FDG) Model to support the establishment of production strategies in an energy-sector company facing uncertainty. This FDG model combines Data Envelopment Analysis (DEA) with concepts of the Fuzzy and Game Theories. The model enables an assessment of productive and economic efficiency of the company's products that may result in a more profitable product portfolio. An important additional result for the FDG model made it possible to identify the products portfolio whose are more sensitive to uncertainty.

3 - Evidential Chains-based Reasoning for Cardiac Health State Prediction in the Context of Physical Examinations

Haiyan Yu, Dr., Chongqing University of Posts and Telecommunications, College of Management, 92 Weijin Road, Mailbox 9069, Chongqing, P.R.C, 400065, China, yhy188@gmail.com

Our model leverage the sharing information of data set through belief function, integrating the subjective probabilities among the heterogenous entities. The type of Bernoulli perturbation is considered and the stochastic perturbation term is deduced. To learn the parameters of the model, we propose specially designed maximum likelihood methods, solving the uncertainty of the noise distribution and the entity similarity. The model attain the training accuracy of any nearest neighborhood classifier, and provide better generalization. The numerical experiments of cardiac diagnosis data sets with mis-annotated entities verified this method.

4 - Surrogate Model Algorithm for Computationally Expensive Multiobjective Optimization Problems

Juliane Mueller, Lawrence Berkeley National Lab, Berkeley, CA, 94720, United States, juliane.mueller2901@gmail.com

Optimization problems arise in many engineering application areas. Often, several conflicting objectives must be optimized simultaneously. For these multi-objective problems, there does not exist a single solution that optimizes all objective functions. Rather, a set of trade-off (Pareto-optimal) solutions must be identified. We consider optimization problems whose objective function evaluations require computationally expensive black-box simulations and for which derivative information is not available. We present a solution approach that employs computationally cheap surrogate models to approximate the expensive objective functions and guide the search for improved solutions.

■ WB03

King's 3

Logistics and Supply Chain Management

Contributed Session

Chair: Sajjad Farahani, Milwaukee, WI, 53211, United States, sajad.farahani@gmail.com

1 - Cyclic Train Timetabling Along with Capacity Analysis with Heterogeneous Rolling Stock

Mojtaba Heydar, University of Newcastle, 1 university drive, callaghan, 2308, Australia, mojtaba.heydar@gmail.com

A mixed integer linear program for cyclic train timetabling and platforming on a single track, bi-directional rail line. Two conflicting objectives: (1) minimizing cycle length (primary objective) and (2) minimizing total train journey time (secondary objective) are combined into a single weighted sum objective. In order to solve large scale instances, various heuristics and exact methods are employed for computing secondary parameters and for finding lower and upper bounds on the primary objective to find optimal in a reasonable amount of time.

2 - Liner Service Network Design with Transit Deadline and Speed Optimization

Yan Zhang, Associate Professor, Dalian Maritime University, No.1 Lingshui Road, Dalian, 116023, China, yan.zhang@dlmu.edu.cn

This paper proposes a container shipping network designing problem by taking account of container transit deadline and speed optimization. Given a set of container shipment demands with delivery deadlines, the problem is to determine itineraries of portcalls, the numbers, types and speeds of ships deployed on these itineraries and determine the amount of cargo transported between any two ports, in order to maximize its total profit. We first formulate it as a non-linear mixed integer programming. A column generation based heuristic method is proposed for solving this problem. Numerical experiments show that the proposed solution algorithm is efficient to find good quality solutions.

3 - Oligopolistic Container Shipping Market: Empirical Characterization of Freight Rate Realization and Investment Behavior

Philipp Rau, WHU, Burgplatz 2, Vallendar, 56179, Germany, philipp.rau@whu.edu

The shipping industry and container shipping in particular has been suffering from substantial overcapacity. Previous studies have found that this mismatch in supply and demand may have been caused by non-optimal investment decisions and the underlying methods. Real options analysis has been suggested as a superior investment appraisal method in container shipping, but its application in an oligopolistic container shipping market has not been tested empirically yet. We characterize the oligopoly price function with an econometric freight rate model. Based on the results, we analyze container shipping investment behavior under the assumption of a real options trigger policy.

4 - On the Optimal Control of Remanufacturing Activities with Stochastic Return and Quality Variation

Sajjad Farahani, PhD Student, University of Wisconsin-Milwaukee, 3200 N. Cramer St., Milwaukee, WI, 53211, United States, Farahani@uwm.edu

This paper develops a model for the optimal disposition decision for product returns in a remanufacturing system with limited recoverable inventory capacity. The remanufacturer wishes to determine which returned product to accept to be remanufactured for reselling, and any unaccepted returns may be salvaged at a value that increases with their quality level. A Markov decision problem is formulated in order to evaluated various performance measures for this system and obtain the optimal remanufacturing policy. A detailed numerical study reveals that our approach to the disposition problem outperforms the current industrial practice ignoring quality grade of returned products.

■ WB04

Queen's 4

Globalization and Network Optimization

Contributed Session

Chair: Victor Manuel Preciado, University of Pennsylvania, Philadelphia, PA, 19103, United States, preciado@seas.upenn.edu

1 - Strategic Outsourcing in the Presence of Arm's Length Principle and Tax Consideration

Jiayan Xu, The Chinese University of Hong Kong, Shatin, Hong Kong, jiayanxu@baf.cuhk.edu.hk

We study the strategic outsourcing interaction between an integrated multinational firm (MNF) and its rival. MNF decides whether to supply input to the rival who then decides whether to make the input itself or outsource to MNF. MNF positions its manufacturing function in a cost and tax heaven, and its transfer pricing decision is further restricted by the arm's length principle, which states that the internal transfer price should be equal to the external input price. We find that with ALP, the rival has strategic outsourcing incentive and may buy more expensive input from MNF when tax difference is small. MNF's supply decision also depends on the tax difference.

2 - Drivers of Information Sharing in Global Sourcing: A Case of Apparel Value Chain

Rakhi Thakur, Professor, S.P. Jain Institute of Management and Research, Bhavans Campus, Munshi Nagar, Dadabhai Road Andheri West, Mumbai, 400058, India, rakhithakur@gmail.com

The apparel value chains are one of the most diverse due to the raw materials used, technologies deployed and products produced. Information sharing makes value chains more efficient and organizations more effective. The findings of this study highlight three themes of the drivers of sharing information in apparel value chains. First, oriented towards optimizing transactional costs including developing human assets, product costing, managing uncertainties and meeting contractual specifications. The second based on relationship between partners varying from commitment to collaboration and communication. The third based on activities in the network and position of actors in the value chain.

3 - Co-authorship and the Measurement of Individual Productivity

Rafael Treibich, Assistant Professor, University of Southern Denmark, Campusvej, 55, Odense, 5000, Denmark, rtr@sam.sdu.dk

Although research has become predominantly collaborative, none of the existing measures of individual academic productivity properly accounts for co-authorship, separating an author's contribution from her collaborators'. We propose a new measure, CoScore, that formally addresses this issue. CoScore uses the varying levels of success of all academic partnerships to infer, simultaneously, individual productivity and authorship, the extent of an author's contribution to each paper. The scores of all authors are determined endogenously via the solution of a fixed point problem. We illustrate CoScore for the one thousandth most cited papers in economics and characterize it axiomatically.

4 - Optimal Resource Allocation for Network Centrality

Victor Manuel Preciado, Raj and Neera Singh Assistant Professor, University of Pennsylvania, 3330 Walnut Street, Philadelphia, PA, 19104, United States, preciado@seas.upenn.edu

An important problem in search engine optimization (SEO) is to find the optimal allocation of resources to affect the visibility of a website in a search engine. The visibility of a website is computed using a network centrality index, such as Page-rank or Bonacich centrality. Therefore, the SEO problem can be posed as finding the optimal allocation of resources to maximize the network centrality index of a given node. We propose a convex optimization framework, based on geometric programming, to solve the SEO problem in weighted and directed networks. Our results are relevant in a wide range of applications, from social networking to eMarketing.

■ WB05

Queen's 5

Operations Management in Healthcare

Invited: Global Health

Invited Session

Chair: Kin Keung Lai, City University of Hong Kong, Tat Chee Ave, Kowloon, Hong Kong, mskklai@cityu.edu.hk

1 - Does Basic Health Insurance Reduce Medical Expense: An Application of Meta-analysis

Jian Chai, Xidian University, Xian, China, Chaijian0376@126.com

This paper is aimed to make sense of what real effect of the implement of basic healthcare insurance on individual's medical expense in China. This works apply meta-analysis to the problem due to previous studies drew different conclusions on it. For 31 related papers, we first implement a conditional Dirichlet-based Bayesian semi-parametric model specific to meta-analysis, deeming healthcare possesses little probability reducing one's medical expense. Then, we proceed meta-regression analysis with the age group as moderators, concluding it reduces one's medical expense by average 11.94% for the non-old group, while does little help for the old ones, even positive to some extent. Besides, the findings are supported by the results of conditional Dirichlet-based Bayesian semi-parametric model respectively imposed on the two groups. According to the aging population and increasing medical expense in China, we finally propose "public hospital, public welfare" and"prevent disease before" for the medical reform.

2 - Bi-level Multi-objective Hospital Outpatient Physician Allocation Model under Uncertainty

Xiaoyang Zhou, Shaanxi Normal Univeristy, Xian, China, x.y.zhou@foxmail.com, Canhui Zhao

This paper takes the hospital outpatient department as the subject of study, based on the bi-level structure of hospital and departments, combines the characteristics in the healthcare sector such as uncertainty, professionalism and multi-levelness, considers the hospital revenue management and department physician allocation, uses fuzzy optimization model to help hospital conduct physician allocation and establish the outpatient physician allocation optimization model including the specialists and general physicians. This model combines revenue management and physician allocation, and uses chance operator to analyze the fuzzy parameters.

3 - Research on Innovation Docking Paths and Network Diffusion Mechanism of Mobile-Health Service based on the Small-World Networks

Jing Han, Shaanxi Normal University, Xian, China, hanjing@snnu.edu.cn

This paper aims to describe the self-organizational evolutionary paths in the process of knowledge diffusion and innovation paths docking between hospitals and patients to analyze the mobile health service in the framework of small-world networks theory.

4 - Appointment Booking System in Outpatient Clinics

Kin Keung Lai, City University of Hong Kong, mskklai@cityu.edu.hk

In this paper, we discuss one of the busiest and crucial topics in healthcare research- Ambulatory Care Centre (ACC) consultation reservation system. We examine the scheduling of outpatient appointments in a robust optimization methodology to reduce the operational cost while maintaining the healthcare service quality. We discuss the findings and insights for healthcare physicians to improve operational efficiency and service quality.

■ WB06

Queen's 6

Inventory Management: II

Contributed Session

Chair: Eric Enkele Longomo, University of Portsmouth, Portsmouth, PO5 4EL, United Kingdom, eric.longomo@port.ac.uk

1 - Joint Pricing and Inventory Management for Substitutable and Perishable Products under Demand Uncertainty

Fei Fang, University of Southampton, Highfield Campus, University Road, Southampton, SO171BJ, United Kingdom, F.Fang@soton.ac.uk

This research aims to develop two stochastic optimization models for decision making problems in inventory management, most notably for the pricing and inventory decisions relating to perishable products in both the retail and manufacturing sectors. Numeral test results are reported through a case study based on a high-street fashion company. The benefits of considering pricing and inventory decisions simultaneously will be demonstrated where the total profit is observed to be significantly improved through the consideration of price substitution between substitutable products.

2 - Inventory Rationing in a (S, S) System with Compound Poisson Demand

Sugoutam Ghosh, Antalya International University, Antalya, Turkey, sugoutam@gmail.com

We consider an inventory system where demand for same item arrives from two demand classes which are differentiated based on their service level requirement. A critical level inventory rationing and (s, S) review policy is followed. We assume that the demand from both the classes follow compound Poisson process. The distribution for the number of lower class demand out of a given total demand is derived empirically and found to be modified normal distribution. Using this approximate distribution we determine the long-run approximate cost for the system. We develop bounds to determine the optimal solutions. Then we carry out an extensive numerical experiments to find out the performance of the model.

3 - Operating Policies for a Retail Fulfillment Center – Should SKUs be Stocked at Multiple Locations?

Mark S Hillier, University of Washington, Box 353226, Seattle, WA, 98195, United States, mhillier@uw.edu

We describe a problem at an internet retailer's fulfillment center. The fulfillment center is divided into a number of zones and each SKU can be stored in any number of these zones. We show that the problem of minimizing expected operating costs is related to the number of zones in which each SKU is stored. As SKUs are stored in more zones, the expected number of zones a picker would need to visit to pick a random order decreases, while replenishment and inventory costs typically increase. We show that the problem of calculating the expected number of zones a picker would need to visit can be modeled as a variation of a random set-covering problem. Since this problem is NP-hard, we develop an effective heuristic.

4 - Flexibility Analysis on a Supply Chain Contract under Stochastic Demand: A Steady State Approach

Eric Enkele Longomo, Mr, University of Portsmouth, Yorke Street, Southsea, Portsmouth, PO5 4EL, United Kingdom, eric.longomo@port.ac.uk

We consider a two-echelon SC in a Buyer/Supplier setting, coordinated through QF contract and
affected as follows: The buyer is allowed some degrees of flexibility with regards to the initial quantity reservation (Q) but is required to commit to a minimum purchase quantity below the nominal order. The supplier on his part, guarantees to meet the firm order provided that it doesn't exceed the maximum allowable purchase quantity. The purpose of this study is to develop a stationary inventory model with Markovian demand and subsequently choose the values of the parameters controlling the cost model in order to minimise the average long run costs associated with our problem structure.

■ WB07

Kohala 1

Queueing Systems and Stochastic Processes

Contributed Session

Chair: Oualid Jouini, CentraleSupelec, Chatenay-Malabry, 92290, France, oualid.jouini@ecp.fr

2 - Distributions for Sum of Distances Between the Pairs of Random Points

Kemal Gursoy, Professor, Rutgers University, 100 Rockafeller Road,, Room 5146, Piscataway, NJ, 08854, United States, kgursoy@rci.rutgers.edu

In this work, asymptotic probability distributions for the sum of the distances between the pair of independently selected randomly points was investigated. Although distances between the pairs of independent random points are not independent, a weaker condition for the independence of these distances, based on the four independent random points being pairwise independent, could be formulated. Hence, standard limit theorems may be utilized.

4 - Front-office Multitasking Between Service Encounters and Back-office Tasks

Oualid Jouini, Associate Profesor, CentraleSupelec, Laboratoire Genie Industriel, Grande Voie De Vignes, Chatenay-Malabry, 92290, France, oualid.jouini@ecp.fr

We model the work of a front-line service worker, who interacts with customers in a three stages process. Stages one and three require an interaction between server and customer, while stage two is a self service task. In addition to customer interactions, the server deals with non-priority back-office tasks, or tasks that do not require interaction with the customer. The objective is to find the optimal job routing policy that maximizes the expected proportion of time spent on non-priority tasks subject to a constraint on the priority task waiting time. The main result is that the server should always take an extreme decision either for the use of the times between priority tasks or during the interlude.

3 - An Empirical Analysis of the Relationship Between Product Life Cycle and Return Rate in IT Industry

Hsiu-chen Yang, National Chung Hsing University, No. 7, Aly. 32, Ln. 200, Furen St., East Dist, Taichung, 40141, Taiwan, verycute712@yahoo.com.tw

Reducing product return rate is a critical task to manufacturers for warranty evaluation under severely market competition. Conventional business is to sell product under warranty base where additional revenue expected with low return rate. Very limited study investigating product life cycle as well as channel type may be the effective approach to diminish product return rate enabling manufacturers taking proper action timely. This study attempts to exam whether the product life cycle is related to the return rate. By collecting empirical data, the relationship for two channel types - B2B and B2C are analyzed.

■ WB08

Kohala 2

Marketing and Business Applications

Contributed Session

Chair: Wei-yu Kevin Chiang, City University of Hong Kong, City University of Hong Kong, Hong Kong, wchiang@cityu.edu.hk

1 - TV Viewing and Advertising Targeting

Yiting Deng, University of Notre Dame, 379 Mendoza College of Business, University of Notre Dame, South Bend, IN, 46556, United States, ydeng@nd.edu

Television, the predominant advertising medium, is being transformed by the micro-targeting capabilities of DVRs and STBs. Accordingly, this paper uses a proprietary, household-level, single source data set to develop a second-by-second show and advertisement viewing model, using this approach to forecast consumers' exposure to advertising and the downstream consequences for sales. We find that micro-targeting simultaneously lowers advertising costs and increases advertising views among brands' currently targeted consumers, and that these advantages are amplified when advertisers are allowed to buy real-time as opposed to up-front.

2 - Impulsive Purchasing Behavior after Self-Control

Xuan Zhang, China University of Petroleum, Beijing, Room 1004, New Office Building (South), Beijing, 102249, China, zhangxuan822@hotmail.com

In the field of marketing, impulsive purchasing has always been a hot topic. Almost no consumer do shopping totally rationally for everything they buy. Self-control failure is regarded as an important cause of impulsive purchasing in the literature. However, this research shows that impulsive purchasing behaviors are actually more likely to happen after exerting self-control, no matter whether it succeeds or fails. Self-regulatory resource model is used to explain this phenomenon. Self-control processes would deplete resources in different domains, thus exerting effects on consumers' impulsive purchasing behaviors.

3 - Whom to Empower? Performance Impacts of the CMO-CFO Power Relationship in the TMT

Cecilia Wiedeck, TU Dortmund, Dortmund, 20149, Germany, cwiedeck@yahoo.de

Recent studies attest to the beneficial effects of increasing marketing's influence in TMTs. Yet the zero-sum perspective of power suggests that increasing the influence of one function also entails suppressing contributions of another. We draw on theories of intraorganizational power to examine how empowering the CMO vis-à-vis the CFO affects firm performance in different configurational settings. Using a twelve-year dataset on over 200 firms, we show that CMOs being more powerful than CFOs is beneficial for firms in complex and munificent markets and for firms with a related diversification strategy but is detrimental for firms in dynamic markets or with an unrelated diversification strategy.

4 - Strategic Promotional Mix with Risk Averse Buyers

Wei-yu Kevin Chiang, City University of Hong Kong, Department of Management Sciences, Tat Chee Avenue, Hong Kong, Hong Kong, wchiang@cityu.edu.hk

We consider a firm selling a search good in a market consisting of heterogeneous consumers whose idiosyncratic valuations are ex ante uncertain. To increase the awareness of the product's existence, the firm has two promotional strategies, hype advertising campaign and referral reward program. Whereas both strategies allow previously ignorant consumers to learn of a product's existence, due to source credibility and the nature of communications, only those who become aware of the product's existence through referrals will learn their own product valuation. We investigate the most profitable combination of these two promotion strategies.

■ WB09

Kohala 3

New Ventures, Finance and Inventions

Invited: Entrepreneurship and Innovation

Invited Session

Chair: Mario Daniele Amore, Bocconi University, Via Roentgen 1, Milan, 20136, Italy, mario.amore@unibocconi.it

1 - Innovation through Exaptation and Its Determinants: The Role of Technological Complexity, Analogy Making & Patent Scope

Mariano Mastrogiorgio, IE University, Madrid, Spain, mmastrogiorgio@faculty.ie.edu

The concept of exaptation has been recently introduced in innovation studies in order to shed light on serendipitous function-driven channels of innovation. Previous empirical studies have only focused on the organization-level conditions of exaptation. This paper fills the gaps by focusing on invention and inventor-level conditions such as technological complexity, inventors' analogical ability, and patent scope. To test our hypotheses, we analyse a large sample of U.S. patents obtained from the USPTO and NBER databases. Based on our findings, we discuss a number of implications of exaptation for the management of innovation as well as for policy makers.

2 - Attracting Early-stage Investors: Is Debt a Deterrent or an Incentive?

Mircea Epure, Universitat Pompeu Fabra and BGSE, Barcelona, Spain, mircea.epure@upf.edu, Martí Guasch

We analyze how debt is related to outside equity investments in entrepreneurial firms. We argue that investors respond differently to higher or lower debt, while the type of debt (personal or business) also matters. Using a panel of new ventures from the Kauffman Firm Survey, our empirical strategy is based on a Heckman selection model and a propensity score matching analysis. We show that debt, particularly business debt, is positively related to outside equity investments. We posit that start-ups with higher business debt can send more credible signals to capital markets, and explore how cash and the firm-bank relationship are possible information mechanisms for attracting outside equity.

3 - The Gravity of Scientific Disclosure in Technological Competition

Antonio Della Malva, KU Leuven, antonio.dellamalva@kuleuven.be

In this paper, we shed light on the impact of scientific publications by firms on the choice of technological trajectories and competition by rivals. We test our predictions using a representative sample of US firms from the semiconductor industry. By relying on a gravity model that contrasts every firm directly with its competitors, we show that scientific publications of a focal firm incentivizes competitors to build on this knowledge. This effect is increasing if the firm receiving information has built up a specific scientific absorptive capacity. Our findings are consistent with the view that firms can actively influence the R&D strategies of competitors by strategically disclosing knowledge.

4 - All-Star Cast, No Story: Building Investor Confidence in Blank-Check Companies

Ivana Naumovska, INSEAD, Boulevard de Constance, 77300, France, ivana.naumovska@insead.edu, Edward Zajac

In this study, we examine how investors value companies seeking to go public that have no operations and exist solely for the purpose of finding and acquiring a private company. More specifically, we analyze the role of the managerial reputation, social status and celebrity in the valuation of such blank-check IPOs, known as special-purpose acquisition companies (SPACs). We posit that these three managerial attributes, comprising elements of human and social capital, individually and jointly drive perceptions of corporate value. Our findings, based on analysis of this rarely studied phenomenon, show how investors' valuations are dually shaped by social and technical considerations.

■ WB10

Kohala 4

Optimization in Clinical Practice

Sponsored: Optimization

Sponsored Session

Chair: Manuel Tetschke, Otto-von-Guericke University Magdeburg, Universitaetsplatz 2, Magdeburg, 39106, Germany, tetschke@ovgu.de

Co-Chair: Tobias Weber, Otto-von-Guericke University Magdeburg, Universitaetsplatz 2, Magdeburg, 39106, Germany, tobias.weber@ovgu.de

1 - Patient-specific Mathematical Neuro-oncology: Optimizing Treatment and Patient Outcomes

Kristin Rae Swanson, Mayo Clinic, kraeswanson@gmail.com

Mathematical neuro-oncology (MNO) is a young and burgeoning field that leverages mathematical models to quantify neurological cancer progression and predict response to therapies, with a primary focus on the brain. My research group has helped lead this field by specializing in mathematical modeling of primary brain tumors with a focus on using routine clinical data to create patient-specific models. Our work demonstrates how routine clinical data combined with mathematical models can be leveraged to provide insights into patient-specific tumor behavior and treatment response, with a direct focus on clinically relevant predictions.

2 - Optimizing the Individual Treatment of Patients with Polycythemia Vera

Manuel Tetschke, Otto-von-Guericke University Magdeburg, tetschke@ovgu.de

Polycythemia vera is a chronic myeloproliferative neoplasm (a type of blood cancer). The initial treatment of the patients is blood-letting (phlebotomy) at regular intervals, which is complemented with chemotherapy if necessary. Until now it is not known how to find the optimal frequency of the phlebotomies. To achieve a practically relevant solution for this problem, we are working closely with haematologists and oncologists. In the talk an approach to model the disease with the help of an erythropoiesis model is presented. The model parameters are identified individually for each patient. On this basis an Optimal Control problem is used to find the best treatment protocol for each patient.

3 - Isogeometric Parallel Solvers for the Bidomain Systemunder in Electrocardiology

Lara Antonella Charawi, Università degli Studi di Pavia, laraantonella.charawi@unipv.it

We investigate the use of domain decomposition methods for the isogeometric discretization of the Bidomain model, which describes the bioelectrical activity of the heart tissue. Due to the presence of very different scales in both space and time, the numerical discretization by isogeometric analysis in space and semi-implicit methods in time produces a very ill-conditioned linear system that must be solved at each time step. The proposed multilevel additive Schwarz preconditioner results scalable and optimal. Parallel numerical tests on an idealized human left ventricle geometry, described by NURBS, show the good convergence properties.

4 - Source Inversion for Cardiac Arrhythmia using Graphs

Tobias Weber, Otto-von-Guericke University Magdeburg, weber@ovgu.de

We are interested in a type of cardiac arrhythmia where a single source within a heart chamber initiates a centrifugally spreading premature beat. One treatment modality is catheter ablation. The operator takes measurement points with a catheter tip on the inner surface of the heart chamber. These are chosen heuristically until the source is identified and further ablated. To minimize the duration of the procedure one wants to take as few measurements as possible. In the talk an algorithm is presented that places measurement points at specific locations to estimate the source with maximal likelihood. The problem is modeled based on a graph to abstract the mesh that describes the geometry.

■ WB11

Kona 1

OR Applications

Contributed Session

Chair: Tianqin Shi, San Jose State University, San Jose State University, San Jose, CA, 95192-0164, United States, tianqin.shi@sjsu.edu

1 - Remaining Useful Life Estimation Based on Logical Analysis of Survival Data for Machining Processes

Ahmed Elsheikh, PhD. Student, École Polytechnique de Montréal, Montreal, QC, H3T1J4, Canada, ahmed.elsheikh@polymtl.ca

Faults diagnosis and prognosis followed by efficient condition-based maintenance (CBM) reduce production costs, and ensure product quality. Automating these processes decreases the reliance on human experts, who are scarce and prune to biases, their knowledge is not easily to be transferred, and do not cope fast enough with new technologies. Decisions based on condition-monitoring data analysis is the state-of-the-art solution towards increasing production efficiency. This paper proposes a new prognostic procedure based on logical analysis of survival data (LASD), which is used to predict the remaining useful life (RUL) of machining tools based on analyzing online measurements.

2 - Politics in Technology Strategy Implementation

Marc-Elliott Finkelstein, IE, Maria de Molina, Madrid, Spain, marcfinkelstein@yahoo.com

Organizations expend significant resources to develop a technology strategy, yet too often fail to accomplish it. They commonly perceive the failure to stem from a lack of resources and capabilities, yet exploratory research suggests that organizational politics are significantly more impactful. This seminar will present case studies and examine the variables that correlate to outcomes.

3 - Ethics Game During Information System Construction in the Information Age

Yue Ding, Southwest Jiaotong University, Chengdu, China, dingyue@swjtu.edu.cn

Users' resistance which lead to the failure of new information systems can be due to high switching cost and fear of substituted by the new system. Based on agent utility maximization, this research established a multi-agent model with asymmetric information to solve the principal-agent problem between the promoter of information system and experienced users. With the promotion of information system, our paper proposes dual incentive mechanism composed by credibility and performance in order to eliminate the risk of experienced users' egoist behavior. Results showed that experienced users' ethical game and effective incentive mechanism can eliminate experieced users' egoist behavior.

4 - The Effects of Patent Extension and Pharmaceutical Stewardship Programs on Green Pharmacy

Tianqin Shi, San Jose State University, One Washington Square, San Jose, CA, 95192-0164, United States, tianqin.shi@sjsu.edu

The eco-toxicity arising from unused pharmaceuticals has drawn considerable attention. In this paper, an innovative pharmaceutical company faces price-dependent demand and decides whether to adopt green pharmacy in response to the regulatory policy as well as the competition from a generic company. A pharmaceutical company incurs a fixed cost to choose green pharmacy. We examine the impacts of two regulatory policies, patent extension and take-back regulation, on the choice of green pharmacy and the environment.

■ WB12

Kona 2

Strategic Planning and Sustainability

Contributed Session

Chair: Nuri Onat, University of Central Florida, University of Central Florida, Orlando, FL, 32816, United States, nconat@knights.ucf.edu

1 - Community Structure and Evaluating the Performance of the Pet Bottle Recycling Auctions in Japan

Kazuaki Okubo, Assistant Professor, Saitama University, 255 Shimo-okubo, Sakura-ku, Saitama, 338-8570, Japan, okubo@dp.civil.saitama-u.ac.jp

This study examines auctions where recyclers bid for set-period contracts to recycle polyethylene terephthalate (PET) bottles which are sold by municipalities in Japan. In these auctions, a few large recyclers seem to be able to win many auctions because of its scale economics and contract with distant municipalities. Long distance trades increase transportation cost. I investigate the community structure of the network that is constructed by considering municipality and recycler are connected if the recycler wins the auction. I applied structural estimation approach to estimate the effect of transportation cost and scale economies on the recycler's bidding behavior and social welfare.

2 - Driving Innovation From the Top: the Effect of R & D Power in Top Management on Performance Considering Operational Responsibilities

Florian Garms, Researcher, TU Dortmund University, Martin-Schmeißer-Weg 12, Dortmund, 44227, Germany, florian.garms@tu-dortmund.de

How to efficiently foster innovation continues to be a key question for researchers and practitioners in their effort to decrypt the secret of company performance, leading to many studies on research and development (R&D) functions. A perspective on R&D representation in top management however is largely missing, despite its strategic and operational influence. Analyzing a panel data set of S&P 500 companies, we show the non-linear relationship of top management R&D executives' power and superior company performance. Furthermore we demonstrate how combining R&D with operational responsibilities changes this relationship offering insights into the design of effective technology functions.

3 - Psychological Facilitators and Barriers of Adopting Green Cars in China

Juelin Yin, Associate Professor, Xi'an Jiaotong-Liverpool University, Suzhou, China, juelin.yin@xjtlu.edu.cn

This study conducted a nationwide online survey in China to explore the Chinese consumers' attitude and intention towards adopting green cars. It demonstrates the positive effects of typical Chinese cultural elements, including man-nature orientation, long-term orientation and face-consciousness, in influencing the Chinese consumers' adoption intentions of electric vehicles. It also identifies the role of ethical evaluation (deontological evaluation) in mediating the influence of cultural antecedents on adoption intention, and importantly different types of mediation effects are identified for different cultural antecedents.

4 - Dynamic Sustainability Assessment of Electric Vehicles: A System Dynamics Approach

Nuri Onat, Postdoctoral Research Fellow, Arizona State University, Tempe, AZ, 85281, United States, Nuri.Onat@asu.edu

This research aims to advance the current life cycle assessment practices by introducing a novel system based approach. System Dynamics modeling is utilized to model US transportation system and its interdependencies with the environment, society, and economy. Overall, several extreme scenarios are tested to reveal macro-level sustainability impacts of alternative vehicle options. Analysis results reveal that the feedback impacts within the system are found to be smaller compared to exogenous components such as expected trends in population, economy, and greenhouse gas emissions from rest of the world.

■ WB13

Kona 3

Network

Contributed Session

Chair: Yuri Smirnov, FreeMonee Network, FreeMonee Network, Palo Alto, CA, 94306, United States, ysmirnoff@gmail.com

1 - Finding Influential Groups in Networks using Betweenness Centrality

Alexander Veremyev, University of Florida REEF, 1350 Poquito Rd. N, Shalimar, FL, 32579, United States, averemyev@ufl.edu

We consider the problem of identifying the most influential group of nodes in a network, which has the largest value of betweenness centrality or one of its variants. We demonstrate that this problem can be modeled as a mixed integer program and can be solved for reasonably sized network instances using of-the-shelf MIP solvers. Furthermore, we generalize our approach for identification of central groups of graph elements (nodes and/or edges) satisfying, if necessary, some additional cohesiveness properties. Finally, we present computational study conducted with different types of real-life and synthetic network instances to show the effectiveness and flexibility of the proposed framework.

2 - Facebook Long Term Network Capacity Planning

Yuri Smirnov, Scientist, Facebook, Inc., 1 Hacker Way, Menlo Park, CA, 94025, United States, ysmirnoff@fb.com

Facebook applications are experiencing an explosive growth along all dimensions. The number of monthly users has exceeded 1.5B, the number of daily users is more than 1B, the number of advertisers is more than 1M and other applications such as Messenger and What's Up are getting close to the level of 1B users. It translates into a continuously growing need in network capacity to support uninterrupted traffic including peak demands. Given long lead times and substantial effort in coordinating collaborative planning and execution with 3rd party vendors, optimization-based Long-Term Network Capacity Planning became the crucial driving guide toward seamless and healthy growth of the company network.

3 - A Case Study: Development of a Neural Network Based Project Performance Evaluation System for a Defense Company in Turkey
Gizem Sekkeli, Aselsan, Ankara, Turkey, gizem1306@gmail.com

This paper aims to explain the process of developing a performance evaluation system for the largest defense company in Turkey. The process consists of defining 'project success' which we refer as the final success realized at the end of the project, identifying set of performance metrics, fitting a 'good' model relating initial/interim 'performance metrics' to project success, and developing a continuously learning system. The model is fitted by neural network. The learning system is constructed based on Neural Network model updating procedure. Software is developed to serve all the project managers synchronously, to be used as a part of their periodic project control routines.

4 - Environmental Quality and Differential Subsidies for EVS Adoption under Consumer Inertia
Lulu Shao, PhD, Huazhong University of Science and Technology, No.1037,Luoyu Road, Wuhan, 430074, China, glxysll@hust.edu.cn

Government differential subsidies for electric vehicle (EV) are analyzed considering the consumer inertia and energy prices. First, we segment potential consumers, and introduce the product's environmental quality, consumer inertia, differential subsidies, as well as energy prices into consumer utility model. Then, by solving the model, the optimal pricing strategy maximizing manufacturer's profit and the optimal government subsidy policy maximizing social welfare are obtained. Finally, the condition is gained that government should set differential subsidy. We further explain the effect of diversification of marketing conditions on social welfare through numerical experiments.

■ WB14

Kona 4

Nurse Scheduling and Staffing

Sponsored: Health Applications

Sponsored Session

Chair: Emily Tucker, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48105, United States, eltuck@umich.edu

1 - Designing a Nurse Scheduling Model for Implementation
Emily L. Tucker, University of Michigan, Ann Arbor, MI, United States, eltuck@umich.edu, Kayse Lee Maass, Eva Cahnman, Kerstin Rider, Amy McGonegal, Mark S. Daskin, Mark S. Daskin

While nurse scheduling is a well-studied problem, relatively few models are implemented in practice. As a case study, we discuss scheduling surgical nurses and technicians at the University of Michigan Health System. Currently, three Clinical Nurse Supervisors each spend over one week every month to schedule 200 staff members by hand. To greatly reduce this time, we present a mixed-integer linear programming optimization model that considers hospital policies and staff preferences to minimize a measure of infeasibility. To simplify the model's use, we present a user interface to allow the supervisors to produce a schedule, review metrics, and adjust monthly conditions as requirements change.

2 - Nurse Staffing in Perianesthesia Care Units using Discrete Event Simulation
Sauleh Siddiqui, Johns Hopkins University, siddiqui@jhu.edu

We use a discrete event simulation to model patient flow and nurse staffing in a perianesthesia care unit (PACU) at Johns Hopkins Hospital. The simulation generates patients which flow through perioperative care, resulting in detailed output on predicted patient census, boarding times, and length of stay. This output was then used to determine nurse staffing at various levels of patient flow. We show that reducing patient length of stay in the PACU by an hour results in three fewer beds and one fewer nurse needed to provide care.

3 - An Exploratory Analysis Between Patient Falls and Nurse Staffing Levels
Coleen R Wilder, Assistant Professor, Valparaiso University, 353 Sheffield Drive, Valparaiso, IN, 46383, United States, crwilder@yahoo.com

Patient falls are a safety issue for which registered nurses are held accountable. The purpose of this study was to examine the correlation between nurse staffing levels and patient falls to enhance understanding of the contributing factors. Differences between units and seasonal factors were also examined for statistical significance. A retrospective cross-sectional cohort analysis was conducted using monthly data from the National Database of Nursing Quality Indicators for the years 2010-2014. A small mid-western facility was selected and five adult units were examined as follows: rehabilitation, critical care, medical, surgical, and medical-surgical combination.

■ WB15

Kona 5

Data-Driven Operations

Sponsored: Manufacturing & Service Operations Management

Sponsored Session

Chair: Gah-Yi Vahn, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, gvahn@london.edu

1 - Omnichannel Retail Markdown Pricing and Inventory Optimization
Joline Uichanco, University of Michigan, Ross School of Business, jolineu@umich.edu

Many large retailers are offering omnichannel fulfillment through programs such as "buy online pickup in store" or "ship from store". Inventory, traditionally exclusive to one channel, can now be shared between the brick-and-mortar channel and the online channel. In this work, we present an omnichannel price and inventory optimization model which determines the store inventory to reserve for online fulfillment and the markdown prices across channels. We model omnichannel demand as a discrete choice model. We test our model on actual data from a large consumer electronics retailer and show significant profit improvement using our model. We also present results from a pilot implementation.

2 - Data-driven Pricing
Kris Johnson Ferreira, Harvard Business School, Boston, MA, United States, kferreira@hbs.edu, Bin Hong Alex Lee, David Simchi-Levi

We present our work with Rue La La, an online retailer who offers limited-time discounts on designer apparel. One of their main challenges is revenue management for new products. We use machine learning to build a demand prediction model, the structure of which poses challenges on creating a pricing policy. We develop theory around multi-product price optimization and use this to create and implement a pricing decision support tool. Field experiment results show significant increases in revenue.

3 - The Data-driven (s,S) Policy: Why You Can Have Confidence in Censored Demand Data.
Gah-Yi Vahn, London Business School, gvahn@london.edu

We revisit the classical dynamic inventory management problem of Scarf (1959b) from a distribution-free, data-driven perspective. We propose a nonparametric estimation procedure for the optimal (s,S) policy that yields an asymptotically optimal estimated policy and analytically derive confidence intervals around it. We further consider having a portion of the data censored from the absence of backlogging.

4 - On Cooperative Purchasing and Inventory Transfer as Collaborating Instruments for Competitors
LI LI, Assistant Professor, Lingnan (University) College, Sun Yat-Sen University, Lingnan (University) College,Sun Yat-Sen University,, No. 135, Xingang Xi Road, Guangzhou, P.R.China, Guangzhou, China, lili239@mail.sysu.edu.cn

We explore collaboration between competitors in a setting where two firms can coordinate their orders with supplier (cooperative purchasing), or relocate stocks after knowing actual market conditions but before serving their respective markets (inventory transfer). Cooperative purchasing is more effective in relieving firms' competition pressure and improving their sourcing efficiency but cause supplier to suffer a profit loss. Inventory transfer allows firms to profit from market volatility by resource pooling and can be egalitarian to benefit every individual party. The strategic interplay between two collaborating tools will remain intact when the supplier offers a volume discount.

■ WB16

Waikoloa 1

Supply Chain Management: III

Contributed Session

Chair: Matan Shnaiderman, Bar-Ilan University, Bar-Ilan University, Ramat-Gan, 52900, Israel, shnidem@biu.ac.il

1 - Moral Hazard Problem and Collaborative Decision Making in Capacity Reservation Contract for Semiconductor Industry

Yasuhiko Takemoto, Associate Professor, Prefectural University of Hiroshima, Hiroshima, Japan, ys-take@pu-hiroshima.ac.jp

Though the cost of establishing semiconductor equipment is expensive, equipment becomes obsolete quickly by new technology emerging in succession. Also capacity of semiconductor equipment must be decided ahead of actual demand because the lead time necessary to prepare capacity is long. A typical type of contracts in semiconductor industry is a capacity reservation contract in which a set maker offers a semiconductor manufacturer the incentive to gaining the sufficient capacity. This study discusses first a moral hazard problem in the capacity reservation contract. Then, we propose collaborative decision making about contract parameters between the set maker and semiconductor manufacturer.

2 - Forecasting Performance Measures for Sales and Supply Coordination

Ki-Seok Choi, Hankuk University of Foreign Studies, College of Engineering, Room 528, Yongin, 449-791, Korea, Republic of, kchoi@hufs.ac.kr

Coordiation of sales and supply departments is one of the objectives in supply chain management to improve the performance of the entire supply chain. However, it is often hard to achieve specially when the sales and supply departments have their own objectives. Even though increasing forecasting accuracy is one of the common objectives for sales department, it requires a careful consideration in designing a forecasting performance measure to achieve the overall effectiveness of the whole supply chain management. In this paper, we demonstrate the problems of forecasting error measures regarding sales and supply coordination and suggest what needs to be considered in designing such measures.

3 - R&D and Quality Supply Chain's Strategy under Cost-Plus and Wholesale Price Contracts

Fouad El Ouardighi, Professor, ESSEC Business School, Avenue B Hirsch BP 105, Cergy Pontoise, 95021, France, elouardighi@essec.fr

We develop a dynamic game of collaboration between a manufacturer and its supplier, where the fundamental issue is, for each firm, how to allocate own resources between improving the design quality and reducing the production cost of a finished product. The supply chain's members agree on a linear contract where the supplier either updates the transfer price at every period of time, i.e., cost-plus contract, or sets the transfer price once for all at the beginning of the game, i.e., wholesale price contract. To account for strategic interaction between the supply chain members, we derive the closed-loop Nash equilibria, with the cooperative solution as a benchmark.

4 - Control and Enforcement in Order to Increase Supplier Inventory in a JIT Contract

Matan Shnaiderman, Bar-Ilan University, Bar-Ilan University, Ramat-Gan, 52900, Israel, shnidem@biu.ac.il

In order to ensure that suppliers meet their commitments to fulfill orders on time, customers must enforce penalties. Initiating a policy of sanctions, the customer becomes the lead player in a Stackelberg game and forces the supplier to hold inventory, which is made available to the customer in real-time. We show that the customer can force the supplier to hold inventory up to some maximal value, rendering actual enforcement of sanctions unnecessary. However, escalation of the enforcement level can in fact reduce the capacity of the supplier to replenish on time. Numerical examples show that the customer's costs may be only 2% higher than his costs while all inventory is necessarily replenished on time.

■ WB18

Waikoloa 3

R&D and Technology Management

Contributed Session

Chair: Deok-Hwan Kim, Daejeon, 305-343, Korea, Republic of, thekan0723@gmail.com

1 - Is it Worth the Global Vendetta Against Patent Infringement?

Mahmut Sonmez, Senior Lecturer in Management Science, University of Texas at San Antonio, College of Business, Department of Management Science & Statistics, San Antonio, TX, 78249-0631, United States, mcyigms6@yahoo.com

This paper investigates how court verdicts against patent infringement affect corporate market value. Based on 16 litigated cases between Apple and Samsung, we demonstrate that patent litigation verdicts matter little to the market value for the plaintiff and defendant. This relationship holds true across six international jurisdictions. The findings also suggest that home-turf advantages are overrated for dispute resolution. The findings widen the debate of litigation-performance relationship and prompt future studies. They also imply the need for firms to prioritize amicable partnership over bitter feud.

2 - Socially Responsible Big Data and Analytics in a Thin Talent Pool

Fortune Mhlanga, Dean and Professor, Lipscomb University, 1 University Park Drive, Nashville, TN, 37204, United States, fortune.mhlanga@lipscomb.edu

Both geospatial modeling and of Big data management and analytics are bringing about renewed growing interest in data-driven decision making with high processing complexity. This talk presents a Big data and geospatially-enabled predictive model ecosystem for interpersonal violence, with methods and tools that are general enough to apply to other socio-medical problems involving the spread of disease and (possibly) other domains. Interestingly, as we tackle the solutions to disease, cancer, world hunger, systemic violence and many other problems, we find that we do not lack data or the methods of capturing it. We lack people with the passion and ability to use our data as a tool for social good.

3 - A Case Study on R&D Knowledge Management in KIER

Deok-Hwan Kim, Senior Researcher, Korea Institute of Energy Research, 152 Gajeong-Ro, Yuseong-Gu, Daejeon, 305-343, Korea, Republic of, thekan0723@gmail.com

Similar to Dr. Deming's principles, the bulk of the cause of failure in R&D belong the R&D process. Here, R&D process can be defined as a series of actions that produce intended knowledge for achieving the goal of the R&D project. That is, the quality of R&D depends on a systematic management of R&D knowledge. Typically, R&D knowledge is created and accumulated in various forms of documents and records. This study illustrates a case of integration system for R&D knowledge management in KIER. The system provides various functions, such as progression management, document and record management with a classification standard, e-lab note, and risk management.

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MA02 Future Research Directions and Funding Opportunities for Homeland Security and Disaster Management
MA03 Behavioral Operations and Marketing or Cost
MA04 Adaptive Monitoring and Intervention Design
MA05 Effective and Secure Healthcare Management
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Plenary – Gang Yu

Monday, 11:00am - 12:30pm

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Plenary – Thomas L. Magnanti

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