

INFORMS International Israel

Tel Aviv University
June 28 - July 1, 1998

Israel/Tel Aviv

MANAGEMENT SCIENCE AND OPERATIONS
RESEARCH IN AN EMERGING REGION

ISRAEL

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Sponsored by
Institute for Operations Research and the Management Sciences (INFORMS)
in cooperation with Tel Aviv University and Operations Research Society of Israel (ORSIS)

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INFORMS MEETING CALENDAR

JUNE 28 - JULY 1, 1998

INFORMS Israel International 1998
Tel Aviv University
Co-Chairs: Ben Lev & Jacob Hornik
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JUNE 29 - 30, 1998

INFORMS MSOM Conference
University of Washington
Co-Chairs: Ted Klasterin & Derek Atkins
tedk@u.washington.edu
atkins@dean.commerce.ubc.ca

JULY 11 - 13, 1998

Marketing Science Conference
INSEAD
Co-Chairs: Hubert Gatignon & Erin Anderson
gatignon@insead.fr
anderson@insead.fr

OCTOBER 25 - 28, 1998

INFORMS Seattle Fall 1998
Washington State Convention
& Trade Center
& Sheraton Seattle Hotel & Towers
Co-Chairs: Marisa Altschul & Al Maimon
marisa.altschul@pss.boeing.com
albert.maimon@pss.boeing.com

JANUARY 2 - 6, 1999

INFORMS Organization Science Meeting
Keystone Resort & Conference Center,
Keystone, CO

MAY 2 - 5, 1999

INFORMS Cincinnati Spring 1999
Cincinnati Convention Center,
the Omni Netherland Plaza
& the Hyatt Regency
General Chair: David F. Rogers
david.rogers@uc.edu

NOVEMBER 7 - 10, 1999

INFORMS Philadelphia Fall 1999
Philadelphia Marriott
General Chair: G. Anandalingam
anand@seas.upenn.edu

TABLE OF CONTENTS

Welcome Messages.....	F2 - F5
Organizing & Program Committee.....	F6
General Information.....	F7
Registration.....	F8
Social Program.....	F9
Sponsoring Organizations.....	F9
Technical Program.....	F10
	Plenary
	Keynotes
	Tutorials
	Workshop
Daily Planner.....	F15
Scheduled Sessions.....	1 - 50
Program Index.....	1 - 2
Participant Index.....	1 - 4
Cluster Chairs.....	B1 - B2

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עיריית תל-אביב-יפו
Municipality of Tel-Aviv-Yafo



ראש העיר
The Mayor

March 1, 1998

Dear Friends,

Welcome to Tel Aviv-Yafo and the INFORMS International Meeting.

As Israel's largest city and its business and commercial hub, Tel Aviv-Yafo has hosted many of the hundreds of international conferences, congresses and gatherings that have been held in our country. Visitors enjoy the numerous facilities that assure the success of the particular event in which they are participating, as well as the many attractions that make a visit to Tel Aviv-Yafo a unique a special experience.

The city of Tel Aviv-Yafo constitutes a blend of old and new, ancient sites and historical monuments, alongside modern architectural buildings, shopping malls, museums and hotels. I encourage you to sample the fine cuisine and entertainment that the "Non Stop City" has to offer.

I am confident that your visit to Tel Aviv-Yafo will be a rewarding experience that you will long remember.



Sincerely yours,

RONI MILO
Mayor of Tel Aviv-Yafo



Message from INFORMS President

Dear Colleague,

I'm delighted to welcome you and participants from all over the world to the 1998 INFORMS International conference, "*Management Science and Operations Research in an Emerging Region.*" This meeting is a wonderful opportunity for people to meet, exchange ideas and enhance knowledge.

1998 marks special anniversaries for Israel, INFORMS and our hosts from the Operational Research Society of Israel, ORSIS. This is the fiftieth anniversary of the State of Israel, whose emphasis on science and technology was exemplified by its first President, the noted chemist, Chaim Weizmann. This is also the 25th anniversary of the first international conference of management science in Israel, which was convened under the auspices of one of our founding organizations, The Institute of Management Sciences, TIMS.

Since that time, Israel has transformed itself into a major technology center in the Middle East. As the 21st Century approaches, Israeli operations researchers and management scientists set an example for the research and practitioner community. I congratulate my colleagues in ORSIS for their fine work - and express my gratitude to them for being such good hosts.

On behalf of all of us at INFORMS, I thank Ben Lev and Jacob Hornik for all their hard work coordinating this fine conference, which boasts more than 650 papers on a variety of specialized topics in our field. Thanks, too, to everyone at ORSIS and Tel Aviv University, who made sure this conference would be warm and welcoming. Our gratitude, as always, goes to the staff of INFORMS who coordinated this program.

I know you will find this conference enlightening and the special events in this historic land exhilarating. Welcome and enjoy!

**Karla Hoffman, President
INFORMS**



Member Application

Member Dues and Benefits

Regular \$90

- OR/MS Today
- FREE choice of journal
- discount on additional journals
- membership directory
- meeting registration discount

Student \$23

- OR/MS Today
- OR/MS Tomorrow
- Student Union
- 50% off journals
- membership directory
- FREE on-line job placement
- FREE membership to one section/society

Retired \$23

- OR/MS Today
- 50% off journals
- membership directory
- meeting registration discount

Journals	1998	Non-member	Regular	Stu/Ret
<input type="checkbox"/> Information Systems Research	V. 9	\$82.00	\$50.00	\$25.00
<input type="checkbox"/> Interfaces (real world applications)	V.28	\$82.00	\$40.00	\$20.00
<input type="checkbox"/> Journal on Computing	V.10	\$75.00	\$45.00	\$22.50
<input type="checkbox"/> Management Science	V.44	\$119.00	\$50.00	\$25.00
<input type="checkbox"/> Marketing Science	V.17	\$88.00	\$50.00	\$25.00
<input type="checkbox"/> Mathematics of Operations Research	V.23	\$82.00	\$40.00	\$20.00
<input type="checkbox"/> Operations Research	V.46	\$119.00	\$50.00	\$25.00
<input type="checkbox"/> Organization Science	V. 9	\$71.00	\$50.00	\$25.00
<input type="checkbox"/> Transportation Science	V.32	\$69.00	\$40.00	\$20.00

Societies, Sections, Fora (non-member/regular/student-retired dues)

- | | |
|---|--|
| <input type="checkbox"/> Decision Analysis Society (\$15/10/5) | <input type="checkbox"/> Military Applications Society (\$16/10/5) |
| <input type="checkbox"/> Accounting, Auditing, & Tax (\$7.50/5/5) | <input type="checkbox"/> Management Control Systems (\$4.50/3/3) |
| <input type="checkbox"/> Applied Probability (\$15/10/5) | <input type="checkbox"/> Management of Productivity & Technology (\$4.50/3/3) |
| <input type="checkbox"/> Artificial Intelligence (\$15/10/10) | <input type="checkbox"/> Manufacturing & Service Operations Management (\$10/10/5) |
| <input type="checkbox"/> Aviation Applications (\$10/5/5) | <input type="checkbox"/> Marketing (\$15/10/5) |
| <input type="checkbox"/> Computer Science (\$7/7/1) | <input type="checkbox"/> Optimization (\$5/5/5) |
| <input type="checkbox"/> CPMS, the Practice Section of INFORMS (\$24/16/16) | <input type="checkbox"/> Organization Science (\$15/8/8) |
| <input type="checkbox"/> Energy, Natural Resources, & the Environment (\$5/2/1) | <input type="checkbox"/> Public Programs & Processes (\$6/4/4) |
| <input type="checkbox"/> Finance (\$15/10/5) | <input type="checkbox"/> Railroad Applications (\$25/15/5) |
| <input type="checkbox"/> Group Decision & Negotiation (\$7.50/5/5) | <input type="checkbox"/> Simulation (\$6/6/3) |
| <input type="checkbox"/> Health Applications (\$20/10/5) | <input type="checkbox"/> Social Science Applications (\$5/4/2) |
| <input type="checkbox"/> Information Systems (\$15/10/10) | <input type="checkbox"/> Technology Management (\$22.50/15/10) |
| <input type="checkbox"/> Location Analysis (\$7.50/6/0) | <input type="checkbox"/> Telecommunications (\$7.50/5/5) |
| <input type="checkbox"/> Logistics (\$7.50/5/5) | <input type="checkbox"/> Transportation Science (\$15/10/3) |
| <input type="checkbox"/> Forum on Education (INFORMED) (\$0/0/0) | |
| <input type="checkbox"/> Pre-Collegiate Teachers' Forum (\$25/10/0) | |
| <input type="checkbox"/> Women in OR/MS Forum (\$10/10/5) | |

NAME _____ JOB TITLE _____

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Student: My free society/section is _____ Regular: My free journal is _____

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ISRAEL

MANAGEMENT SCIENCE AND OPERATIONS RESEARCH IN AN EMERGING REGION

Message From the General Co-Chairs

We welcome you to the 1998 INFORMS/ORSIS Joint International Meeting in Tel Aviv. A diverse society situated at one of the world's major crossroads joining Europe, Asia and Africa, Israel is a truly cosmopolitan country. Recent developments in the Middle East have made Israel one of the world's fastest growing economies with the expectation that the region will emerge as a world economic power.

Israel, which celebrated 50 years of existence last month, reflects the ancient and the new. As the Holy Land, it is home to ancient sites of major world religions. This, combined with modern developments in architecture, industry and infrastructure, makes the country a tourist and business attraction.

The theme of the meeting, "*Management Science and Operations Research in an Emerging Region*," reflects the role of the various disciplines to the economic and business success of emerging industries as well as of the Middle Eastern countries and the region as a whole. OR/MS researchers and practitioners will have the opportunity to share ideas and work together to find ways to enhance industrial operations in emerging economies, especially in high-tech, service industries and the public sector.

The conference is held on the campus of Tel Aviv University, the largest university in Israel. The 220-acre modern campus, located in Israel's cultural, financial and industrial heartland, is a major center of teaching and research, serving 20,000 students, comprised of nine faculties, 106 departments, and over 75 research institutes. The university enjoys extensive research contacts with leading overseas academic and scientific institutions as well as with major Israeli businesses and industries.

The conference's main hotel is the Ramada Continental, situated on Tel Aviv's famous promenade along the Mediterranean shore. It is a short walk from the bustling city center of Tel Aviv. The city's cultural, entertainment and business centers, as well as its fashionable shopping, are at your doorstep. There is a second hotel, the Grand Beach hotel, located just a few blocks away.

We have prepared an exciting program. The opening session on Monday at 10:30 will feature Professor Yair Aharoni, one of the General Chairs of the TIMS Israel meeting in 1973, as our plenary speaker. We have seven semi-plenary speakers, 20 parallel tracks with 200 sessions, 650 papers, covering a wide variety range topics from telecommunication to internet, the WWW, organization, production, supply chain, applied probability, marketing and many others. We hope you will find the program stimulating.

On behalf of INFORMS, we want to offer our thanks to our colleagues and supporting academic institutions: Tel Aviv University, University of Michigan-Dearborn, ORSIS; and particularly to the extremely hardworking members of the organizing committees, cluster chairs, and many others who help make this meeting possible.

This is the second time INFORMS has held a meeting in Israel. Back in June 1973, The Institute of Management Science (TIMS) held its XX International meeting in Israel. Many of us still remember this successful meeting. Our challenge is to make the 1998 meeting even better. If you haven't seen Israel since 1973, you're in for a big surprise!

We extend our warmest welcome and trust that you will enjoy this memorable and exiting meeting!

Jacob Hornik & Benjamin Lev
General Co-Chairs

ORGANIZING & PROGRAM COMMITTEE

Samir Abuznaid
Hebron University

Anant Balakrishnan
Pennsylvania State University

Mike Ball
University of Maryland

Amiya Chakravarty
Tulane University

Suk-Gwon Chang
Hanyang University

Moshe Dror
University of Arizona

Boaz Golany
Technion, Haifa

Sidney L. Hantler
IBM Corporation

Jack Kleijnen
Tilburg University

Murat Koksalan
Middle East Tech. University

Moshe Kress
Center for Military Analyses

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Yannis Siskos
Technical University of Crete

Yutaka Takahashi
Nara Institute of Science &
Technology

Arik Tamir
Tel Aviv University

Uri Yechiali
Tel Aviv University

Jacob Zehavi
Tel Aviv University

GENERAL INFORMATION

Authors - The first author listed for each abstract should make the presentation.

Banking & Currency - Banks are usually open on Sunday, Tuesday and Thursday, 8:30am - 12:30pm and again from 4:00 - 6:00pm. On Monday and Wednesday, they're open from 8:30am - 12:30pm and on Friday and the eve of holy days, from 8:30am - 12noon. Many ATM machines accept international credit cards during non-banking hours.

Foreign currency may be exchanged at any bank and at many hotels. The currency of Israel is the shekel. Travelers may bring an unlimited amount of local or foreign currency into Israel in either cash or travelers checks. Major credit cards (American Express, Diner's Club, VISA, MasterCard, Access and EuroCard) are widely accepted.

Buses & Taxi Service - Shuttle buses to and from Tel Aviv University will be provided at no charge. Buses will leave the Ramada Continental and the Grand Beach hotels and run from 7:30 - 8:30am. Return transportation from the University to both hotels will be provided each evening following the last session. Please check your registration pack for the transportation schedule. Tel Aviv University is approximately 15 minutes from downtown Tel Aviv.

Taxi service is easily available from Ben-Gurion International Airport to downtown Tel Aviv. Taxi fares are between \$30 - \$45 and the ride is approximately 30 minutes.

There are also a wide variety of car rental agencies to chose from.

Climate - Israel enjoys long, warm, dry summers. The climate in late June/early July is relatively warm, averaging 28°C or 82°F with no rain. Humidity is about 60%.

Dining - There are many fine restaurants within a short walking distance of the hotels with a wide variety of menus and cuisine to choose from. There are several food outlets on the campus.

Dress - Dress is casual and informal in Tel Aviv.

Electricity - A converter and adapter are necessary for electrical appliances. Electricity is 220 volts.

Hotels & Accommodations *(Deadline May 15)*

Both hotels, the Ramada Continental and the Grand Beach Hotel, are within easy walking distance to the center of Tel Aviv and all main tourist attractions. The Ramada, on the beach, has an indoor heated swimming pool, Jacuzzi, saunas, sundeck and fitness room. Each room has a private balcony facing the Mediterranean, air-conditioning, cable TV, radio and direct-dial phones. The Grand Beach has a rooftop swimming pool, beauty parlor and barber shop. All rooms have air-conditioning, radio, direct-dial phones and TV. The beach is nearby.

Rates are per room/per night and include Israeli buffet breakfast and service charge. Rooms are limited and will be assigned on a first-come/first-served basis. A one-night deposit is required to accept a hotel reservation by credit card. Please return hotel reservation form to MICA no later than May 15; by FAX to 860-243-9730 or by mail to MICA, 34 Jerome Ave., Bloomfield, CT 06002, USA.

Cancellation Policy: 30 days prior/one-night fee. 7 days prior/two-night fee. Less than 72 hours/total fee. Hotel checkout time will be 12noon. If you would like to arrange a later checkout, please set this up at the hotel registration desk when you check in.

Messages - To reach participants during the conference, please contact Professor Jacob Hornik's office at Tel Aviv University at 972-03-6408098 or by fax at 972-03-6414215. A message board will be set up in the registration area to leave notes for participants. To reach someone at the Ramada Continental, the phone number is 03-5272626 and the fax is 03-5272576. The phone number for the Grand Beach is 03-5466555 and the fax is 03-5466589.

Smoking Policy - Smoking is prohibited in meeting rooms during sessions.

Time Difference - The time in Israel is 7 hours ahead of the United States.

Travel & Tour Desk - During the conference, a special Tour & Travel Desk will be set up by Amiel Tours. Their staff will provide information on sightseeing, shopping, transportation, additional tours, etc.

REGISTRATION

Advance Registration *(Deadline June 1)*

Attendees are urged to register in advance for the conference. Complete the pre-registration form and mail to INFORMS Israel, 2 Charles Street, Suite 300, Providence, RI 02904 by June 1. Fees may be paid by credit card (American Express, MasterCard, VISA only - fax to 401-274-3189) or by check or money order, payable to INFORMS Israel '98. Registration payments may also be made via the Web at <http://www.informs.org> using your credit card - this is a secure server. The deadline for advance registration will be strictly enforced; all payments postmarked after the June 1 deadline will be charged the full, on-site registration fee. Registration materials will be available in the registration area.

On-Site Registration - Meeting registration will be held at the Ramada Continental on Sunday, June 28 only, and at Tel Aviv University on Monday through Wednesday during the following hours:

Sunday, June 28	4:00pm - 8:00pm
Monday, June 29	7:30am - 5:00pm
Tuesday, June 30	7:30am - 5:00pm
Wednesday, July 1	7:30am - 12noon

The registration fee allows admittance to all technical sessions, the Welcome Reception and the General Reception. Name badges **MUST** be worn to all INFORMS sessions, functions and events. Misplaced badges may be replaced at the registration desk by showing your receipt. Meals are not included in the registration fee. If you attend workshops or special paid functions, an additional fee is required. **All attendees, including cluster and session chairs and invited speakers must register and pay the registration fee.**

Rates

Deadline Dates	On/Before 6/1	After 6/1
INFORMS Members	\$ 295	\$345
Non-Members	\$ 335	\$385
Student/Retired	\$ 65	\$ 65
Guests	\$ 35	\$ 35

Refund & Cancellation Policy - Payments will be refunded only if a written cancellation is received in the INFORMS Rhode Island office no later than June 24. Cancellations may also be faxed to 401-274-3189 or e-mailed to meetings@informs.org and must meet this deadline.

TRAVEL & TOURS

MICA is our authorized travel agent and will be handling all ground arrangements for the INFORMS Israel 1998 Meeting. They are also offering discounted airfares to Israel from the US. Please call for a quote from your home city; ask for Rita or Joyce at 800-ASK-MICA (800-275-6422) or 800-286-8900 for information on hotels, tours or airfare. You can also FAX your request to 860-243-9730.

Full-Day Jerusalem Tour, *Deadline May 1*

Sunday, June 28

8:00am - Depart hotel and drive directly to Jerusalem via the main highway. Ascend the Mt. of Olives and enjoy the panoramic view of the Golden City. Descend via the Kidron Valley and continue to the Old City for a walking tour that includes the Christian Quarter. Walk along the Via Dolorosa to the Church of the Holy Sepulchre. Walk through the colorful Arab Market and enter the Jewish Quarter. Walk along the reconstructed Cardo, formerly a market place and view the Western Wall, the last remnant of the Jewish Temple. Depart the Old City and drive to the Israel Museum to view the Dead Sea Scrolls

housed in the Shrine of the Book. Leave Jerusalem at 5:00pm and return to Tel Aviv. Arrival at hotel about 6:15pm. (US\$37/person)

Half-Day Caesarea Tour, *Deadline May 1*

Monday, June 29

8:30am - Depart Tel Aviv and drive via the Coastal Highway to the old crusader city of Caesarea. Visit the open-air theater now restored and used as one of Israel's leading concert venues. Visitors walk across the drawbridge of the moat through the guardhouse and into the ruins of the Old City. Stroll through the cobbled streets, warehouses and well-preserved port. Continue on to Zichron Yaacov and visit the Gardens of Ramat Hanadiv (Hill of the Philanthropist) named in memory of Baron de Rothschild, whose impressive vaulted tomb lies here. Arrival at hotel about 2:00pm. (US\$38/person).

Half-Day Jaffa Tour, *Deadline May 1*

Tuesday, June 30

9:00am - Depart hotel and drive past Rabin Square to view the memorial dedicated to the former Prime

Minister Itzak Rabin located at the place where he was assassinated during a peace rally in November 1995. Continue to Dizengoff Street with its quaint boutiques and coffee shops. Pass the Mann Auditorium, home of the Israeli Philharmonic Orchestra. Visit the Carmel Market and enjoy a walk down the colorful lanes with displays of fruit and vegetables. Proceed to the old port of Jaffa for a visit

to the Old Port, now an artist's quarter. Walk down the cobbled lanes and browse through the galleries and pottery stores. Arrival at hotel about 1:00pm. (US\$25/person).

Fees include transportation, guide and all entrance fees. Meals are not included. All tours will be conducted in English.

SOCIAL PROGRAM

Sunday, June 28

Welcome Reception 6:00 - 7:30pm

All registered attendees and their guests are invited to the Welcome Reception in the registration area at the Ramada Continental on Sunday evening. This is a perfect opportunity to greet old friends and to meet new ones. Please register for the meeting prior to the reception.

Monday, June 29

General Reception 7:00 - 9:00pm

The General Reception is Monday evening at the Loft in the old Jaffa port. The Loft serves authentic Israeli dishes and is a 5-minute walk from the art quarter of painters, galleries, antiques shops and other tourists attractions. We provide buses from the hotel to the Loft. **This event is partially sponsored by the State of Israel Minister of Tourism.**

SPONSORING ORGANIZATIONS

INFORMS - The Institute for Operations Research and the Management Sciences, INFORMS, was created in January 1995 through the merger of the Operations Research Society of America, ORSA, and The Institute of Management Sciences, TIMS, both of which had been in existence for over 40 years. Building on the foundation of the parent organizations, the merger has created a larger, stronger, more dynamic society of approximately 13,000 members dedicated to advancing the use of OR/MS methodologies. INFORMS' diverse membership base includes academics and practitioners from around the world, enabling both segments of the profession to interact with and learn from one another.

Through 9 leading professional journals, meetings, conferences and an online member service,

INFORMS enables those working in OR, MS and related areas to keep up-to-date on a broad spectrum of research and application topics. Members working in quantitative disciplines such as decision systems and many other specialties are provided ample opportunity to research, discuss and publish in their area of interest. They can also choose from among 31 special interest sections, 36 regional chapters and 43 student chapters. Two INFORMS meetings per year, two international meetings every three years and a number of special interest meetings enable INFORMS members to stay current on research and practice in the dynamic OR/MS professions.

ORSIS - The Operations Research Society of Israel, ORSIS, has the honor of co-hosting the INFORMS International Conference in Israel

this year. It is the year that Israel celebrates its 50th anniversary of independence and Operations Research marks 50 years as a field of inquiry. The title of the conference, "*MS & OR in an Emerging Region*" is indeed a fitting theme. An old-new country, Israel has emerged as a focal point for pilgrims from around the world, providing vivid proof of the enormous potential of the Middle East as an emerging region. ORSIS, a member of IFORS and EURO, was founded in 1966 to promote and enhance the research and practice of OR in Israel. It publishes a newsletter biannually and holds a national conference annually at a chosen location in Israel. Several awards have been established over the years in recognition of excellence in research and application of OR in Israel. Of the 300 or so members, one third are academics, the rest are in

industry, business and the public sector.

Tel Aviv University - The conference sessions will be held on the campus of Tel Aviv University, the largest university in Israel. The 220-acre modern

campus, located in Israel's cultural, financial and industrial heartland, is a major center of teaching and research, comprising 9 faculties, 106 departments and over 75 research institutes. The university enjoys extensive

research contacts with leading overseas academic and scientific institutions as well as with major Israeli businesses and industries.

A campus map will be available at registration .

TECHNICAL PROGRAM

Plenary, Monday, June 29, 10:30 - 11:45am
Bar-Shira Auditorium

MO21 The Impact of Globalization on Management Science, Yair Aharoni, Tel Aviv University

BIOGRAPHY: Yair Aharoni is the Rector of the College of Management. He served as the first dean of the Faculty of Management and was the first director of the Top Executive Program at Tel Aviv University. His work record outside the University includes being the director and chief executive officer of the Jerusalem Institute of Management, a top management development institute, and serving as consultant and director of various industrial firms. Yair Aharoni is Professor Emeritus of Business Policy at Tel Aviv University.

He has held visiting appointments at Boston University, the City University of New York, Columbia University, Harvard University, New York University, Stanford University, the University of California at Berkeley and Duke University as well as IMEDE Management Development Institute in Lausanne, Switzerland, and Technion, the Israel Institute of Technology. Aharoni serves on the board of several journals, including *International Studies in Management*, *Multinational Business Review* and *Journal of International Business Studies* and he was an associate editor of *Management Science* and *Organization Science*.

Aharoni graduated in 1955 from Tel Aviv University, received his M.A. from there in 1958 and his doctorate from Harvard Business School in 1961.

His doctoral thesis, *The Foreign Investment Decision Process*, was published in 1966 and has been translated into Japanese and Spanish. Some of the subsequent books by Aharoni include *Business in the International Environment; Markets, Planning and*

Development; Structure and Conduct in Israeli Industry, The No Risk Society; The Evolution and Management of State-Owned Enterprises; Israel's Political Economy; The Dreams and the Realities and Political Involvement in Israel's Economy. Among books he edited are *Coalitions and Competition: The Globalization of Professional Business Services* and *Changing Roles of State Intervention in Services in an Era of Open International Markets.* He wrote a report published by the UN on *The Globalization of Management Consulting.* In addition to 25 books, monographs and research reports, he is author of over 80 papers and chapters in books and more than 120 cases in Hebrew and English.

Aharoni is a fellow of the Academy of International Business and of the International Academy of Management, and he is a member of the Academy of Management and the Strategic Management Society.

ABSTRACT: A fundamental issue in management science is the generality of what we know. Much of what has been developed in the quest to create knowledge and rules turned out to be country specific or limited to certain culture. Globalization means that rival firms compete against each other on a worldwide basis and domestic industries have linkages across countries. The issue addressed here is the degree to which globalization reduces the variance across national settings. In other words, is management science becoming more universal, and if not, what are the variables that are becoming globally valid and what practices are now transferred across cultural boundaries. Specifically, we discuss the impact of globalization on the theory of multinational enterprise; on the theory of gains from international diversification and analyze whether these gains are reduced by globalization. We discuss also the changes called for in the theory or services that have become tradable as a result of technological changes.

Keynotes, 1:00 - 2:00pm

MONDAY

Room 002 - Teletraffic Theory for Code Division Multiple Access Cellular Systems, *Philip J. Fleming*, Motorola, Inc.

The combination of a number of technologies including radio propagation, macro diversity, digital communications, variable rate speech coding, packet data networking and distributed power control make teletraffic analysis of CDMA cellular telephone systems a unique challenge to teletraffic analysts. We will survey some of the tools and techniques used to model the capacity of such systems.

Room 003 - Survey of Control Mechanics for Multi-Echelon Supply Chains - Implications for Product Design, *Awil Federgruen*

Abstract not available.

Room 111 - The Use of Relaxations Stronger Than Linear Programming for Approximation Algorithms, *Dorit S. Hochbaum*, University of California - Berkeley

We discuss the use of relaxations for the design of approximation algorithm for intractable problems and introduce a novel framework of relaxations which is particularly powerful. The power of the approach is in the strength of the bounds generated and in the efficiency of the algorithms derived. Numerous applications of the technique will be discussed.

Room 112 - Optimal Solutions - Dream & Reality, *Aharon Ben-Tal & Arkadi Nemirovski*, Technion, Israel Institute of Technology

A solution of an optimization problem, even when inputted accurately, may in fact be totally unacceptable due to inaccurate implementation, or due to data uncertainty. We illustrate these phenomena by two engineering design problems: truss design and antenna synthesis. We then present a new methodology, robust optimization, aimed at producing optimal solutions which are stable with respect to data uncertainty. In particular, we derive robust counterparts of linear programs, quadratic and cone-quadratic programs and semi-definite programming problems.

Room 001 Implicit Valuation of a Blood Exclusion Decision, *Edward H. Kaplan*, Yale School of Management

This paper presents an implicit valuation of Israel's decision to exclude blood donations from Ethiopian immigrants. The approach adopts assumptions that

deliberately overstate the public health effectiveness of this policy, for if such an analysis fails to justify exclusion on public health grounds, nothing will. Following a review of the controversy surrounding this policy, we discuss estimates of recent HIV incidence in Israel and use these to create (over) estimates of HIV incidence among potential blood donors. We then report a model for determining the probability that an antibody-negative donation is potentially infectious, and (over) estimate this risk for Ethiopian and non-Ethiopian Israeli donors. Considering the observed mix of these two donor pools, we argue that the exclusion policy reduced the total expected annual number of infectious donations by (at most) 0.10. We then conduct an implicit cost-benefit analysis, and show that under reasonable assumptions, the exclusion policy is not justifiable if the social costs of exclusion exceed \$150,000 per year, or \$2.50 per Ethiopian immigrant annually.

TUESDAY

Room 003 -Data Mining, *Jacob Zahavi*, Tel Aviv University

Recent developments in hardware and software technology have made it all the more easy for organizations to collect and store massive amounts of data. Yet, raw data have no direct benefits unless tapped, analyzed and converted into useful information and knowledge to support decision making.

A new generation of computerized methods is emerging in recent years to help the endeavor of extracting information from mountains of data. These methods are collectively known as data mining. Data mining is a process that evolves from the intersection of such fields as databases, statistics, optimization, machine learning, artificial intelligence, expert systems, visualization, and others. The applications of data mining, which cut across many industries, include targeting, financial analysis, market basket analysis, fraud detection, credit assessment, churn management, and others.

We provide an overall view of data mining and its applications. Specific examples will be given from the area of database marketing.

Room 004 - The Management of Higher Education: Models, Perspectives & Illustrations, *Abraham Mehrez*, Ben Gurion University of the Negev

We focus on the evolution of the past 10 years in the Israeli system of higher education, which has increased from 10 institutions to about 200. During the same period of time, the number of students has doubled and the production of the institutions has become very heterogeneous. Private and public institutions, branches of foreign universities in Israel, private and public independent colleges, regional campuses and Israeli universities constitute the system. The purpose of this presentation is twofold; to analyze through micro and macro game models the quality of the students in this system and to derive the distribution of students in the system under various scenarios.

Room 002 - Correlated Equilibria & Weather Forecasting: It is All a Matter of Approach, Sergiu Hart

How can one measure the accuracy of the TV weatherperson who announces, "There is a 60%

chance that it will rain tomorrow"? How can one beat the weatherperson at their own game? How can simple adaptive rules of behavior lead to sophisticated ways of playing games? Answers to these and other questions, using Blackwell's approachability theorem, will be presented.

Room 112 -Post-Solution Analysis in LP from an Interior Solution, Harvey Greenberg

This emphasizes the use of the optimal partition, obtained by most interior point methods, for sensitivity analysis and debugging. The information is different than that of a basic solution (unless unique), and this demonstrates circumstances under which the partition contains preferred information. The presentation begins with terms and concepts, assuming knowledge of LP, but not of interior point methods or of the solutions they generate.

Tutorials, 1:00 - 2:00pm

MONDAY

Room 004 - What Can the World Wide Web Do for YOU?!

Moshe Sniedovich, moshe@ms.unimelb.edu.au

We explore the WWW from the viewpoint of OR/MS. We examine the facilities that WWW technologies provide for teaching, learning and practicing OR/MS and the resources they require. The exposition will be as non-technical as possible and no prior experience or background are needed.

Room 205 - Statistical Inference About Risk, Karl C. Mosler, mosler@wiso-uni-koeln.de

When choosing among risky alternatives, a principal problem is to determine which of two possible choices contain more risk. A risky alternative is considered as a probability distribution of outcomes and its risk is compared by means of a risk parameter, e.g., variance, or a risk ordering, e.g., stochastic dominance. Applications include decision support in investment,

finance, insurance, reliability and other areas of OR. In most concrete applications, information on the probability distribution stems from experimental or observational data and therefore, contains a sampling error. However, this is often neglected in the practical comparison of alternatives. This tutorial introduces statistical methods for comparing alternatives with respect to risk. We begin with parametric procedures to compare variance and other risk parameters then recent non-parametric tests for stochastic dominance (first and second degree) are surveyed. Cases of censored and dependent observations are discussed, and finally, reference is given to commercial and other statistical software.

Room 110 - Logistics: A New Teaching Approach, Avraham Shub, shtub@eng.tau.ac.il

This is a presentation of modern tools for teaching logistics. The participants are managing a

simulated plant, including the functions of purchasing, production planning and control, inventory and finance. By tackling problems typical to a real production organization, the participants learn how to utilize the capabilities of a modern management information system, how to coordinate the different functions in the organization and how to focus on the most important problems in the organization. We focus on the teaching methodology and the supporting teaching tool called the Operations Trainer.

Room 201 - Set Partitioning, Linear Programming & Combinatorial Problems in Supply Chain Management, David Simchi-Levi, levi@iems.nwu.edu

A classic and recently popular method for solving many hard combinatorial problems is based on formulating these problems as set-partitioning models. This is done commonly for crew scheduling, vehicle routing,

graph partitioning, machine scheduling and many others. We explain the excellent empirical performance of the set-partitioning technique for a number of problems including vehicle routing, bin-packing and parallel machine scheduling problems. This is done by characterizing the average and worst case relative difference between the linear programming relaxation of the set-partitioning formulation and the optimal solution. We then apply the set-partitioning method to tactical problems in supply-chain management involving inventory and transportation. In particular, we consider the problem of integrating inventory policies and transportation strategies so as to minimize system-wide costs by taking advantage of the shipping cost structure. We identify structural properties of the resulting formulation, which lead to development of a new algorithm. Preliminary results suggest that the algorithm is very effective.

Room 111 - Some Future Directions in Vehicle Routing

Research, Bruce L. Golden,
bgolden@umdacc.umd.edu

Recently, a variety of metaheuristics has been used by researchers to solve VRPs. For the most part, high-quality solutions have been obtained, but the algorithms are often slow and involve many parameters. We examine where we are and where we ought to go from here.

Room 205 - Industry Roadmapping Workshop

Michael Radnor; m-radnor@nwu.edu

Roadmaps for industries such as chemicals, electronics, Internet, manufacturing controls, rapid prototyping, various materials areas and other industries, developed in connection with an NCMS program will be presented by industry experts. Lessons learned and other implications for small as well as large firms will be discussed in an open session by participants and speakers.

Room 203 - On Equitable Resource Allocation Problems - A Lexicographic Minimax Approach, Hanan Luss,
hluss@att.com

We review a variety of resource allocation problems in which it is desirable to allocate limited resources equitably among competing activities. A resource allocation solution is called equitable if no performance function value can be improved without either violating a constraint or degrading an already equal or worse-off performance function value associated with a different activity. Applications for such problems are found in diverse areas, including distribution, production planning, workforce management, emergency services and telecommunications. The problems reviewed include large-scale allocation problems with multiple resources, multi-period allocation problems and problems with substitutable resources. Efficient algorithms for many models will be described. Hopefully this presentation will help practitioners to formulate and solve diverse resource allocation problems and motivate researchers to explore new models and algorithmic approaches.

Workshop

Sunday, June 28 Ramada Continental Hotel Smart Simulation & Monte Carlo Techniques Reuven Rubinstein

Stochastic systems abound in real-world applications. Examples include traffic systems, FMSs, computer-communications systems, inventory systems, production lines, coherent lifetime systems, PERT networks and flow networks. Most of these systems can be modeled in terms of discrete events whose occurrence causes the system to change from one state to another. Such systems are known as discrete-event systems, DESs. For most real-world DESs, analytical methods are not available and they must be studied via simulation. In designing, analyzing and operating such complex DES, one is interested, however, not only in *performance evaluation* but also in *sensitivity analysis* and *optimization*, SAO. Sensitivity analysis is concerned with evaluating sensitivities (gradients, Hessians, etc.) of performance measures with respect to parameters of interest. It provides guidance for design and operational decisions and plays a pivotal role in identifying the most significant system parameters, as well as bottleneck subsystems. Optimization is concerned with a DES as a whole; in particular, it makes use of sensitivity analysis to find the optimal solution with respect to parameters of interest.

Traffic light systems: Here, the performance measure might be a vehicle's average delay as it proceeds from a given origin to a given destination, or the average number of vehicles waiting for a green light at a given intersection. The sensitivity and decision parameters might be the average rate at which vehicles arrive at intersections and the rate of light changes from green to red. What will the vehicle's average delay be, if the interarrival rate at a given intersection were to increase (decrease), say, by 10-50%? What would be the corresponding impact of adding one or more traffic lights to the system? Which parameters are most significant in causing bottlenecks (high congestion in the system), and how can these bottlenecks be prevented or removed most effectively? How can the average delay in the system be minimized, subject to certain constraints?

Stochastic networks: One might wish to employ sensitivity analysis in order to minimize the mean shortest path in the network with respect, say, to network link parameters, subject to certain constraints. PERT networks and flow networks are

common examples. In the former, input and output variables may represent activity durations and minimum project duration, respectively. In the latter, they may represent flow capacities and maximal flow capacities.

I present a number of efficient (smart) Monte Carlo techniques for performance evaluation, sensitivity analysis and optimization of computer simulation models. In particular the audience will learn how the calculation of simulation output statistics can be speeded by factors of tens and hundreds, for typical performance measures, and by factor of thousands, for rare event simulations. This in turn implies that, if the conventional method would require hours or days of computer simulation, our method would require minutes. How a single simulation run can be used to estimate an entire response surface and associated gradient (sensitivity) curves in an efficient way. How the optimal solution of constrained optimization programs can be found. Examples include the minimization of the mean waiting time in queueing networks with respect to service rate parameters, subject to certain constraints involving rare-event probabilities. It will be shown that all the above are feasible due to the fact that the simulation experiments to be performed on a digital computer are largely computational and not purely statistical. We also explain how to use the most valuable information obtained during the course of simulation in an efficient (smart) way and in particular, how to convert the original "black box" system into an "almost white box" system (the term "almost" stands for the fact that sensitivity analysis and optimization are performed in a stochastic rather than a deterministic sense).

A research software package demonstrating the efficacy and efficiency of the proposed techniques will be made available for the participants, as well as a number of case studies. Participants are encouraged to bring their own examples and case studies to run during and after the workshop.

Who should attend? Simulation practitioners, computer scientists, industrial, electrical and financial engineers, graduate students and anyone interested in fast simulation of discrete event systems.

- Fast estimation of performance measures for both static and dynamic models via simulation.
- Fast estimation of response surfaces from a single simulation run.

- Fast estimation of derivatives (sensitivities) from a single simulation run.
- Fast estimation of probabilities of rare events via probability change-of-measure.
- Optimization of computer simulation models with rare events.
- Combinatorial and global optimization via Markov chain, entropy and importance sampling.
- Case studies and software presentation.

Expected benefit: Key ideas and features of modern simulation. Special emphasis will be placed on the estimation of rare-event probabilities, sensitivity

analysis and optimization of complex computer simulation models involving rare events.

I will show how to take advantage of simple change-of-measure ideas so as to reduce the time complexity required by statistical computations in Monte Carlo simulations, such as performance measures (averages) and sensitivities (gradients). Furthermore, it will be demonstrated how to exploit these ideas in the computation of response surfaces, and specifically, how to avoid multiple simulation runs, by computing such from a single simulation runs. These ideas will then extended to the speeding up of computations in stochastic optimization models.

DAILY PLANNER

MONDAY	TUESDAY	WEDNESDAY
<p>Session MA 8:30 - 10:00</p>	<p>Session TA 8:30 - 10:00</p>	<p>Session WA 8:30 - 10:00</p>
<p>Opening Session 10:30 - 11:45 Plenary Speaker: Yair Aharoni</p>	<p>Session TB 10:15 - 11:45</p>	<p>Session WB 10:15 - 11:45</p>
<p>Session MS 1:00 - 2:00 Keynotes & Tutorials</p>	<p>Session TS 1:00 - 2:00 Keynotes & Tutorials</p>	<p>Session WC 11:45 - 1:15</p>
<p>Session MC 2:00 - 3:30</p>	<p>Session TC 2:00 - 3:30</p>	
<p>Session MD 3:45 - 5:15</p>	<p>Session TD 3:45 - 5:15</p>	

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Monday 08:30-10:00**MA01 Behavioral Issues in MCDM**

Cluster: MCDM

Invited Session

Chair: James Corner, Univ. of Waikato, Dept. of Mgmt. Systems, Private Bag 3105, Hamilton, New Zealand

1) **Lessons Learned for Communicating Multiobjective Analysis Techniques & Results**, *Gregory S. Parnell*, VA Commonwealth Univ., Richmond, VA 23284-4000, *Jack A. Jackson, Jack M. Kloeber, Richard F. Deckro*

We describe our lessons learned communicating multiobjective DA techniques and results to technical leaders and decision makers. We use executive summary presentations to present multiobjective methods and obtain the support of technical leaders and decision makers responsible for funding our analysis projects. We illustrate our techniques for presenting DA results.

2) **Descriptive Theories of Multiobjective Decision Making**, *Stuart Dillon*, Univ. of Waikato, Private Bag 3105, Hamilton, New Zealand, *James Corner, John T. Buchanan*

We review and categorize several descriptive decision making theories from the research literature in an effort to see how they might inform the development of prescriptive theories and solution techniques. Implications for the design of future techniques are offered.

3) **A Study of Managerial Descriptive Decision Processes**, *Stuart Dillon*, Univ. of Waikato, Private Bag 3105, Hamilton, New Zealand, *John T. Buchanan, James Corner*

We report on an explanatory case study of 23 managers and decision makers in a local government organization. Each manager was interviewed in depth to understand their decision making processes in the context of their specific job. We identify a range of factors which appear to influence decision process and link these results back to the existing descriptive theories of multiobjective decision making.

MA02 Adaptive Enterprise Technology: Models, Processes & Issues

Cluster: Enterprise Technology

Invited Session

Chair: Michael J. Shaw, Univ. of IL, Dept. of Bus. Admin., 2051 Beckman Inst., Urbana, IL 61801

1) **Issues in Multi-Agent Simulation**, *William Fulkerson*, John Deere & Co., Comp. Info. Systems, John Deere Rd., Moline, IL 61265-8098, wf28155@deere.com

Multi-agent simulation is an appealing technology for decision support applications. However, the "devil is in the details." We outline some of the current hard and soft issues that must be addressed before multi-agent simulation can be accepted as a management decision support tool.

2) **A Generic Structure for Business Process Modeling**, *Fu-Ren Lin*, 2010 S Orchard St., Apt. B, Urbana, IL 61801, *Meng-Chyn Yang, Yu-Hua Bai*

We propose a generic structure for business process modeling. Several business process modeling methods are generalized to develop a generic business process modeling approach, which possesses essential features suitable for business process modeling. An order fulfillment process in supply chain networks is presented to demonstrate this generic modeling method.

3) **The Disaggregation of the Corporation: The Emerging Role of the Dedicated Foundry**, *Russell W. Wright*, Univ. of Illinois, Dept. of Bus. Admin., 350 Commerce West Building, Champaign, IL 62820, rwwright@uiuc.edu

We examine how firms in the semiconductor industry are developing 3 separate "thought worlds" within their product development process. We will argue that the emergency of these thought worlds is creating new organizational boundaries and that firms are using these new organizational boundaries to disaggregate and disintermediate.

4) **Networked Enterprises as Complex Adaptive Systems**, *Michael J. Shaw*, Univ. of IL, Dept. of Bus. Admin., 2051 Beckman Inst., Urbana, IL 61801

As firms are using new organizational boundaries to disaggregate and disintermediate, they begin to evolve together as an organic structure, forming complex, adaptive relationships. It is similar to networked organizations, but they are also dynamic and highly adaptive. I will show how theoretical research in complex adaptive systems can be used to shed light on the structural and process characteristics of such networked enterprises.

MA03 Survival of the Fittest? Multilevel, Multidisciplinary Perspectives

Sponsor: College on Organization Science

Sponsored Session

Chair: Helaine J. Korn, Baruch College/CUNY, Sch. of Business, 17 Lexington Ave., Box F1831, New York, NY 10010, hkorn@baruch.cuny.edu

1) **Survival of the Fittest? The Influence of Person-Group Affective Fit on Work Attitudes, Group Processes & Work Outcomes**, *Sigal Barsadem*, Yale Sch. of Mgmt., 135 Prospect St., New Haven, CT 06511, sbarsade@horus.som.yale.edu

There has been much evidence that an employee's fit with his or her work environment leads to more positive employee attitudes and work outcomes. Most research examining fit has focused on demographic characteristics, values, skills or cognitively based personality variables. I posit another important area in which employee fit can lead to "survival" within a work group: an employee's "affective fit," that is, an employee's dispositional affective congruence with the rest of his or her work team. It is predicted that affective fit will have a significant influence on individual employee attitudes and behavior, including individual survival-or-turnover, as well as on group processes and outcomes. These hypotheses are tested in a sample of CEOs and their senior management teams.

2) **Survival of the Fittest? Meritocracy & Social Networks in the Hiring Process**, *Trond Peterson*, Univ. of CA, Haas Sch. of Bus., Berkeley, CA 94720, trond@haas.berkeley.edu, *Ishak Saporta, Marc-David Seidel*

Discrimination occurs at many levels in the employment process. We investigate the effects of discrimination in the hiring process. Decisions to make a job offer, initial offer amount, final offer amount, decision to accept the offer and survival in the organization are investigated. Findings suggest that discrimination effects for demographic categories disappear when controlling for the effects of social networks.

3) **Survival of the Fittest? Empirical Review & Evaluation of the Role of Organizational Size in Ecological Research on Mortality in the...**, *Helaine J. Korn*, Baruch College/CUNY, Sch. of Business, 17 Lexington Ave., Box F1831, New York, NY 10010, hkorn@baruch.cuny.edu, *Stephen J. Mezas*

We review and evaluate the state of previous ecological research about the determinants of organizational mortality. We posit that the relationships uncovered by this prior research may be biased because of the failure to account for the impact of organizational size on organizational mortality. We examine the contributions of various determinants of organizational mortality in the American feature film industry from 1912-29.

4) **Survival of the Fittest? A Social-Structural View of Competitive Advantage & Survival**, *Ilan Talmud*, Univ. of Haifa, Haifa, 31905, Israel, talmud@soc.haifa.ac.il

We delineate various forms of firms' competitive advantage using a social-structural perspective on the market and deriving several testable hypotheses regarding social capital and corporate survival. Israeli data on corporate social capital and firms' survival are analyzed. Implications of the findings for a general theory of imperfect competition are discussed.

5) **Survival of the Fittest? The Abuse of the Business Judgment Rule in Corporate Mergers & Acquisitions**, *Mark Sirower*, NYU, Stern Sch. of Bus., 44 W 4th St., New York, NY 10012-1126, msirower@stern.nyu.edu, *Rikki Abzug*

Playing the acquisition game continues to destroy value for acquiring firms. The business judgment rule has traditionally protected those officers and directors from fiduciary liability suits so long as their decisions are informed decisions. We present evidence that the duties of care and loyalty owed by officers and directors have been legally diluted and that remedies embedded in 4 literatures are, upon analysis, ineffective to protect the shareholders of acquiring firms.

MA04 Optimization Techniques in Network Design

Cluster: Telecommunications Network Modeling & Optimization

Invited Session

Chair: Young Ki Kim, Chungbuk Ntl. Univ., Dept. of MIS, 48 Gaeshin-dong, Chongju, Chungbuk, 360-763, Korea, ykkim@cbucc.chungbuk.ac.kr

1) **Performance Analysis of Multiperiod Network Design Algorithms & Developing a New Design Method**, *Jay Ick Lim*, Ajou Univ., Sch. of Bus. Admin., San 5, Wonchon-dong, Suwon, Kyunggi-do, 442-749, Korea, limjay@www.ajou.ac.kr

We compare the performance of 2 different network design algorithms on multi-period horizon, which were published in the major journals in 1992 and

1996. The first is based on the Lagrangian method and integer programming, the other on the flow deviation and heuristic. From the result of the performance analysis, a new solution method is suggested and developed.

2) **A Packet Network Design with Two-Level Hierarchy: A Heuristic Approach**, *Young Ki Kim*, Chungbuk Ntl. Univ., Dept. of MIS, 48 Gaeshin-dong, Chongju, Chungbuk, 360-763, Korea, ykkim@cubucc.chungbuk.ac.kr, *Seok Ha Koh*

We address the problem of designing a packet network which has the 2-level hierarchy structure: access module and resource module, being a LAN and a backbone network respectively. The topology is built to be bi-connected and dual-homed for its survivability. We use the flow deviation algorithm for the bifurcated routing. Transmission capacity is assigned to accommodate the traffic requirement within a permissible packet delay.

MA05 Resource Allocation & Pricing in Broadband Networks

Cluster: Operations Research in Telecommunications
Invited Session

Chair: Costas Courcoubetis, University of Crete, ICS-FORTH, Crete, Greece, courcou@ics.forth.gr

1) **Revenue Management in Network Services**, *Ioannis Paschalidis*, Boston Univ., Dept. of Manufacturing Eng., 15 St Marys St, Boston, MA 02215, *John Tsitsiklis*

No abstract supplied.

2) **Demand Driven Pricing in Loss Systems**, *Costas Courcoubetis*, University of Crete, ICS-FORTH, Crete, Greece, courcou@ics.forth.gr, *Martin Reiman*

No abstract supplied.

3) **No Title Supplied**, *Ravi R. Mazumdar*, Univ. of Essex, Dept. of Math., UK, *Catherine Rosengerg*, *H. Yaiche*

No abstract supplied.

4) **No Title Supplied**, *Richard R. Weber*, Cambridge Univ., Statistical Labs., 16 Mill Ln, Cambridge, CB2 1SB, UK

No abstract supplied.

MA06 Alternative Organizational Forms: Structures & Processes

Sponsor: College on Organization Science
Sponsored Session

Chair: Tal Simons, Tel Aviv Univ., Tel Aviv, 69978, Israel

1) **Institutionalization of Opposition in a Service Cooperative**, *Asaf Darr*, Univ. of Haifa, Org. Studies Dept., Dept. of Sociology/Anthrop., Mt. Carmel Haifa, 31905, Israel, darr@soc.haifa.ac.il

What forms of institutionalization of opposition exist in producer and service cooperatives? Most existing studies focus on democratic elections of management. Other forms are rarely explored. This case study tries to address this question by examining daily work routines in a 66-year-old taxi cooperative operating in Tel Aviv, Israel. Forms of institutionalization of opposition in the taxi cooperative studied include a formal tribunal composed of elected judges and mechanisms that inscribe the institutionalization of opposition in the local division of labor. Discussion centers on unique aspects of institution of opposition in a democratic service cooperative and their implications for studies of non-democratic firms.

2) **Alternative Governance Mechanisms in a Kibbutz Organization**, *Zur Shapira*, NYU, 44 W 4th St., Rm. 7-60, New York, NY 10012-1126, zshapira@stern.nyu.edu

Agency theory looks at organizations as a nexus of contracts. The idea is that if a legal contract is not sufficient in solving agency problems, incentive contracts will. Transaction cost economics theory makes several assumptions about agents and proposes that under different situations, 3 forms of controls may be efficient: market control, bureaucratic control and clan control. In the past decade, the kibbutz as an economic organization has changed dramatically. We attempt to analyze how different notions of governance and control may apply to the modern form of the kibbutz. Comparisons to governance mechanisms and controls used in for profit organizations such as investment banks will be discussed.

3) **Conflict & Learning in Alternative Organizations**, *Victor Friedman*, Ruppin Institute, Academic Ctr., Emek Hefer, 40250, Israel

Although conflict plays a central role in all organizations, it is a particularly difficult issue for "alternative" organizations, particularly those that espouse values of cooperation, solidarity and social justice. Studies of kibbutz and other

alternative organizations reveal the difficulties such organizations face in dealing with conflict. The problem is not just conflict itself but rather the fear and avoidance of conflict, which prevent organizational members from dealing openly with central organizational dilemmas. We suggest that alternative organizations need to develop a capacity for "engaging" conflict in order to prevent stagnation and to stimulate learning.

4) **Hybridity in Kibbutz Economic Organization**, *Chris Warhurst*, Univ. of Glasgow, Dept. of MS, Glasgow, G12 8LF, Scotland UK, c.warhurst@mgt.gla.ac.uk

Debate has long raged about an alleged tension in kibbutz economic activity between capitalist organization on the one hand, manifest in hierarchy and centralization and on the other hand, socialist organization, manifest in the diffusion of decision-making and egalitarian. The main focus of analysis in exploring this tension has usually been kibbutz industry.

MA07 Derivative Securities I

Cluster: Finance
Invited Session

Chair: Jerome Detemple, McGill Univ., 1001 Sherbrooke St. W, Montreal, Quebec, H3A 1G5, Canada, detemple@management.mcgill.ca

1) **A Stochastic Mesh Method for Pricing High-Dimensional American Options**, *Mark Broadie*, Columbia Univ., 415 Uris Hall, 3022 Broadway, New York, NY 10027-6902, mbroadie@research.gsb.columbia.edu, *Paul Glasserman*

We present a new stochastic mesh method for pricing high-dimensional American options when there is a finite but possibly large number of exercise dates. The algorithm provides point estimates and confidence intervals and it converges to the correct values as the computational effort increases.

2) **Stochastic Time Changes & Asset Price Dynamics**, *Helyette Geman*, Univ. of Paris, Dept. of Finance, ESSEC BP 105 95021, Cergy Pontoise Cedex, France, p-geman@edu.essec.fr

We extend the use of subordinated processes introduced in Clark (1973) to high frequency data. Moreover, we show that without any assumption on the distribution of the stochastic time change, a quasi-perfect normality of returns on the SP 500 is recovered when the "stochastic clock" is driven by the number of transactions.

3) **A Semi-Analytic Approach in Pricing American Options with Stochastic Interest Rates**, *Ton Vorst*, Erasmus Univ., Dept. of Finance, PO Box 1738, Rotterdam, 3000, The Netherlands, vorst@few.eur.nl

For American options in a stochastic interest rate environment, there are 2 sources of uncertainty. We construct a simple binomial tree for the forward risk adjusted stock price and analytically determine in each node the early exercise values. The method can be extended to other American options on 2 variables.

4) **An Empirical Investigation of Long Memory in the Short Rate & the Yield Curve**, *Kris Jacobs*, McGill Univ., Fac. of Mgmt., 1001 Sherbrooke St. W, Montreal, Quebec, H3A 1G5, Canada, jacobs@management.mcgill.ca, *Jin-Chuan Duan*

We empirically investigate a long memory equilibrium interest rate model. The equilibrium interest rate dynamic is heteroskedastic and interest rates are nonnegative. By deriving the dynamic for the short interest rate in an equilibrium setting, we are able to investigate the presence of long memory in the yield curve.

MA08 Banking

Cluster: Finance
Invited Session

Chair: Paul Fatti, Univ. of the Witwatersrand, Dept. Stats. & Actuarial Sci., PO WITS, Johannesburg, 2050, South Africa, 010lpfs@cosmos.wits.ac.za

1) **OR in Banking: An Overview**, *Paul Fatti*, Univ. of the Witwatersrand, Dept. Stats. & Actuarial Sci., PO WITS, Johannesburg, 2050, South Africa, 010lpfs@cosmos.wits.ac.za

The application of OR in the banking environment has seen a dramatic increase in the past few years. While much of this increase has been in financial risk management and derivatives trading, there is a lot of scope for traditional OR applications in the management and operations of a bank.

2) **The October 1997 Market Move in South Africa**, *Elmarie van Breda*, Standard Corporate & Merchant Bank, PO Box 47, Auckland Park, Johannesburg Gauteng, 2006, South Africa, vanbredae@scmb.co.za

In October 1997 South Africa experienced a market move related to

international moves. We discuss the effect of international players in South Africa, liquidity issues and the use of value at risk measures. We analyze market related data before and during this period to explain institutions' published losses or gains.

3) **Forecasting in Financial Markets, Johannes Dladla**, Transnet, 8 Hillside Rd., Parktown Johannesburg, 2193, South Africa, vsuid@transnet.co.za

Recent developments in financial forecasting, such as cointegration and the Garch & Var models, are applied to forecasting the South African bond markets, equities and currencies. Their performances are compared with those of the more traditional techniques, such as regression and ARIMA modeling.

MA09 Drawing Lessons From Experience

Invited Session

Chair: Shmuel Ellis, Tel Aviv Univ., Recananti Grad. Sch. of Bus., Ramat Aviv, Tel Aviv, 69975, Israel

1) **Team, Individual & Organizational Learning at Two Nuclear Power Plants, John S. Carroll**, MIT, Sloan School of Mgmt., 50 Memorial Dr., Cambridge, MA 02139, jcarroll@mit.edu, **Jenny W. Rudolph, Sachi Takeda, Theodore L. Wiederhold**

High-hazard industries such as nuclear power plants have a variety of mechanisms for identifying problems and making improvements in order to avoid problems that escalate into accidents. One major learning process is to report as many undesirable conditions as possible, classify them by their seriousness and informativeness, investigate them and make recommendations for corrective actions. A study was conducted at 2 nuclear power plants using the 25 most serious incidents reported during the previous 2 years, which were investigated by multidisciplinary teams of 3-9 people. Questionnaires were given to all team members regarding team composition, process, product and plant changes. Manager "customers" and/or "sponsors" of these investigations and corrective actions also answered questionnaires about the team reports and the outcomes of change. The reports themselves are being coded. Finally, a sample survey to all plant personnel will inquire about what they know regarding a subset of the incidents and the sources of their knowledge. Overall, we are looking at how the team learned, how the team members individually learned from their experience on the team and how the organization learned through this activity.

2) **Organizational Learning in High-Hazard Industries: Some Lessons Learned from the Air Transportation Industry, Michal Tamuz**, Univ. of TX, 1200 Herman Pressler, W-230, Sch. of Public Health, Houston, TX 77030, tamuz@utsp.h.uh.itmc.edu

Researchers from high reliability organizations and normal accidents perspectives agree on the importance of organizational learning but disagree on its viability (Sagan, 1993). Drawing on studies of aviation safety ISS, we examine the conditions that influence the capacity for organizational learning in high-hazard industries.

3) **Do Managers Learn From Experience?, Dan Zakay**, Tel-Aviv Univ., Dept. of Psychology, Ramat-Aviv, 69978, Israel, dzakay@ccsg.tau.ac.il

A survey was conducted among Israeli managers representing different types of organizations. They were asked to answer a questionnaire designed to explore how managers learn from outcomes of past decisions. The questionnaire explored all the phases of the learning process, beginning with initiation of the process and ending with the implementation of the lessons learned. A set of questions was designed to explore what heuristics characterize the learning and what methods (if any) are used in order to overcome potential biases, e.g., hindsight. Based on the findings, typical problems which prevent managers from achieving effective learning are defined. Methods for improving the learning process are discussed.

4) **Warnings Heeded: Acquiring & Using Knowledge in Response to Unusual Events, Alfred Marcus**, Univ. of MN, Carlson Sch. of Mgmt., 271 19th Ave. S, Minneapolis, MN 55455, amarcus@csom.umn.edu, **Mary L. Nichols**

Retrospective analysis suggests that paying inadequate attention to what is known contributes to accidents. Organizations don't intentionally neglect what is known but in hindsight, it appears they haven't made sound use of warnings they have, partly due to resource constraints and the way resources have been allocated. We examine the process of acquiring and using knowledge in response to unusual events in a hazardous industry. Our interest is neither in accidents per se nor in high reliable operations, but in conditions of drift within a band of safety that is affected by signals, feedback loops and imperfect watchfulness. Drawing from the resource-based theory of the firm, we examine situations where resource limitations may compromise safety but not result in accidents. We show how resource limitations can be overcome by heeding the warning that unusual events provide. Heeding the warnings depends on capabilities we identify as resilience, exploration, turnover, external search, imposed solutions and leaders as commanders and controllers. A priori, these

capabilities should not be encouraged, but should a facility fall into a threatened position, they are likely to be adopted to prevent further drift. A priori, they should not be encouraged since it is unclear if they accomplish anything more than preventing further drift. They heed the warnings of unusual events but do not necessarily restore the organization to an enhanced safety position. When an organization is firmly entrenched in the band of safety, we find contrasting capabilities such as anticipation, exploitation, inbreeding, internal development, voluntary adoption and leaders as catalysts and facilitators. These findings from a hazardous industry can be extended to other organizations that experience stress and are trying to recover.

MA10 Technology Management I

Sponsor: Technology Management Section
Sponsored Session

Chair: Dundar F. Kocaoglu, Portland State Univ., Eng. Mgmt. Program, Portland, OR 97207-0751, kocaoglu@emp.pdx.edu

1) **Understanding the Differences Between Students & Professionals in a Team-Based Design Process, Robert P. Smith**, Univ. of WA, Dept. of IE, Box 352560, Seattle, WA 98195, smith@ieng.washington.edu

As researchers in engineering design and product development, we are interested in observing and understanding how design occurs. How is the design process employed affected by the skills and knowledge of the people involved? This study demonstrates significant differences between how students and practicing engineers accomplish a team design task.

2) **Project Management: The Next Competitive Weapon, Aaron Shenhar**, Stevens Institute of Tech., Howe School of Tech Mgmt., Castle Point on the Hudson, Hoboken, NJ 07030, ashenhar@stevens-tech.edu, **Dov Dvir, Asher Tishler**

We develop an integrative, strategic approach to project management to exploit project competitiveness. Following our previous contingency studies, we combine 3 dimensions: style, adaptation and learning. Style involves strategy, culture, organization, processes and tools, adaptation concentrates on new contingencies for different projects and learning is addressed at the corporate, project and individual levels.

3) **Modern Software Development Through Outsourcing, Valery Tarasenko**, NTUU, Faculty of Mktg, 37 Peremoga Ave., Bld. 1, Kiev, 252056, Ukraine, val@cad.ntu-kpi.kiev.ua

Rapidly advancing technology places enormous pressure on IT departments to provide the latest skills. Outsourcing is a wise solution that makes the best talent available to a company and saves it from investing too much in talent resources that are likely to change because it allows them to take advantage of usability of quality, productivity and cost advantages.

4) **withdrawn - author request of 5/18, Nathan D. Ainspan**, Cornell Univ., Dept. of HR, Sch. of Ind. & Lbr. Relations, 393 Ives Hall, Ithaca, NY 14853, ndal@cornell.edu, **Theresa Welbourne**

MA11 Production

Invited Session

Chair: Dan Braha, Ben-Gurion Univ., Dept. of IE, PO Box 653, Beer-Sheva, 84105, Israel, brahad@bgumail.bgu.ac.il

1) **Implementation of a Customized Pull System for Aerospace Production, Gary Collison**, Boeing Commercial Aircraft, 5P-03, PO Box 20487, Portland, OR 97294-0487, **Stanley B. Gershwin**

Boeing Portland's 777 Flap Support Business produces complex machined components. The milling machines used are complex, customized machines designed specifically for these products. To regulate production in the presence of high variability, Boeing began implementation of a pull-type production control policy. The original design was completed in March of 1997...

2) **Feeder Assignment Optimization in Placement Machines: A Quadratic Assignment Problem in Printed Circuit Board Assembly, Or Ilhan**, Bogazici Univ., IE Dept., Bebek, Istanbul, 80815, Turkey, **Atik Koksak**

There are many heuristic solution procedures with comparable, good performance records (on randomly generated data) for the NP-hard QAP. In general, the performance of these procedures depends on problem parameters, while in most QAP implementations in manufacturing environments, problem data carries certain structure. Feeder configuration and operations sequencing in automated component placement machines are considered...

3) **Extensions of Pull Production Control Mechanisms in Multi-Stage Manufacturing Systems, George J. Liberopoulos**, Univ. of Thessaly, Dept. of Mech. & IE, Pedion Areos, Volos, GR-38334, Greece, glib@uth.gr, **Yves P. Dallery**

We study extensions of pull production control mechanisms to manufacturing systems with several production stages forming assembly/disassembly networks, producing multiple part types, involving reworking and scrapping of parts and batching of parts and demands.

4) A Dynamic Programming Scheme for Design-of-Experiments Under Imperfect State Information, *Irada Ben-Gal*, Boston Univ., Dept. of Mfg. Eng., 15 St. Mary's St., Boston, MA 02215, *Michael Caramanis*

We consider a sequential design-of-experiments scheme. The objective is to maximize certain information measures over a feasible set of sequential experiments. We develop optimal sequential design-of-experiments strategies using concepts from IT, mainly entropy, mutual information and error correcting codes and employ the methods of stochastic DP under imperfect state information.

5) Neural Network-Based Adaptive Production Control of FMS in Random Environments, *Lior Iaroslavitz*, Tel Aviv Univ., Dept. of IE, Tel Aviv, Israel, *Yohanan Arzi*

We deal with the real-time production control of FMSs operating in a highly variable produce-to-order environment. Since the use of a single scheduling rule at all times does not take into consideration the current state of the system, the proposed production control system suggests that at the beginning of every scheduling period, the most appropriate scheduling rule should be chosen based on the state of the system.

MA12 Optimization I

Contributed Session

Chair: Julian M. Benjamin, NC A&T State Univ., Dept. of Econ. & Logistics, Greensboro, NC 27408-6742, benjamin@ncat.edu

1) Convergence of Truncated Conjugate Gradient Methods for Solving Nonsymmetric Linear Systems, *Ubaldo M. Garcia-Palomares*, Univ. Simon Bolivar, Dept. Procesos y Sistemas, Apartado 89000, Caracas, 1081-A, Venezuela, garciap@usb.ve

CGs are the paradigm of nonsymmetric linear systems. We prove that truncated CGs, that is, conjugate gradients with fewer number of iterations than the dimension of the problem, converge to a solution of the system. Furthermore, convergence still holds if the system is split in several blocks and CGs are simultaneously applied to each block. Encouraging numerical tests are reported.

2) Relaxation-Based Methods for Hierarchical Covering Location Problems, *Roberto D. Galvao*, COPPE/Federal Univ. Rio de Janeiro, CP 68507, Rio de Janeiro, 21945-970, Brazil, galvao@pep.ufrj.br, *T. Brian Boffey*, *Virgilio J.M.F. Filho*

We develop Lagrangean and surrogate relaxation-based methods for a hierarchical covering location problem formulated by Moore & ReVelle in 1982. This is a 2-level model; the lower level facilities provide only a level-1 service, whereas the higher level facilities provide both level-2 and level-1 service.

3) Forecasting Ridership for a Van Service, *Julian M. Benjamin*, NC A&T State Univ., Dept. of Econ. & Logistics, Greensboro, NC 27408-6742, benjamin@ncat.edu, *Ryoichi Sakano*

For an elderly and disabled van service, a discrete choice model forecasts ridership. Aggregate ridership is estimated by micro-simulation, total enumeration and an aggregate function. A unique queueing model forecasts expected demand for different service levels specifically considering the inter-dependence of supply and demand.

MA13 Generalized Convexity & Monotonicity I

Cluster: Heuristic Programming & Applications

Invited Session

Chair: Siegfried Schaible, Univ. of CA, Grad. Sch. of Mgmt., Riverside, CA 92521-0203, schaible@ucr.edu

1) Convexity of Indirect Utility Functions, *Juan-Enrique Martinez-Legaz*, Univ. Autonoma de Barcelona, Dept. D'Economia/Hist. Econ., Bellaterra, 08193, Spain, jemartinez@volcano.uab.es

The class of utility functions inducing convex indirect utility functions is characterized by means of a generalized convexity property. A set of elementary functions generating the whole class is presented. Some relations between this characterization and the Mitjushin-Polterovich conditions for the monotonicity of demand functions are discussed.

2) Optimization via Composite Linearization, *Moshe Sniedovich*, Univ. of Melbourne, Dept. of Math. & Stats., Parkville, Victoria, 3052, Australia, moshe@ms.unimelb.edu.au, *Leonid Churilov*

We examine the important role that generalized convexity plays in (global) optimization of composite objective functions via (composite) linearization. We

show that composite linearization provides a very effective framework for collaboration between global, classic and combinatorial optimization methods. We will focus on fractional, multiplicative and DC programming problems.

3) withdrawn - author request of 5/14, *Igor A. Bykadorov*, Novosibirsk State Univ., Russian Acad. of Sci, Sobolev inst for Math, Novosibirsk 90, 630090, Russia, bykad@math.nsc.ru

MA14 Development & Analysis of Algorithms for Combinatorial Problems

Invited Session

Chair: David Simchi-Levi, Northwestern Univ., Dept. of IE & Mgmt. Services, 2225 N Campus Dr., Evanston, IL 60208-3119, levi@iems.nwu.edu

1) Dependent Randomized Rounding Algorithms, *Dimitris Bertsimas*, MIT, Sloan School of Management, E53-359, Cambridge, MA 02139, *Teo Chung Piao*

We describe the application of randomized rounding algorithms to derive approximation algorithms for a variety of optimization problems. The examples to be discussed are the non-stationary joint replenishment problem and a break bulk routing problem.

2) Probabilistic Analysis of Flow Shop Problems, *Philip Kaminsky*, Univ. of California, Dept. of IEOR, 4135 Etcheverry Hall, Berkeley, CA 94720-1777, *David Simchi-Levi*

We present a characterization of the asymptotic optimal solution value of the classic flow shop scheduling problem when the objective is to minimize mean flow time.

3) General-Purpose Algorithms & Systems for Combinatorial Optimization, *Robert Fourer*, Northwestern Univ., Dept. of IE/MS, 2225 N Campus Dr., Evanston, IL 60208-3119, 4er@iems.nwu.edu, *Collette R. Coullard*, *Jonathan H. Owen*

General-purpose modeling systems have had little impact on combinatorial optimization outside of IP, but recent developments in logic programming algorithms and object-oriented system design are changing this situation. We describe 2 approaches from our current research, one employing an algebraic modeling language and the other a "toolkit" for network optimization.

MA15 Fluid Methods in Control of Queueing Networks & Scheduling

Cluster: Applied Probability

Invited Session

Chair: Gideon Weiss, Univ. of Haifa, Dept. of Stats., Haifa, 31905, Israel, gweiss@stat.haifa.ac.il

1) Value Iteration & Network Optimization, *Sean P. Meyn*, Univ. of IL, Dept. of Elec. & Comp. Eng., Coordinated Sci. Lab., Urbana, IL 61801

The value iteration algorithm is convergent for the multiclass queueing network control problem, provided that the algorithm is initialized with a stochastic Lyapunov function. Two choices are considered: the quadratic test function constructed using the LP of Kumar & Meyn, and the value function for an associated fluid network model. We found that either choice leads to a significant improvement in the speed of convergence of the algorithm.

2) Optimal Control of Some Fluid Models, *Ulrich Rieder*, Univ. of Ulm, Ulm, D-89069, Germany, *Nicole Baeuerle*

We propose an optimal control approach to the optimization of deterministic and stochastic fluid models of several queueing networks. We aim to derive structural results for optimal policies. In particular, we state sufficient conditions for the existence of optimal index policies for single-server fluid networks. For parallel servers, we show that optimal routing policies are of switching type. Results are compared with analogous results in stochastic networks.

3) Call Admission Control: Optimal Policies & Fluid Models, *Ger M. Koole*, Vrije Univ. - Amsterdam, Fac. of Math. & Comp., de Boelelaan 1081A, Amsterdam, 1081 HV, The Netherlands, *Eitan Altman*, *Tania Jimenez*

Call admission control of multiple classes to a group of servers without waiting room is considered. For the original model, several structural results are derived, using DP. Then, its fluid model is formulated, and again the optimal control is studied. Our results are illustrated with some numerical examples.

4) withdrawn - author request of 4/16, *Gideon Weiss*, Univ. of Haifa, Dept. of Stats., Haifa, 31905, Israel, gweiss@stat.haifa.ac.il

MA16 Statistical Analysis of Operational Robotic Phenomena**Invited Session**

Chair: Abraham Mehrez, Ben-Gurion Univ. of the Negev, Dept. of IE&M, POB 653, Beer-Sheva, 84105, Israel

1) A Statistical-Economic Framework for Evaluating the Effect of Robot Repeatability on Profit, Abraham Mehrez, Ben-Gurion Univ. of the Negev, Dept. of IE&M, POB 653, Beer-Sheva, 84105, Israel, O. Felix Offodile

This presentation is a statistical-economic model for evaluating robot precision as measured by its positional repeatability. The model formulated assumes that repeatability follows a Rayleigh distribution. An economic measure maximizing the expected profit per unit time is developed, leading to an optimal velocity solution for a given task. Additional properties of the solution and sensitivity analyses are also provided. Finally, the model is validated by an empirical study of a simulated multi-station assembly operation with a PUMA robot that meets a random set of task requirements.

2) Performance Measurement of Robotic Systems, Yael Edan, Ben-Gurion Univ. of Negev, Dept. of IE&M, Beer-Sheva, Israel, Lea Friedman, Abraham Mehrez, Leonid Slutski

A 3-dimensional statistical evaluation framework for performance measurement of robotic systems has been developed. A specific experimental setup has been designed, implemented and evaluated for different robot characteristics, i.e., velocities and target locations, and for a specific task. A statistical analysis method to evaluate performance is demonstrated. Results indicate the significance of this methodology since the capabilities and performance of a particular robot depend on actual operating conditions.

3) Study of Control Tools for Telerobotic Operations, Yael Edan, Ben-Gurion Univ. of Negev, Dept. of IE&M, Beer-Sheva, Israel, Lea Friedman, Leonid Slutski

We present experimental results of a study evaluating different control tools for telerobotic operations. A new control algorithm using adaptive coordinate parameter control was implemented for a simple industrial task (moving the robot from one point to another as fast as possible within a prescribed accuracy). Experiments were conducted to determine the optimal gain factor for the adaptive algorithms. Performance of the adaptive control algorithm was compared to position and velocity control for different accuracies and target distance. In addition, 2 ergonomic tools, mouse and joystick, were compared. Experimental results will be presented.

MA17 Asymptotic Behavior of Queues**Cluster: Queues****Invited Session**

Chair: Neil O'Connell, BRIMS, HP Labs, Filton Rd., Stoke Gifford, Bristol, BS12 6QZ, UK, noc@hplb.hpl.hp.co

1) Large Deviations in Stochastic Discrete Event Systems, Fergal W. Toomey, Dublin Inst. for Advanced Studies, Sch. of Theoretical Physics, 10 Burlington Rd., Dublin, 4, Ireland, toomey@stp.dias.ie

A discrete event system is a dynamic system whose evolution over time can be described efficiently in terms of a sequence of discrete events; thus, traditional queuing and Petri networks are examples of discrete event systems. We use what has become known as the algebraic approach to the modeling of stochastic first-order recursive equations involving random operators of a certain class.

2) Fixed Points for Queues..., Balaji Prabhakar, MIT, Lab. for Info. & Dec. Systems, 77 Mass Ave., Rm. 35-205, Cambridge, MA 02139

The well-known theorem of Burke states that if a Poisson process of rate $\lambda < 1$ is input to an exponential-server queue of service rate 1, then the output from the queue is a rate λ Poisson process. In this sense, the Poisson process is a "fixed point" for an exponential-server queue. We consider a general/GI/1 queue whose mean service time equals 1.

3) ...And Their Large Deviations Behaviour, Neil O'Connell, BRIMS, HP Labs, Filton Rd., Stoke Gifford, Bristol, BS12 6QZ, UK, noc@hplb.hpl.hp.co

In the previous talk it was shown that if the service time in a /GI/1 queue has mean 1 and satisfies the condition $[E(S^2 \log + S\{2+a\}) < \infty]$ for some $a > 0$, then for every $\lambda < 1$, a unique, stationary, rate λ fixed point exists. So fixed points exist, but what can we say about them? We present a large deviation principle for each rate λ fixed point and give an explicit formula for the rate function...

4) Analysis of the Asymptotic Behavior of Some 2-Queue Systems, Neil O'Connell, BRIMS, HP Labs, Filton Rd., Stoke Gifford, Bristol, BS12 6QZ, UK, noc@hplb.hpl.hp.co

We obtain analytic expressions for the asymptotic probability of buffer overflows for "serve the longer queue" and "exhaustive polling" systems with asymmetric exponential service rates, using large deviation theory. We compare discrete time models to continuous time models and, for a more realistic model, add a "switching cost."

5) Large Deviations Asymptotics For Some Two Queue Systems, Remi Mennesson, Technion, Electrical Eng., Haifa, 32000, Israel, remi@technion.technion.ac.il

We obtain analytic expressions for the asymptotic probability of buffer overflows for "serve the longer queue" and "exhaustive polling" systems with asymmetric exponential service rates, using large deviation theory. We compare discrete time models to continuous time models and, for a more realistic model, add a "switching cost."

MA18 Preference Modeling & Applications**Cluster: Choice Engineering****Invited Session**

Chair: Jonathan Barzilai, Dalhousie Univ., Dept. of IE, Sexton Campus, PO Box 1000, Halifax, Nova Scotia, B3J 2X4, Canada, barzilai@tuns.ca

1) Decision Issues in Forest Ecosystem Management, Eldon Archibald Gunn, DalTech, Dept. of IE, Halifax, Nova Scotia, B3J 2X4, Canada, gunnea@tuns.ca

Forest management has always posed strong challenges to DA. As foresters increasingly are charged with the maintenance of both terrestrial and aquatic environment, and with the recognition of the role of the forest in providing recreation and other non-timer values to society, these decision problems intensify. We review some decision problems identified with forest management community...

2) Scales for Ratio Measurement, Bertram Schoner, Simon Fraser Univ., Faculty of Bus. Admin., Burnaby, BC, V5A 1S6, Canada, schoner@sfu.ca

We discuss alternatives to the traditional paired comparison scales for ratio measurement of the value of alternatives in MCDM problems. Both numerical and graphical methods are presented.

3) Preference Function Modeling: A New MCDA Methodology, Jonathan Barzilai, Dalhousie Univ., Dept. of IE, Sexton Campus, PO Box 1000, Halifax, Nova Scotia, B3J 2X4, Canada, barzilai@tuns.ca

We present a new methodology for MCDA under certainty, PFM. PFM does not utilize the non-intuitive concepts of subjective probabilities and indifference between hypothetical lotteries. The methodology is built on sound theoretical foundations, is intuitive, easy to use and widely applicable.

4) Ellsberg Re-Visited: Modeling the Effects of Vagueness on Risky Choice, David V. Budescu, Univ. of IL, Dept. of Psychology, 603 E Daniel St., Urbana, IL 61820, dbudescu@s.psych.uiuc.edu

Numerous studies have confirmed Ellsberg's prediction (1961) that precise prospects are preferred to prospects with vague (imprecisely specified) probabilities. I describe a series of studies in which this "aversion to vagueness" effect is generalized to prospects with vague outcomes and propose a descriptive model consistent with this pattern of preferences.

MA19 Transshipments & Substitutions**Sponsor: Section on Logistics****Sponsored Session**

Chair: Yale T. Herer, Tel-Aviv Univ., Fac. of Eng., Dept. of IE, Ramat Aviv, 69978, Israel, yale@eng.tau.ac.il

1) Stochastic Modeling of Supply Chain Management in the Oil Industry, M. A. H. Dempster, Univ. of Cambridge, Judge Inst. of Mgmt., Trumpington St., Cambridge, CB2 1AG, UK, mahd2@cam.ac.uk

We will describe the initial design of, and prototypes for, a model-based DSS for oil supply production and distribution strategic planning. The problem involves a consortium of operators sharing common network infrastructures in which transshipment decisions and substitution of purchased resources exterior to the network are key...

2) Random Yield & Random Demand in Production Systems with Downward Substitution, Yehuda Bassok, Univ. of WA, Dept. of MS, Seattle, WA 981959, yehuda@u.washington.edu

We present 2 multi-product downward substitution problems. In the first, we assume N products with random demands. The second model assumes one input and N output grades. The output of each grade as well as the demands are random. We show that the problems can be solved, optimally, by a greedy

algorithm.

3) **The Dynamic Transshipment Problem**, *Yale T. Herer*, Tel-Aviv Univ., Fac. of Eng., Dept. of IE, Ramat Aviv, 69978, Israel, yale@eng.tau.ac.il, *Michal Tzur*

We investigate the issue of transshipments for the first time in a dynamic deterministic demand environment. We provide interesting structural properties of optimal policies and explore all reasons for using transshipments. Based on this structure, we develop exact algorithms to solve the problem and identify when its complexity is polynomial.

4) **Assortment Problem with an Application**, *Ashish Tripathy*, USAir, 2345 Crystal Dr., Crystal Park 4, DCA/H700, Arlington, VA 22227, *Haldun Sural*, *Yigal Gerchak*

The assortment problem seeks stocking policies for items that are related through substitution. We model its discrete multi-dimensional version as a location problem and apply the dual descent procedure to solve it. Computational results are given for test problems and the real data provided by a company.

MA20 New Product Development & Commercialization Invited Session

Chair: *Koty Lapid*, Hungarian Academy, PO Box 3317, Beer Sheva, Israel, kolap@magnet.hu

1) **Leading & Leapfrogging Innovation Communities: Technological Innovation in the Early US & Japanese Semiconductor Industries**, *Leonard Lynn*, Case Western Reserve Univ., Weatherhead Sch. of Mgmt., Cleveland, OH

We draw on newly available documentary sources on technological innovation in the Japanese and US semiconductor industries from 1947 to 1977. Special attention is given the commercialization of the transistor radio and IC calculator. We explore how the Japanese industry overcame strong US technological leads in both these technologies to dominate world markets. A theoretical framework developed by the author and colleagues is used to organize the comparison and facilitate the derivation of conclusions relevant to both theory and policy.

2) **Commonalities in Reengineered Business Processes: How Far Can a Company Move Away from Principles of Division of Management & Labor?**, *Koty Lapid*, Hungarian Academy, PO Box 3317, Beer Sheva, Israel, kolap@magnet.hu

Reengineering advocates moving away from systems employing the principles of division of management and labor. In reality, quite a few companies had kept traditional organizational structures and focused on using continuous improvement. We discuss some important points of the 2 approaches.

3) **Putting Information Technology into Practice: A Case Study of Implementation-Cooperation**, *Yoram Yordan*, Sharit Tech. Ltd.

We describe the implementation-cooperation between 2 companies, the US and Israel. Cross-functional teams solve enterprise-wide problems using concepts and methods of technology management.

Monday 10:30-11:45

MO21 Opening Session

Chair: To be announced

1) **Plenary: The Impact of Globalization on Management Science**, *Yair Aharoni*, Tel Aviv Univ., Recanati Grad. Sch. Bus. Admin, Tel Aviv, 69978, Israel

A fundamental issue in MS is the generality of what we know. Much of what has been developed in the quest to create knowledge and rules turned out to be country specific or limited to certain culture. Globalization means that rival firms compete against each other on a worldwide basis and domestic industries have linkages across countries. The issue addressed here is the degree to which globalization reduces the variance across national settings. In other words, is MS becoming more universal, and if not, what are the variables that are becoming globally valid and what practices are now transferred across cultural boundaries? Specifically, we discuss the impact of globalization on the theory of multinational enterprise; on the theory of gains from international diversification, we analyze whether these gains are reduced by globalization. We discuss also the changes called for in the theory of services that have become tradable as a result of technological changes.

Monday 13:00-14:00

MS02 **Invited Tutorial: What Can the World Wide Web do for You?!**

Invited Session

Chair: *Moshe Sniedovich*, Univ. of Melbourne, Dept. of Math. & Stats., Parkville, Victoria, 3052, Australia, moshe@ms.unimelb.edu.au

1) **Invited Tutorial: What Can the WWW Do For You?!**, *Moshe Sniedovich*, Univ. of Melbourne, Dept. of Math. & Stats., Parkville, Victoria, 3052, Australia, moshe@ms.unimelb.edu.au

We shall explore the WWW from the viewpoint of OR/MS. We will examine the facilities that WWW technologies provide for teaching/learning/practicing OR/MS and the resources that they require. The exposition will be as non-technical as possible and no prior experience/background in this area will be assumed.

MS04 Keynote: Teletraffic Theory for CDMA Cellular Systems

Invited Session

Chair: *Philip J. Fleming*, Motorola, Inc., 1501 W Shure Dr., Arlington Hts, IL 60004, fleming@cig.mot.com

1) **Keynote: Teletraffic Theory for Code Division Multiple Access Cellular Systems**, *Philip J. Fleming*, Motorola, Inc., 1501 W Shure Dr., Arlington Hts, IL 60004, fleming@cig.mot.com

The combination of a number of technologies including radio propagation, macro diversity, digital communications, variable rate speech coding, packet data networking and distributed power control make teletraffic analysis of CDMA cellular telephone systems a unique challenge to teletraffic analysts. We will survey some of the tools and techniques used to model the capacity of such systems.

MS09 Keynote: A Survey of Control Mechanics for Multi-Echelon Supply Chains - Implications for Product Design

Invited Session

Chair: *Awi Federgruen*, Columbia Univ., Graduate School of Business, 419 Uris Hall, New York, NY 10027

1) **Keynote: A Survey of Control Mechanics for Multi-Echelon Supply Chains - Implications for Product Design**, *Awi Federgruen*, Columbia Univ., Graduate School of Business, 419 Uris Hall, New York, NY 10027

No abstract supplied.

MS13 Keynote: The Use of Relaxations Stronger than Linear Programming for Approximation Algorithms

Invited Session

Chair: *Dorit S. Hochbaum*, Univ. of CA, Sch. of Bus., 350 Barrows Hall, Berkeley, CA 94720

1) **Keynote: The Use of Relaxations Stronger than Linear Programming for Approximation Algorithms**, *Dorit S. Hochbaum*, Univ. of CA, Sch. of Bus., 350 Barrows Hall, Berkeley, CA 94720

We discuss the use of relaxations for the design of an approximation algorithm for intractable problems and introduce a novel framework of relaxations which is particularly powerful. The power of the approach is in the strength of the bounds generated and in the efficiency of the algorithms derived. Numerous applications of the technique will be discussed.

MS15 Keynote: Optimal Solutions - Dream & Reality

Invited Session

Chair: *Aharon Ben-Tal*, Technion Israel Inst. of Tech., Faculty of IE & Mgmt., Haifa, 32000, Israel

Co-Chair: *Arkadi Nemirovsky*

1) **Keynote: Optimal Solutions - Dream & Reality**, *Aharon Ben-Tal*, Technion Israel Inst. of Tech., Faculty of IE & Mgmt., Haifa, 32000, Israel, *Arkadi Nemirovsky*

A solution of an optimization problem, even when input accurately, may in fact be totally unacceptable due to inaccurate implementation or due to data uncertainty. We illustrate these phenomena by 2 engineering design problems: truss design and antenna synthesis. We then present a new methodology - robust optimization, aimed at producing optimal solutions which are stable with respect to data uncertainty. In particular, we derive robust counterparts of LPs, quadratic and cone-quadratic programs and semi-definite programming problems.

MS16 Keynote: Implicit Valuation of a Blood Exclusion Decision**Invited Session**

Chair: Edward H. Kaplan, Yale Univ., Sch. of Mgmt., Box 208200, New Haven, CT 06520-8200, edward.kaplan@yale.edu

1) Keynote: Implicit Valuation of a Blood Exclusion Decision, Edward H. Kaplan, Yale Univ., Sch. of Mgmt., Box 208200, New Haven, CT 06520-8200, edward.kaplan@yale.edu

We present an implicit valuation of Israel's decision to exclude blood donations from Ethiopian immigrants. The approach adopts assumptions that deliberately overstate the public health effectiveness of this policy, for if such an analysis fails to justify exclusion on public health grounds, nothing will. Following a review of the controversy surrounding this policy, we discuss estimates of recent HIV incidence in Israel and use these to create (over) estimates of HIV incidence among potential blood donors. We then report a model for determining the probability that an antibody-negative donation is potentially infectious, and (over) estimate this risk for Ethiopian and non-Ethiopian Israeli donors. Considering the observed mix of these 2 donor pools, we argue that the exclusion policy reduced the total expected annual number of infectious donations by (at most) 0.10. We then conduct an implicit cost-benefit analysis and show that under these reasonable assumptions, the exclusion policy is not justifiable if the social costs of exclusion exceed \$150,000 per year, or \$2.50 per Ethiopian immigrant annually.

MS18 Invited Tutorial: Statistical Inference About Risk**Invited Session**

Chair: Wilfried Seidel, Univ. der Bundeswehr Hamburg, Fachbereich Wirtschafts & Org., Hamburg, 22039, Germany, w_sever@unibw-hamburg.de

1) Tutorial: Statistical Inference about Risk, Karl C. Mosler, Univ. of Koeln, Wirtschafts-Und Sozialstat., albertus-Magnus-Platz, Koeln, D-50923, Germany, mosler@wiso.uni-koeln.de

This tutorial introduces statistical methods for comparing alternatives with respect to risk. It starts with parametric procedures to compare, e.g., variances, then recent non-parametric tests for stochastic dominance (first and second degree) are surveyed. The cases of censored and dependent observations are discussed and reference to software is given.

MS19 Logistics: A New Teaching Approach**Sponsor: Section on Logistics****Sponsored Session**

Chair: Avraham Shtub, Tel Aviv Univ., Dept. of IE, Ramat Aviv, Tel Aviv, 69978, Israel, shtub@eng.tau.ac.il

1) Logistics: A New Teaching Approach, Avraham Shtub, Tel Aviv Univ., Dept. of IE, Ramat Aviv, Tel Aviv, 69978, Israel, shtub@eng.tau.ac.il

We present a modern tool for teaching logistics, which is based on role playing. Each participant takes on a separate role in managing a simulated logistics system. By tackling problems, the participants learn to coordinate the different functions in the system and to focus on the most important problems.

Monday 14:00-15:30**MC01 MCDM & the Environment****Cluster: MCDM****Invited Session**

Chair: Marjan Van Herwijnen, Free Univ., Inst. for Environ. Studies, De Boelelaan 1081, Amsterdam, 1081 HV, The Netherlands, marjan@ivm.vu.nl

1) Cleaning the Soil of a Residential Area: An MCDM Application, Joonas Hokkanen, Paavo Ristola Ltd., Vainonkatu 6, Jyväskylä, FIN 40100, Finland, Pekka Salminen, Risto Lahdelma

We describe a real application of our multicriteria technique SMAA-2 in the context of technology competition arranged for cleaning the soil of a planned residential area in Helsinki. However, due to the earlier use of the area, its soil and ground water have to be cleaned. Therefore, a competition was started in order to develop the know-how of dealing with polluted soil. The competitors were evaluated based on 6 criteria defined by the Competition Board.

2) Evaluation Methods in Land Development Projects, Hubert N. van Lier, Wageningen Agr. Univ., Dept. of Env. Sci., Gen. Foulkesweg 13, Wageningen, 6703 BJ, The Netherlands, huub.vanlier@ctt.rpv.wau.nl

Evaluation methods in LDPs in Holland in the past and in the future are

discussed. Evaluation methods are seen as part of policy and planning methods. The increased use of multicriteria methods in the past to determine urgencies and to improve plans, HELP-system, is documented. Furthermore, recent approaches embedded in DSSs, BEL-system, are described.

3) Structuring Small Farmer's Goals in a River Micro Basin Development Program, Elio Holz, Campus Universitario, EPS CP 476 Trindade, Florianopolis, SC, 88040-9700, Brazil, Leonardo Ensslin

In Santa Catarina State, Brazil, a governmental river micro basin development program is taking place. Research was done to highlight the most important criteria that represent farmers private goals in the farming business. Tradeoffs between them and environmental impacts were established. We will show how the model was structured using a constructivist multicriteria decision aid approach.

4) Multicriteria Decision Making for Spatial Environmental Problems, Marjan Van Herwijnen, Free Univ., Inst. for Environ. Studies, de Boelelaan 1081, Amsterdam, 1081 HV, The Netherlands, marjan@ivm.vu.nl, Ron Janssen

In environmental management, the performance of policy alternatives is often represented as maps. The decision maker is asked to use these maps to compare alternatives and ultimately to select the one preferred. To support their decisions, multicriteria decision methods combined with spatial analysis are implemented in a spatial DSS.

MC02 Marketing Technology Practice**Cluster: Enterprise Technology****Invited Session**

Chair: Leon Schwartz, Pitney Bowes Inc., MSC 5003, 1 Elmcroft Rd., Stamford, CT 06296

1) The Interbusiness Marketing Technology Data Warehouse, Leon Schwartz, Pitney Bowes Inc., MSC 5003, 1 Elmcroft Rd., Stamford, CT 06296

The IMT database brings together key customer data across all Pitney Bowes business units to create a unified picture of the total customer relationship for some 3 million customer accounts at almost 2 million locations. The process includes complicated name and address matching. Data cleansing takes place before the database load. Updating is a lengthy, tricky process that requires much care. So, with all the work that still needs to be done, does this warehouse approach to data really make a difference? Absolutely! First, we can respond much more quickly when we receive a request. Secondly, we can deliver a view of the customer that does not exist anywhere else in the company.

2) Successful Application of Personal Modeling Tools for Marketing Managers, Gary L. Lilien, PA State Univ., 402 BAB, University Park, PA 16802, G5L@psu.edu

Marketing engineering, using decision models to make marketing decisions, has traditionally been restricted in its application to a few highly trained experts. But in this age of powerful desktop computers and minimal corporate staff, these tools are needed by front line managers to develop quick and dirty solutions. We demonstrate an integrated set of computer tools aimed at addressing this problem and provide several case studies of successful use of these tools in time-sensitive business situations. We show that the tools provide both quantitative guidance as well as important qualitative insight that enhances marketing decision making.

3) Database Marketing: The New Wave of One-to-One Marketing, Samuel Koslowsky, Harte Hanks, New York, NY, koslowsky@harte-hanks.com

Database marketing has become a critical element in a firm's overall marketing mix. We define precisely what this new direction is, what major firms are doing with it and various strategies being employed to drive successful programs. Special emphasis will be given to direct marketing modeling and how this technology has become a significant ingredient for database marketers.

MC03 From Networks to Networking: Dynamic Views of Interorganizational Relationships**Sponsor: College on Organization Science****Sponsored Session**

Chair: Joseph Lampel, St. Andrews Univ., Dept. of Mgmt., St. Katherine W, The Scores, Scotland, KY16 9AL, UK, jl10@st-andrews.ac.uk

1) Metaphors for Networks: Emergence, Structures & Outcomes, Amalya Oliver, Hebrew Univ. of Jerusalem, Dept. of Sociology/Anthrop., Mt. Scopus Jerusalem, 91905, Israel, amalyao@cc.huji.ac.il

The use of the concept of networks overgeneralizes a wide variety of metaphors

network members hold over the emergence, structure and outcome of their own (micro level) networks and organizational (macro level) networks. We will untangle some of the perceptions, the assumptions they are based on and discuss their possible outcomes.

2) Inter-Organizational Network Dynamics: Partner Signaling & Selection, Candace Jones, Boston College, Org. Studies Dept., Carroll Sch. of Mgmt., Chestnut Hill, MA 02167, jonescq@bc.edu

Most research on network and multi-partner alliances has focused on either motivations for entering into or mechanisms for managing networks. However, network formation and evolution cannot be understood without insight into how and why network members choose one another. Yet, there is little research on how partners signal their interest and credentials for participating in networks, how partners select one another and what criteria these selections are based upon. Drawing on literatures from the sociology, economics and organization theory, I develop a conceptual framework for how partners signal and select one another and how these processes influence network formation and evolution. The framework argues that partners signal and select one another on the basis of status perception, homophile on key attributes, reputation generated from third party interactions and experience generated from prior interaction with same party.

3) From the Foreign to the Creation of Something (Almost) Familiar: How Social Networks Can Shed Light on Working Cultures that Emerge in..., Jane Salk, Groupe Essec, BP 105, Cergy-Pontoise Cedex, 95021, France, salk@edu.essec.fr

Dual heritages of corporate and national origin cultural differences make alliance teams prone to problems of poor integration, conflict and misunderstanding. Corporate and national identity differences imported by individuals into such a team affect the creation of a new team-specific social order. Ongoing social interactions are a powerful vehicle for the creation of shared norms and beliefs. However, such shared norms and beliefs are a function of country and company origins, task environment and who chooses to interact with whom. We explore the empirical problems of distinguishing between the roles of culture, structure and context in determining the integration of such teams. I will discuss the research design and present results from initial empirical work using network methods.

4) Networks & Metacapabilities: The Formation of Virtual Organizations in Project-Based Industries, Joseph Lampel, St. Andrews Univ., Dept. of Mgmt., St. Katherine W, The Scores, Scotland, KY16 9AL, UK, j110@st-andrews.ac.uk

Project-based industries such as movies, construction engineering and aerospace constitute a complex ecology of firms with multiple capabilities. These are combined and recombined by networks for specific projects. Projects represent virtual organizations each with its own mission, structure and life-cycle. The strategic advantage of firms in the sector depends on developing metacapabilities for transforming networks into virtual organizations. We explore the concept of relational metacapabilities within the framework of learning and resource base theories of the firm. The problems of developing and transferring these capabilities is discussed using a variety of empirical examples from project-based industries.

MC04 Telecommunication Network Routing & Design Modeling

Cluster: Telecommunications Network Modeling & Optimization
Invited Session

Chair: Young Lee, AT&T, 101 Crawfords Corner Rd., Rm. 3C-508A, Holmdel, NJ 07733, younglee@ems.att.com

1) ATM Network Bandwidth Configuration Under PNNI Framework, Anurag Maunder, AT&T Labs., 101 Crawfords Corner Rd., Rm. 3C-527, Holmdel, NJ 07733

An important problem associated with ATM networks is to design virtual paths to provide adequate quality of service and to reduce signalling without deteriorating the network performance. The PNNI framework suggested by the ATM forum allows the virtual path configuration but is quite message intensive. We attempt to configure the ATM network under PNNI framework and study various tradeoffs.

2) withdrawn - author request of 5/18, Yunhee Jang, AT&T Labs., 101 Crawfords Corner Rd., Rm. 3B-538, Holmdel, NJ 07733

3) End-to-End Dynamic Routing Schemes for Multi-Destination Traffic Networks, Young Lee, AT&T, 101 Crawfords Corner Rd., Rm. 3C-508A, Holmdel, NJ 07733, younglee@ems.att.com

We present an end-to-end state-dependent dynamic routing strategy in circuit-switched networks with multi-destination traffic. Multi-destination traffic is referred to as a traffic type with multiple destinations such that the traffic can be routed to any one of the multiple destinations. In selecting the destination, the routing strategy employs real-time link load status information of both the backbone and the destination links to determine the least loaded route for each

call that arrives at a switch.

4) Link Scheduling Policies for Stable Load Distribution in Multiprocessor Systems, Muralidharan S. Kodialam, Bell Labs., Lucent Technologies, 101 Crawfords Corner Rd., Holmdel, NJ 07733

We derive necessary and sufficient conditions for the existence of stable link scheduling schemes in multiprocessor systems where the processors as well as the transport links are constrained resources. We show that the space of achievable system throughputs for a general class of policies can be described by a polymatroid polyhedron. Though the polyhedron has an exponential number of constraints, we develop efficient algorithms to check for membership in this polyhedron, determine if there exists a stable link scheduling policy and determine a stable policy if one exists.

MC05 Network Traffic Issues

Cluster: Operations Research in Telecommunications
Invited Session

Chair: M. Mateescu, GMD-FOKUS, Germany, mateescu@fokus.gmd.de

1) Internet Routing: The Efficiency of Pragmatism, M. Smirnov, GMD FOKUS, Berlin, Germany

Connectionless best effort communication service as provided by the Internet relies mainly on the routing capabilities of the Internet gateways. Existing routing is highly diverse in the sense of both paradigms and particular routing protocols. Collaboration of diverse routing protocols is a challenging task and Internet seems to cope with this challenge, sometimes based on good mathematics behind the protocol, sometimes based on ad hoc heuristics. We will overview the above diversity (unicast and multicast routing, intra- and inter-domain, hop-by-hop and peer, etc.) and will investigate the emerging routing paradigms such as QoS-based routing and multi-protocol label switching. Almost all new next generation Internet projects rely on ATM technology at their backbone level and the ATM imposes a new dimension of complexity with regard to the optimal P routing over ATM: shortcut management. The problem will be investigated from both multicast and QoS viewpoints.

2) Application & Evaluation of Large Deviation Techniques for Traffic Engineering in Broadband Networks, Costas Courcoubetis, University of Crete, ICS-FORTH, Crete, Greece, courcou@ics.forth.gr

No abstract supplied.

MC06 Managerial Attention

Sponsor: College on Organization Science
Sponsored Session

Chair: Alan B. Eisner, Pace Univ., Lubin Sch. of Bus., 861 Bedford Rd., Pleasantville, NY 10570, eisner@pace.edu

1) Effects of Environmental Change on Executive Attention: Analysis of Auto Industry Letters to Shareholders, 1963-87, Steve Freeman, MIT, Sloan Sch. of Mgmt., 50 Memorial Dr., Cambridge, MA 02139, sff@mit.edu

I develop constructs of organizational attention based on themes and actions reported in American automaker letters to shareholders. Findings suggest long response lags to emerging Japanese preeminence and an attention structure rooted in organizational identity rather than economic rationality, managerial vision or sociological constraint.

2) Organizational Attention & Adaptation, William Ocasio, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., Leverone 392, Evanston, IL 60208, wocasio@nwu.edu

We apply an attention-based view to explain whether and how organizations adapt to changing environments. We reexamine 5 classic studies of organizational inertia and change and develop a set of conclusions on how the organization's attention structures and channels shape its ability to adapt.

3) Managerial Decision Making & Attention Allocation, Alan B. Eisner, Pace Univ., Lubin Sch. of Bus., 861 Bedford Rd., Pleasantville, NY 10570, eisner@pace.edu, Zur Shapira

We address the issue of priority-setting among tasks by managers by proposing analogies from job-shop scheduling theory. We develop a model that views managers employing both rationality and affective judgments with a limited processing capacity and discuss the results of our tests.

4) Calling Attention to Issues: Publicity, Politics & Post-Market Surveillance in the Medical Device Industry, Michal Tamuz, Univ. of TX, 1200 Herman Pressler, W-230, Sch. of Public Health, Houston, TX 77030, tamuz@utsph.sph.uth.itmciedu, Gerald R.

Goodman

We study industry-level processes that call attention to safety issues in the medical device industry. We examine how a safety monitoring system, designed to scan the environment for emerging issues, competes with highly-publicized device failures in calling attention to issues and how these competing processes influence organizational learning.

MC07 Derivative Securities IICluster: **Finance**

Invited Session

Chair: Avi Bick, Simon Fraser Univ., Fac. of Bus. Admin., Burnaby, BC, V5A 1S6, Canada, bick@sfu.ca

1) **Bayesian Semi-Parametric Option Valuation, F. Douglas Foster**, Univ. of IA, Pappajohn Sch. of Bus. Admin., Iowa City, IA 52242

We investigate numerical Bayes implementation of options pricing models. We use Bayesian techniques to compute a predictive density that uses past data and a range of prior beliefs. This numerical predictive density is translated into a risk-neutral density used to price options and compute hedging parameters. Our procedures are compared to traditional implementations and to other non-parametric procedures, specifically an entropical transformation of past data. The relative performance of traditional, Bayesian and canonical pricing procedures are explored for a number of contracts.

2) **Implied Convenience Yield in Options Prices, Haim Reisman**, Israel Inst. of Tech., Technion, Fac. of IE & Mgmt., Haifa, 32000, Israel, reisman@ie.technion.ac.il

In markets with transaction costs, there may not be an equivalent measure under which both the stock and the options are martingales. We interpret the drift terms in the option prices as convenience yields and derive an explicit formula for its implied values in terms of current option prices.

3) **More General Properties of Derivatives, Yaacov Bergman**, Hebrew Univ., Sch. of Bus., Jerusalem, 91905, Israel, msyberg@mscc.huji.ac.il

Probabilistic solutions to parabolic PDEs are used to derive general properties of derivatives. For example, in a diffusive 1-factor model of the term structure, if the second partial of the risk-adjusted drift of the short-term rate is bounded by 2 from above, then bond prices are convex in that rate.

4) **Futures Pricing via Futures Strategies, Avi Bick**, Simon Fraser Univ., Fac. of Bus. Admin., Burnaby, BC, V5A 1S6, Canada, bick@sfu.ca

Dynamic spanning with futures contracts deserves special attention because they are always-zero-value securities and their futures prices are cumulative cash flows. We show that, under certain conditions, a futures contract can be replicated by a dynamic futures strategy in "reference" (underlying) futures contracts and this is translated into a relationship between the corresponding futures prices.

MC08 Real Estate ICluster: **Finance**

Invited Session

Chair: Danny Ben-Shahar, Interdisciplinary Ctr. Herzliya, PO Box 167, Herzliya, 46150, Israel, dannyb@icd.ac.il

1) **On the Agglomeration of Non-Residential Activities in an Urban Area, David Pines**, Tel Aviv Univ., Sch. of Economics, Ramat Aviv, Tel Aviv, 69978, Israel, pines@econ.tau.ac.il

We explain the emergence of subcenters in an urban area, characterize the activities located in the secondary vs. those located in the central business district and analyze the determinants of the centrifugal and the centripetal effects. New results are reported which are at odds with the prevailing literature.

2) **Timeline, Task & Team: A Framework for Teaching Real Estate, Noga Meyers**, Technion - Israel Inst. of Tech., Fac. of Architecture, Ctr. for Urban/Regional Study, Haifa, 32000, Israel, Daniel Gat

A stylized model of the real estate development process is background for teaching real estate. The framework is site- and timeline-centered but it reaches backward into pre-takeoff conditions, forward into "what's next" and outward into the larger systems which motivate, propel and support the ongoing real estate enterprise. Seven case studies verify the model.

3) **A Real Estate Lease Contract: Who Should Pay the Brokerage Service?, Danny Ben-Shahar**, Interdisciplinary Ctr. Herzliya, PO Box 167, Herzliya, 46150, Israel, dannyb@icd.ac.il

We study the homeowner's optimal strategy in imposing the real estate

brokerage service fee on the prospective renter. We identify the equilibria and determine their properties both under complete and asymmetric information. The model attempts to explain the phenomenon in which homeowners occasionally share the mediation costs with their tenants.

MC09 Optimal Maintenance & Production Planning

Invited Session

Chair: Viliam Makis, Univ. of Toronto, Dept. of MIE, 5 King's College Rd., Toronto, Ontario, M5S 3G8, Canada, makis@mie.utoronto.ca

1) **A Simple Recursive Markov Chain Model to Determine the Optimal Replacement Policies Under Imperfect Repair, C. E. Love**, Ott-Von-Guericke Univ., Fac. of Economics & Mgmt., Magdeburg, Germany, love@sfu.ca, **Z. G. Zhang**

A failed system is repaired to a state somewhere between minimal and good-as-new. We address the questions of when a major overhaul should be conducted to completely refresh the system intensity. We show that the problem can be analyzed using a simple recursive Markov model.

2) **Production Arborescences & Myopic Affine Dynamic Models, Matthew J. Sobel**, NYU, Stern Sch., 40 West 4th St., Ste. 7-01A, New York, NY 10012-1118

Consider an arborescence network of stations which produce an item facing an ARMA demand process; excess demand is backordered. Stations have buffer inventories and stochastic yield. Costs of processing and WIP are linear and the cost of ending inventories is convex. The resulting affine structure yields a myopic optimal lot-size policy which is easily computed.

3) **Optimal Production/Maintenance Policy for a Unit Subject to Minor & Major Failures, Viliam Makis**, Univ. of Toronto, Dept. of MIE, 5 King's College Rd., Toronto, Ontario, M5S 3G8, Canada, makis@mie.utoronto.ca

A joint production/maintenance control problem with machine breakdowns and 2 types of failure is considered. The structure of the optimal policy minimizing the long-run expected average cost per unit time is found by analyzing the problem in the framework of semi-Markov decision processes.

MC10 Technology Management IISponsor: **Technology Management Section**

Sponsored Session

Chair: Dundar F. Kocaoglu, Portland State Univ., Eng. Mgmt. Program, Portland, OR 97207-0751, kocaoglu@emp.pdx.edu

1) **withdrawn - author request of 5/25, Hans Georg Gemuenden**, Univ. of Karlsruhe, Inst. for Applied MS & Corp.St, PO Box 6980, Karlsruhe, 7128, Germany, hns.gemuenden@wiwi.uni-karlsruhe.de

2) **International Technology Transfer Success Factors, Burton V. Dean**, San Jose Univ., Dept. of O&M, San Jose, CA 95192-0070, bvdean@aol.com

International technology transfer is the systematic international transmission of new intellectual property, skills and organization values from one R&D entity to another that, if successful, results in customers preferring to routinely use products and services provided by the recipient over others. Rapidly and effectively building R&D organizations in new international locations is a challenge faced by many multinationals. Firms obtain these benefits only after addressing a myriad of international technology transfer related issues. The research reported evaluated international technology transfer for a division of a major Silicon Valley firm to an R&D division abroad. Focus groups were conducted with technology donors and recipients, both managers and engineers were used to determine which factors were critical to transfer success and how these factors interrelate.

3) **Converting Military Technology Through Intrapreneurship: Israeli Research Findings, Israel Azulay**, Tel-Aviv University, Faculty of Mgmt., Ramat Aviv (c/o Miri Lerner), Tel-Aviv, 69987, Israel, azulay1@netvision.net.il, **Miri Lerner, Asher Tishler**

We focus on the relationships between entrepreneurial behavior of employees and managers and their attitudes towards the feasibility of defense technology conversion. The data were collected in 1997 at an Israeli defense company aiming at converting military technology by promoting intrapreneurship among its employees. Theoretical and empirical implications are addressed.

4) **Technology Strategies in the US Electronics Industry, Al Herman**, Planar Advance, Inc., 22750 SW 65th Ave., Tualatin, OR 97062, al=herman%genstaff%avi@banyan

We investigate the relationship between technology strategies and the management process by which they are developed and implemented. Strategy data was collected from 100 US electronic companies and analyzed to identify

content and process patterns. The process-content combinations were then analyzed to determine the relationship to firm performance.

MC11 Semiconductor Manufacturing

Invited Session

Chair: Doron Meyersdorf, TEFEN Ltd., 1065 E Hillsdale Blvd., Ste. 400, Foster City, CA 94404

1) **Development of Semiconductor Manufacturing Systems Using the Object-Process Methodology, *Dov Dori***, Israel Inst. of Tech., Technion City, Fac. of IE&M, Haifa, 32000, Israel, dori@ie.technion.ac.il, *Alon Meller, Doron Meyersdorf*

The process of modeling and designing the semiconductor IS requires an adequate methodology that can systematically and concurrently model the structure and behavior of the system. The OPM is a system development approach that handles processes and objects at the same level of importance and centrality, as opposed to current object-oriented methods whose central building blocks are just objects...

2) **Cycle Time Reduction Methodology for Semiconductor Manufacturing, *Amiram Ponte***, TEFEN Ltd., 14B Raul Valenberg St., Ramat Hachayal, Tel Aviv, 67919, Israel, *Doron Meyersdorf*

Cycle time performance and its impact on a company's competitive edge has been gaining considerable attention recently. We provide a brief review of key concepts related to the manufacturing cycle time and describe a methodology for cycle time reduction projects in semiconductor wafer fabrication facilities, including the critically important implementation road map step.

3) **The Synergy of OEE, COO, TPM & TOC in the Semiconductor Industry, *Doron Meyersdorf***, TEFEN Ltd., 1065 E Hillsdale Blvd., Ste. 400, Foster City, CA 94404, *Eli Pelleg*

We define and illustrate the use of OEE as a solution for bottleneck management. COO, TPM and TOC are reviewed as techniques aimed at defining, measuring and improving factory performance. The semiconductor environment should adopt each concept to gain synergy leading to manufacturing excellence.

4) **The Test Wafer Management System: A Cost Reduction Tool for Semiconductor Fabrication, *Doron Meyersdorf***, TEFEN Ltd., 1065 E Hillsdale Blvd., Ste. 400, Foster City, CA 94404, *Bryce Foster, Rafi Brenner*

The TWMS is a tool used for estimating the test wafer requirements of a semiconductor fab site. The TWMS optimizes the usage of test wafers and minimizes the number of new test wafers required. To determine the usage and requirements of test wafers in a fab, the TWMS uses a complex simulation to account for many dynamic variables that effect the quantity of test wafers.

MC12 Optimization II

Contributed Session

Chair: Joaquim J. Judice, Univ. de Coimbra, Dept. of Mathematica, Coimbra, 3000, Portugal, judice@it.uc.pt

1) **withdrawn - author request of 5/8, *Rongqin Sheng***, Argonne National Lab., Math & Comp. Sci. Division, Argonne National Laboratory, Argonne, IL 60439, sheng@mcs.anl.gov, *Florian Potra, Nathan Brixius*

2) **An Interior Algorithm for Solving Multiobjective Linear Programming Problems, *Ue-Pyng Wen***, Ntl. Tsing Hua Univ., Dept. of IE, 101 Kung Fu Rd., Sec. 2, Hsinchu, Taiwan, upwen@ie.nthu.edu.tw

We present a modified interior algorithm based on an interior MQLP algorithm proposed by Arbel. We improve Arbel's algorithm with some modifications by adopting minimum ratio test, potential push method and normalization. From the computational experience, we show that the proposed modified algorithm provides an effective and accurate approach to solve the MQLP problem.

3) **Composite Phase-One 1-Infinity Methods for Linear Programming, *Jerome G. Braunstein***, OR Concepts Applied, 7356 Painter Ave., Whittier, CA 90602-1853, jerome@orcal.com

Using the infinity norm to measure constraint violations, an algorithm is proposed for solving the LP problem. It has the advantage that no special procedures are required to treat the nonsmoothness of the weighted objective function. A penalty updating algorithm for the composite function is developed. Numerical results are given.

4) **Solution of a General Linear Complementarity Problem Using Smooth Optimization & Application to Global Optimization, *Joaquim J. Judice***, Univ. de Coimbra, Dept. of Mathematica, Coimbra, 3000, Portugal, judice@it.uc.pt, *Luis M. Fernandes*

We show that a solution of a general linear complementarity problem can be

computed by finding a stationary point of a differentiable function on simple bounds. The application of this result to the solution of bilinear and bilevel programs and LCP is investigated. Numerical evidence of its usefulness is reported.

MC13 Generalized Convexity & Monotonicity II

Cluster: Heuristic Programming & Applications

Invited Session

Chair: Siegfried Schaible, Univ. of CA, Grad. Sch. of Mgmt., Riverside, CA 92521-0203, schaible@ucr.aci.ucr.edu

1) **Minimal Pairs of Compact Convex Sets, *Ryszard Urbanski***, ul. Strazewicza 12, Poznan, PL-61-606, Poland, rich@math.amu.edu.pl, *Diethard Pallaschke*

For a topological vector space inclusion minimal representants for elements of the Radstrom-Hoermander lattice of equivalence classes of pairs of nonempty compact convex sets are considered. Sufficient criteria for inclusion minimality, a cutting plane algorithm for reducing pairs of compact convex sets and conditional minimality will be discussed.

2) **Generalized Monotonicity in Equilibrium Problems, *Siegfried Schaible***, Univ. of CA, Grad. Sch. of Mgmt., Riverside, CA 92521-0203, schaible@ucr.aci.ucr.edu

Many classic problems including mathematical problems and variational inequalities can be written in the form of an abstract equilibrium problem. Mathematical programming with generalized convex objective functions has been developed. We survey recent results for the considerably more general equilibrium problems, which involve generalized monotone bifunctions.

3) **Preference Aggregation Rules in Infinite Setting & Voting Games, *Andrey V. Vladimoriv***, Inst. of Control Sciences, Profsojuznaja 65, Moscow, 117806, Russia, avv@ashtech.msk.ru

Axiomatic characterization of ARs of an infinite number of binary relations into one binary relation is considered. It is shown that transitivity of binary relations is equivalent to some generalized order convexity property of AR represented by infinite Boolean vectors. Our main result shows that any transitive AR can be represented as an intersection of its strongly transitive extensions...

MC14 Algorithmic Problems in Molecular Biology

Invited Session

Chair: Ron Shamir, Tel Aviv Univ., Sch. of Math., Dept. of Comp. Sci., Tel Aviv, 69978, Israel, shamir@math.tau.ac.il

1) **Generalized Pattern Matching: The Case of Swaps, *Amihood Amir***, GA Inst. of Tech., Coll. of Computing, 801 Atlantic Dr., Atlanta, GA 30332-0280

Many different meanings can be assigned to the words "generalization" of pattern matching. One such possibility is that of allowing "local" errors. Intuitively, we group under the label "local" errors that take place in a bounded location, as opposed to changes that permeate the entire data, e.g., scaling and rotation. Specifically, consider the most limited local error - the mismatch...

2) **From 4-Taxon Trees to Phylogenies: The Case of Mammalian Evolution, *Benny Chor***, Technion, Dept. of Computer Sci., Haifa, 32000, Israel

We present 2 new approaches for constructing phylogenetic trees. The input is a list of weighted quartets over n taxa. Each quartet is a subtree on 4 taxa and its weight represents a confidence level for the specific topology. The goal is to construct a binary tree with n leaves such that the total weight of the satisfied quartets is maximized, an NP-hard problem...

3) **Interval Graphs with Side (& Size) Constraints, *Itzik Pe'er***, Tel Aviv Univ., Dept. of Comp. Sci., Tel Aviv, 69978, Israel

We study problems of determining whether a given interval graph has a realization which satisfies additional given constraints. Such problems occur frequently in applications where entities are modeled as intervals along a line, i.e., events along a time line, DNA segments along a chromosome, etc. When the additional information is order constraints on pairs of disjoint intervals, we give a linear time algorithm...

4) **An Algorithm for Finding Approximate Multiple Repeats, *Dina Sokol***, Polytechnic Univ., Dept. of Computer Sci., 6 Metro Tech. Ctr., Brooklyn, NY 11201, dsokol@macs.biu.ac.il, dtwers01@weston.poly.edu

A multiple tandem repeat in a sequence S is a (periodic) substring r of S of the form $r = u^* \{a\} u^* \{t\}$, where u is a prefix of r and $u^* \{t\}$ is a prefix of u . An approximate multiple tandem repeat is a multiple repeat with errors; the repeated subsequences are similar but not identical. Exact and inexact repeats occur frequently in the genome...

5) Efficient Algorithms for Protein Structural Comparison & Biomolecular Recognition, Haim Wolfson, Tel Aviv Univ., Comp. Sci. Dept., Sch. of Math. Sci., Tel Aviv, 69978, Israel

We present geometric matching algorithms for structural comparison of proteins and the biomolecular recognition problems. Effective techniques to solve various aspects of these problems have direct consequences to our understanding of protein function and to the industrial design of novel drugs and proteins. We focus on algorithms for automated prediction of protein-protein and protein-ligand docking when one molecule or both are flexible.

MC15 Queueing, Reliability & Inventory

Cluster: Applied Probability

Invited Session

Chair: Wolfgang Stadje, Univ. of Osnabruck, Dept. of Math., Osnabruck, D49069, Germany, wolfgang@mathematik.uni-osnabrueck.de

1) Control of Service Systems with Service Completion Unknown, Donald P. Gaver, Naval Postgrad. Sch., Dept. of OR, Monterey, CA 94305, Patricia A. Jacobs

In a large number of real solutions, a "service" may either not be known to be complete, or is deliberately terminated, possibly before true completion. Examples occur at many levels in the military, in medical diagnosis and treatment, e.g. in the treatment of viral diseases, in forest-fire fighting, and in oil or other mineral exploration. We present various models, both stochastic and deterministic (pseudo-stochastic) that identify and examine the various issues, opportunities and sensitivities. What might be reasonable control strategies if the service time distribution were known, but actual individual service completions are only recognizable with error and false completions may occur?

2) On the Uptime of One Out of n Systems Undergoing Corrective Maintenance, Benny Z. Levikson, Univ. of Haifa, Haifa, Israel, Esther Frostig

We consider systems with n components where (at most) one is operating at a given time point. We assume corrective maintenance is done either by one repairman or by n repairmen. The distributions of the repair time and the operating time of a given component are assumed to be either exponential/exponential, exponential/general or general/exponential. For some cases, we apply results for bounded M/G/1 and G/M/1 queues to derive the uptime, downtime and the availability of these 1 out of n systems.

3) Perishable Inventory Systems with Impatient Demands, Wolfgang Stadje, Univ. of Osnabruck, Dept. of Math., Osnabruck, D49069, Germany, wolfgang@mathematik.uni-osnabrueck.de, David Perry

We study an inventory system for perishable commodities with finite shelf size and finite waiting room for demands with constant or exponential maximum shelf life and maximum waiting time of demands and state-dependent arrival rates. We determine the stationary distribution of the system and derive various cost functionals.

4) On the Maximum of Groeneboom's Local Limit Process, Gerard G. Hooghiemstra, Technical Univ. of Delft, Fac. of ITS, Dept. of Math., Mekelweg 4, Delft, 2628 CD, The Netherlands, Hendrik P. Lopuha

We study the extremal behavior of the stationary processes $V(t)-t$ and $V(t)-t$, on intervals $[0, T]$ increasing to infinity where $V(t)$ is the location of the maximum of standard 2-sided Brownian motion minus a parabolic drift. The result can be applied to the asymptotic behavior of the sup-norm risk of several nonparametric maximum likelihood estimators.

MC16 Cellular Manufacturing

Invited Session

Chair: Michael Masin, Technion, Fac. of IE & Mgmt., Kiriathatechnion, Haifa, 32000, Israel

1) withdrawn - author request of 5/19, Sinriech David, Technion, Fac. of IE & Mgmt., Kiriathatechnion, Haifa, Israel, Abekasis Meir

2) The Effect of Lumpiness on Design of Cellular Manufacturing Systems, Michael Masin, Technion, Fac. of IE & Mgmt., Kiriathatechnion, Haifa, 32000, Israel, Yohanan Arzi, Joseph Bukchin

In lumpy demand environment, the required capacity is affected by the demand variability and by the correlations between the part types to be assigned to the cells. Since the required capacity is influenced by the part types grouping, the part types demand variability and their inter-correlations should be taken into consideration in the cell formation process...

3) withdrawn - author request of 5/10, Yaacov Rubinovitch,

Technion Israel Inst. of Tech., Dept. of IE & Mgmt., Kiriathatechnion, Haifa, 32000, Israel, ierjr01@techunix.technion.ac.il

4) Factors Considered in the Design & Implementation of Manufacturing Cells, Kineret Dekel, Tel-Aviv Univ., Dept. of IE, Fac. of Eng., Tel-Aviv, Israel, Avraham Shtub, Nancy Lea Hyer, Amit Basu

Organizations are motivated into applying manufacturing cells to their operations by an impressive range of benefits. However, based on past research and on our findings, we propose that cellular manufacturing is not just a technical decision but has far reaching social and business consequences as well...

MC17 Tandem Queues & Applications I

Cluster: Queues

Invited Session

Chair: Benjamin Avi-Itzhak, Rutgers Univ., RUTCOR, Fac. of Mgmt., PO Box 5062, New Brunswick, NJ 08903

Co-Chair: Tayfur Altioek

1) Capacity Analysis of Automated Material Handling Systems, W. H. M. Zijm, Univ. of Twente, Fac. of Mech. Eng. & Op. Mgmt., PO Box 217, Enschede, 7500 AE, The Netherlands

We discuss models for the capacity analysis of automated MHSs as they arise in flexible manufacturing and assembly cells, warehouses and sorting systems. A key performance indicator of such systems is the mean response time as a function of the WIP. Both analytical results and applications in practice will be presented.

2) Topological Network Design of M/G/C/C/ State Dependent Queueing Networks, David H. Mitchell, Care Mgmt. Science Corp., 3600 Market St., 6th Fl., Philadelphia, PA 19104, J. MacGregor Smith

The design and analysis of series, merge and splitting topologies of M/G/C/C/ state dependent queueing networks is presented and an analytical approximation methodology is developed to compute the network performance measures. Also, an optimization methodology is developed for determining the optimal capacity requirements of these networks and extensive experimental results are included.

3) Spectral Characteristics of Quasi Birth-Death Models with Applications to Production Lines, Sencer Yeralan, Univ. of FL, Dept. of ISE, 303 Weil Hall, Gainesville, FL 32611, Murat Fadiloglu

New advances on a general framework based on the spectral properties of the model matrices are presented. Most notably, we develop a formal analysis for the cases of highly balanced production lines where a large number of unity eigenvalues are present.

4) Throughputs & Buffer Requirements in Tandem Queues with Correlated Service Times, Benjamin Avi-Itzhak, Rutgers Univ., RUTCOR, Fac. of Mgmt., PO Box 5062, New Brunswick, NJ 08903

We overview recent results related to tandem queues, obtained by the speaker and his co-researchers. The results discussed are mostly throughputs, flow times, required buffers and ordering of servers for various blocking schemes. The intermediate buffers sizes required to avoid blocking when service times are deterministically correlated will be discussed.

MC18 Measuring Decision Situations

Cluster: Choice Engineering

Invited Session

Chair: Jan-Peter Lechner, Univer. Der Bundeswehr, FB Wow, Hamburg, 22039, Germany, jpl@unibw-hamburg.de

1) Opportunistic Choice of Risk in Contests, Anil Gaba, INSEAD, Blvd. de Constance, Fontainebleau, 77305, France, anil.gaga@insead.fr

We examine risk as a choice, and not as a given, for contestants in a winner-take-all setting. It is argued that risk preferences are opportunistic based on the proportion of winners in a contest, a low proportion favoring risk seeking and a high proportion inducing risk aversion.

2) Scenario Driven Probability Judgments, Andreas Reuter, Univ. der Bundeswehr Hamburg, Institut fur Betr. Logistik, FB WOW, Hamburg, 22039, Germany, iblo@unibw-hamburg.de, Jan-Peter Lechner

Estimating the probability of a certain set of future conditions often involves differential reasoning: instead of aggregating probabilities attached to each condition, the transition from one, e.g. the current situation to another is

evaluated in terms of probabilities. While rules of probability might be violated, reasoning patterns appear highly plausible.

3) **Evaluating Decision Criteria, Jan-Peter Lechner**, Univer. Der Bundeswehr, FB Wow, Hamburg, 22039, Germany, jpl@unibw-hamburg.de

By analyzing non-pre-structured rankings of decision alternatives, as revealed from experts or decision makers themselves, multidimensional scaling tools can serve to confirm hierarchical structures of decision criteria and to enhance support for large formalized decision models. Based on rankings of investment proposals for manufacturing equipment, the evaluation procedure is discussed.

MC19 Military Logistics

Sponsor: Section on Logistics
Sponsored Session

Chair: Moshe Kress, CEMA - Ctr. for Military Analyses, PO Box 2250 T1, Haifa, 31021, Israel, kress@ie.technion.ac.il

1) **Operational Effectiveness of Palletized Load Systems, Moshe Kress**, CEMA - Ctr. for Military Analyses, PO Box 2250 T1, Haifa, 31021, Israel, kress@ie.technion.ac.il, *Uri Naot*

A new PLS, which is to enhance the logistic capabilities during battle, has been proposed. We quantitatively compare existing means of transportation and the PLS. By analyzing various criteria dealing with aspects of supplying artillery ammunition, we show that the proposed PLS has advantages over the existing system.

2) **Analytic Models for Scheduling Convoys' Movements, Irit Talmore**, CEMA - Ctr. for Military Analyses, PO Box 2250 T1, Haifa, 31021, Israel, *Moshe Kress*

We present analytical models for scheduling movements of convoys. A model that achieves optimal solutions is formulated. Since this model can only solve problems of limited size, we formulate an approximate model which achieves good solutions. This model is implemented in a DSS that plans movements in a divisional area.

3) **A Descriptive Model for Operational Level Logistics, Moshe Kress**, CEMA - Ctr. for Military Analyses, PO Box 2250 T1, Haifa, 31021, Israel, kress@ie.technion.ac.il

Operational logistics entails setting up logistics bases, selecting and controlling lines of communication, assigning and scheduling transshipments and, most importantly, projecting, analyzing and prioritizing future demands. We present a network-type descriptive model to aid understanding the innate structure of this level of logistics and to reveal the interrelationships among its components.

MC20 The Role of Technology Transfer in Developed & Less Developed Countries

Invited Session

Chair: Koty Lapid, Hungarian Academy, PO Box 3317, Beer Sheva, Israel, kolap@magnet.hu

1) **Hungary's Industrial Innovations System in Transition, Koty Lapid**, Hungarian Academy, PO Box 3317, Beer Sheva, Israel, kolap@magnet.hu, *Henry Etkowitz*

The full potential of Hungarian industrial R&D was not realized during the Socialist era in part due to unwillingness to invest in civilian innovation. We hypothesize that the rather smooth Hungarian innovation transition can be explained, in part, by the international shift of the industrial competitive regime.

2) **Multinationals in the East European Technology Networks: Transfer of a New Culture and/or Conquest of the Last Frontier?, Pal Tamas**, MTA, Managing Director, Hungary

The empirical basis of the paper is a 1995 empirical study of 5400 Hungarian enterprises. Representative survey of the national economy based on personal interviews in the top management of the firm.

3) **withdrawn - author request of 5/21, Veronika Frigyesi**, Hungarian Econ. Assoc.

4) **High-Tech Transfer by Academic Entrepreneurs, Katalin Balazs**, Hungarian Scientific Academy, Hungary

The changes in the economic climate after 1900 forced many of the academics to leave their academic activity and become entrepreneurs. Research based on 50 successful start-up cases revealed that those Hungarian academics who based their business on their special academic knowledge could meet new sophisticated economic opportunities.

Monday 15:45-17:15

MD01 MCDM - Theory

Cluster: MCDM

Invited Session

Chair: Ami Arbel, Tel Aviv Univ., Sch. of Eng., IE Dept., Tel Aviv, 69978, Israel

1) **A Hierarchical Multi-Attribute Method for Conflict Resolution & Environmental Decision Making, Diana S. Yakowitz**, US Dept. of Agriculture, Agricultural Research Service, 2000 E Allen Rd., Tucson, AZ 85719, diana@tucson.ars.ag.gov

An algorithm for computing the value range that an additive value function can attain under a hierarchy will be presented. The method requires only ordinal ranking of the attributes within but not across sub-groupings. Characteristics of the method make it ideal for use in situations of conflict and environmental decision making.

2) **Sensitivity & Conflict Analysis in Multicriteria Decision Making, Alberto Colomi**, Politecnico de Milano, via Ponzio 34/5, Milano, 20133, Italy, colomi@elet.polimi.it, *Eliot Laniado, Simona Muratori*

In both sensitivity and conflict analysis, one of the key points is to measure the distance between decision makers: different definitions of distance between vectors are analyzed and conflict indexes introduced. Two procedures for conflict analysis are introduced: one following the decision process step by step, the other intervening at the end.

3) **Theory of Centers & Its Use in Multiple Objective Linear Programming, Ami Arbel**, Tel Aviv Univ., Sch. of Eng., IE Dept., Tel Aviv, 69978, Israel, *Ronnie Sadka*

The theory of centers and its resulting LP formulation is presented. We discuss 3 types of centers: Euclidean center, minmax center and analytic center. We discuss computational methods for finding them, their geometrical interpretation and a comparison of these different centers. The use of the Euclidean center is demonstrated for developing a new interior-point LP algorithm for problems with multiple objectives.

MD02 Health Care Information Systems

Cluster: Global Information Technology & Management

Invited Session

Chair: Rema Padman, Carnegie Mellon Univ., Heinz Sch. of Policy & Mgmt., Pittsburgh, PA 15213, rp25@cmu.edu

1) **Alarming News: An Update on Patient Monitoring Systems in the Intensive Care Unit, Christine L. Tsien**, Harvard Medical Sch., Div. of Health Sci. & Tech., MIT Lab. for Comp. Sci., chris@medg.lcs.mit.edu, *Roy Schoenberg, Isaac S. Kohane, James C. Fackler*

As many as 86% of patient monitor alarms that sound in the ICU have been found to be false alarms. What is the existing state of ICU patient monitoring that is responsible for this, and are there innovative technological solutions that attempt to effectively address the problem?

2) **Network-Centric Decision Support Systems for Health Care Management, Rema Padman**, Carnegie Mellon Univ., Heinz Sch. of Policy & Mgmt., Pittsburgh, PA 15213, rp25@cmu.edu, *Ramayya Krishnan*

How should recent developments in network-centric technologies be harnessed to meet the information management requirements of health care organizations? We examine the alternative ways in which Web technologies can be used to architect DSSs.

3) **Quality Metrics for Health Care Data, Rema Padman**, Carnegie Mellon Univ., Heinz Sch. of Policy & Mgmt., Pittsburgh, PA 15213, rp25@cmu.edu, *Melissa Tzourakis*

The computer-based capture and processing of various types of information ranging from patient records to claims has heightened the need to assess, measure, then manage the quality of the captured data. We develop several health care application-specific metrics to define and measure the quality of such data. A health care claims processing example is used to illustrate the approach.

4) **Disclosure Limitation Alternatives for Categorical Data with Applications to Confidentiality of Medical Information, George T. Duncan**, Carnegie Mellon Univ., The Heinz Sch., Pittsburgh, PA 15213, gd17@cmu.edu

Common methods for limiting disclosure risk with categorical data include aggregation of categories, cell suppression and various routing methods. Recently, probabilistic mechanisms have been proposed that move entities from one category to another according to a Markov chain. A comparative study of

these methods assesses confidentiality protection and data utility. Applications are made to the sharing of anonymized or de-identified medical data.

MD03 Levels of Learning: Individual, Organizational & Interorganizational

Sponsor: College on Organization Science
Sponsored Session

Chair: Paul Ingram, Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., Pittsburgh, PA 15213, ingram+@andrew.cmu.edu

1) Understanding the Influence of Knowledge Structure on the Sustainability of Learning-Based Competitive Advantage, Susan K. McEvily, Univ. of Pittsburgh, Katz Grad. Sch. of Bus., 252 Mervis Hall, Pittsburgh, PA 15260, smcevily@katz.business.pitt.edu

Research in strategic management has focused increasing attention on learning as a source of competitive advantage. However, we know little about which conditions enable a firm to consistently learn faster than its competitors and thereby sustain a performance advantage. I enable us to predict when a firm that has accumulated greater experience with a technology is most likely to maintain a higher rate of performance improvement. Three characteristics of knowledge structures - complexity, application-specificity and tacitness - and their implications for the value of cumulative experience are examined.

2) Patent Races, Capital Races, Learning Races & Alliance Races in Canadian Biotechnology, 1991-97, Joel Baum, Univ. of Toronto, Rotman Sch. of Mgmt., Rm. 549, 105 St. George St., Toronto, Ontario, M5S 3E6, Canada, baum@mgmt.utoronto.ca gmt.utoronto.ca/~baum, Brian S. Silverman

A fundamental feature of firm's strategies is the degree to which they are oriented toward competition and cooperation with other firms. Firms' strategies can include both competition and cooperation, even with regard to a specific rival. Even cooperative endeavors among firms can contain an element of competition. We focus on the relative degrees and ways in which biotechnology firms' strategies lead them to compete and cooperate in races for capital, patents, learning and alliances, and in the impact of these choices on BF's survival.

3) Where Does Interorganizational Learning Occur?, Bill McEvily, Carnegie Mellon Univ., Grad. Sch. of Ind. Admin., Pittsburgh, PA 15213-3890, bmcevily@andrew.cmu.edu

Past research has demonstrated that firms often learn not only from their own experiences, but also from the experiences of others. We also know that firms differ in their learning abilities, but we don't know whether these differences have implications for what types of other organizations firms may try to learn from. By drawing on and extending the notion of absorptive capacity, we develop a theory of interorganizational learning to explain and predict differences in the type and pattern of interorganizational linkages firms' maintain to exploit external learning opportunities. The core proposition is that a firm's learning orientation toward direct and vicarious experience conditions where it seeks to learn from.

4) On the Nontrivial Relation Between Individual & Organizational Learning, Ido Erev, Israel Inst. of Tech., Fac. of IEM, Haifa, 32000, Israel, erev@technix.technion.ac.il

Three examples are discussed that demonstrate the complexity of potential interactions between individual and organizational learning. All examples show that when individual behavior reflects an adaptive but slow learning process (and can be approximated by a reinforcement learning model), trial and error learning at the organizational level can lead the organization in the wrong direction. Examples include problems that involve the utilization of goal setting techniques, peer assessment and team work. Experimental results that support the theoretical assertions are presented.

MD04 Analytic Methods for Matrix Geometric Systems

Cluster: Performance Analysis of Computer/Communication Systems
Invited Session

Chair: Alexander Dukhovny, San Francisco State Univ., Mathematics Dept., 1600 Holloway Ave., San Francisco, CA 94132, dukhovny@math.sfsu.edu

1) Matrix-Geometric Solution of Bulk GI/M1 Queues with Unbounded Arrival Groups, Alexander Dukhovny, San Francisco State Univ., Mathematics Dept., 1600 Holloway Ave., San Francisco, CA 94132, dukhovny@math.sfsu.edu

For a GI/M1 system with group arrivals, we show that if the generating function of the arrival group size is rational with m poles, the stationary queue distribution is general matrix-geometric of the size m . The ratio matrix, shown to be a unique power-bounded solution of a characteristic matrix equation, is given in terms of its first column.

2) Complex-Analytic & Matrix-Analytic Solutions for a Queueing System Controlled by Queue Length Increments, Lev Abolnikov, Loyola Marymount Univ., 5460 White Oak Ave., K-307, Encino, CA 91316, lev@ecom.net, Alexander Dukhovny

A M/G/1 system is considered that responds to large increases of the queue by switching to a group service mode. Both complex-analytic and matrix-analytic solutions are obtained. The form of the complex-analytic solution is used to reduce the dimension of the matrix-analytic one.

3) Polling Systems in Thermodynamic Limit, Guy Fayolle, INRIA, Domaine de Voluceau, Rocquencourt BP 105, Le Chesnay Cedex, 78153, France, Franck Delcroix

Let P_n be a sequence of standard polling systems, consisting of N nodes attended by V_n mobile servers. We consider the behavior of P_n in the thermodynamic limit, i.e. when both N and V_n tend to infinity. In the first part, P_n is a fully symmetric open queueing network. At each node, arrivals of customers form a Poisson process with constant rate λ . Each customer requires service, whose duration is a random variable exponentially distributed. When a server arrives at a busy node, say i , he serves 1 of the waiting customers and then moves to node j with probability $1/N$; if he reaches a node where there are already as many servers as customers, then he immediately turns towards node j , still with probability $1/n$. The switchover time T_{ij} to go from node i to node j is exponentially distributed, with parameter $1/T$. All stochastic input sequences interarrival times, services, switchover times are assumed mutually independent. When the limit as n goes to infinity of V_n/N is positive and finite we obtain ergodicity conditions and distribution of the customers and of the vehicles at each node. Generalization is given to systems admitting only block-wise symmetry.

MD05 Design of Telecommunication Networks

Cluster: Operations Research in Telecommunications
Invited Session

Chair: J. Westbrook, AT&T Labs., jeffw@research.att.com

1) Sonet Ring Design, Steven Phillips, AT&T labs

No abstract supplied.

2) Approximation for Buy-at-Bulk Net Design, David Peleg, Weizman Inst., Israel

No abstract supplied.

3) Fractional K-Medians by Randomized Rounding, Neal Young, Dartmouth College, Hanover, NH

The k -medians problem is, given an edge-weighted graph G , to choose k of the vertices so as to minimize the sum over all vertices of the distance from the vertex to its nearest chosen vertex. We describe a fast algorithm for a fractional relaxation of the problem, one that is useful for approximation algorithms for the original problem. Our primary interest is in the method by which the algorithm is derived...

MD06 Organizational & Group Decision Making

Sponsor: College on Organization Science
Sponsored Session

Chair: Dan Zakay, Tel-Aviv Univ., Dept. of Psychology, Ramat-Aviv, 69978, Israel, dzakay@ccsg.tau.ac.il

1) Judgment in Organizational Settings: Analysis of the Effect of the Judges' Incentives on the Judgments, Ido Erev, Israel Inst. of Tech., Fac. of IEM, Haifa, 32000, Israel, erev@technix.technion.ac.il, Joachim Meyer, Sharon Gilat

Much of the research on the optimal combination of multiple judgment implicitly assumes that the judgments are not affected by the combination rule. The current research demonstrates that in certain organizational settings in which the judgment (and their combination) are likely to affect the judges, this assumption is likely to be violated. A cognitive game theoretic analysis is proposed to analyze situations of this type. This framework is supported by experimental results that demonstrate some of the nontrivial predicted effects of the judgments. Practical implications are discussed.

2) Averaging Probability Judgments: Tests of the Applicability of a Theorem to a Real Data, Thomas S. Wallsten, Univ. of NC, Dept. of Psychology, Chapel Hill, NC 27599-3270, tom.wallsten@unc.edu, Christiane B. Dietz, David V. Budescu

Let M_j be the mean subjective probability estimate of J judges (or the mean of any monotone increasing transformations of the judgment), and let $P(T/M_j)$ be the probability that an event is true given M_j . We report the results of analyses of real data sets in selected domains in order to explore the behavior of $P(T/M_j)$ as J increases. The exploration is motivated by results of Wallsten, Budescu, Erev & Diederich (1997) and Wallsten & Diederich (1997), who proved that under reasonable symmetry assumptions and a conditional pairwise independence assumption, $P(T/M_j)$ approaches 1(0) as J increases, according to

whether M_j is above (below) the center of the scale. Conditional pairwise independence is violated in these data sets to varying degrees, and there is no guarantee that the other assumptions hold. The theoretical result is quite remarkable and it is of practical interest to know the effects of averaging increasing numbers of judgment with real data.

3) Averaging Probability Judgments: Monte Carlo Tests of the Importance or Pairwise-Independence, David V. Budescu, Univ. of IL, Dept. of Psychology, 603 E Daniel St., Urbana, IL 61820, dbudescu@s.psych.uiuc.edu, Timothy Johnson, Thomas S. Wallsten

Let M_j be the mean subjective probability estimate of J judges (or the mean of any monotone increasing transformations of the judgments) and let $P(T/M_j)$ be the probability that an event is true given M_j . We report the results of simulations designed to explore the behavior of $P(T/M_j)$ as J increases and the sensitivity of the process to violations of conditional pairwise-independence. The exploration is motivated by results of Wallsten, Budescu, Erev & Diederich (1997) and Wallsten & Diederich (1997), who proved that under reasonable symmetry assumptions and a conditional pairwise independence assumption, $P(T/M_j)$ approaches 1(0) as j increases, according to whether M_j is above (below) the center of the scale. The theoretical result is quite remarkable and it is of practical interest to know rates of convergence under the ideal case and robustness of results to violations of the assumptions.

4) The Influence of Decision Heuristics on Strategic Surprises in Industries with Interactive Norms, Joseph Lampel, St. Andrews Univ., Dept. of Mgmt., St. Katherine W, The Scores, Scotland, KY16 9AL, UK, jl10@st-andrews.ac.uk, Zur Shapira

The concept of strategic surprise has been used by writers on military strategy to explain the successful amplification of resources during battle. We apply the same concept to the relationship between buyers and suppliers. First, we examine factors that produce vulnerability to strategic surprise in cooperative situations. We then examine the reasons why firms are caught by surprise in spite of their vigilance. We argue that firms use cognitive heuristics which produce misinterpretation of evidence and a consequent sense of false security. In particular, interaction norms combine with the representatives heuristic to increase the likelihood of misjudgment.

5) The Negative Outcome Bias in the Evaluation of Decisions' Quality by Managers, Dan Zakay, Tel-Aviv Univ., Dept. of Psychology, Ramat-Aviv, 69978, Israel, dzakay@ccsg.tau.ac.il

The negative outcome bias is characterizing the way managers evaluate the quality of past decisions and of the need to analyze the decision making process. It was found that managers tend to perceive a causal positive relationship between the valence of outcomes and the quality of preceding decisions. Similarly, managers are mobilized to initiate a learning process mainly after negative outcomes but not after positive ones. The negative outcome bias poses a severe threat to the optimality of organizational decision making and learning. Potential debiasing methods are discussed.

MD07 Equilibrium Asset Pricing

Cluster: Finance

Invited Session

Chair: David Feldman, The Interdisciplinary Ctr., PO Box 167, Herzlia, 46150, Israel, dfeldman@idc.ac.il

1) Dynamic Equilibrium with Liquidity Constraints, Jerome Detemple, McGill Univ., 1001 Sherbrooke St. W, Montreal, Quebec, H3A 1G5, Canada, detemple@management.mcgill.ca, Angel Serrat

We consider an intertemporal economy with liquidity constrained and unconstrained individuals. Liquidity constraints prevent marketability of future income. Constrained individuals postpone consumption in early age and permanently increase consumption when the constraint binds. Equilibrium is characterized. Under suitable conditions, the interest rate falls and the equity premium increases in the presence of liquidity constraints.

2) Pricing Risk When Risk Aversion Matters, Patrick K. Asea, UCLA, Dept. of Econ., NBER, 405 Hilgard Ave., Los Angeles, CA 90024, asea@econ.ucla.edu, Chenghu Ma, Mthuli Ncube

Under an information structure that is driven by a Levy jump process and stochastic differential recursive utility, we prove that the Bellman equation is sufficient for the optimal choice problem. We derive closed-form solutions for options and demonstrate that the major option pricing models are special cases of our model.

3) Production & the Real Rate of Interest: A Sample Path Equilibrium, David Feldman, The Interdisciplinary Ctr., PO Box 167, Herzlia, 46150, Israel, dfeldman@idc.ac.il

In a production economy where investors do not observe productivity factors, we express equilibrium interest rates as a function of sample paths of returns. While previous literature formed equilibrium interest rates in terms of unobservable moments of returns, we provide a testable equilibrium relation that consists of observable returns.

MD08 Real Estate II

Cluster: Finance

Invited Session

Chair: Daniel Gat, Technion Israel Inst. of Tech., Fac. of Architecture, Ctr. for Urban/Regional Study, Haifa, 32000, Israel, argat@tx.technion.ac.il

1) Product Differentiation in the Greater Tel-Aviv New Dwellings Market: The Role of Design in Value Generation, Ayelet Brosh, Technion Israel Inst. of Tech., Fac. of Architecture, Ctr. for Urban/Regional Study, Haifa, 32000, Israel, Daniel Gat

A hedonic model of new dwelling projects - currently being constructed and marketed in the study region - isolates the effects of product differentiation on market value. The results of analyzing over 240 dwelling types on 38 sites show the still highly important role of location but also demonstrate the importance of planning and design features.

2) A Tale of 3 Cities: Inter- & Intra-Urban Value Determinants of Existing Homes in Jerusalem, Greater Tel Aviv & Greater Haifa, Daniel Gat, Technion Israel Inst. of Tech., Fac. of Architecture, Ctr. for Urban/Regional Study, Haifa, 32000, Israel, argat@tx.technion.ac.il, Nurit Bar Tov

Home prices within the 3 cities are regressed against socioeconomic status, CBD accessibility and city specific attributes such as topography and air quality. The analysis tests for inter-city differences of intercept and slopes of the shared variables. The results: neighborhood socioeconomic status and access to prestigious sites are highly significant positive factors.

3) Urban Focal Points & Design Quality Influence Rents: The Case of the Tel-Aviv Office Market, Daniel Gat, Technion Israel Inst. of Tech., Fac. of Architecture, Ctr. for Urban/Regional Study, Haifa, 32000, Israel, argat@tx.technion.ac.il

Using a hedonic framework, we reveal the factors underlying market rent levels of Tel-Aviv's major office buildings. They include access to any of 3 major urban foci - City, Kirya and Diamond Exchange, quality of building design, building height and floor area. The age of building and area-wide density of manufacturing are detractors from value.

MD09 Operations, Replacement & Maintenance Aspects of Improving the Use of Machines

Invited Session

Chair: Abraham Mehrez, Ben-Gurion Univ. of the Negev, Dept. of IE&M, POB 653, Beer-Sheva, 84105, Israel

1) A Discrete Maintenance Replacement Model Under Technological Breakthrough Expectations, Eli Shemesh, Ben-Gurion Univ. of the Negev, Dept. of IE&M, Beer-Sheva, Israel, Gad Rabinowitz, Abraham Mehrez

Recently, Mehrez & Berman (1994) considered a finite horizon profit maximization 3-machine replacement model under a continuous optimal control setting. Allowing for preventive maintenance to slow the reduction in machine quality and profit caused by obsolescence, their model is formulated to determine the timing of replacing an existing machine with another available machine with improved technology. This decision is considered under uncertainty regarding the exponential probability distribution introduction time of a 3rd machine with a not-yet-achieved breakthrough technology. The optimality of a "bang-bang" i.e., all or nothing, non-increasing preventive maintenance control was shown. This is shown here in a discrete setting and some general conditions allowing the probability distribution of the introduction time to be a monotonically non-increasing function time. A polynomial search procedure is suggested to solve the problem. Under certain conditions, an interior solution is found for both the replacement of the existing machine by the available machine, and the purchase of the third machine once it becomes available. This result implies that management may improve profitability by delaying (but not necessarily foregoing) replacement with a new machine. In some cases, we found that the improvement in profitability was over 25%. Finally, we compare the analysis with Mehrez & Berman's results and supplement it by numerical illustration and computational complexity aspects.

2) Scheduling Two Machines that Require Multiple Types of Maintenance for a Single Operation, Gad Rabinowitz, Ben-Gurion Univ. of the Negev, Dept. of IE&M, Beer-Sheva, 84105, Israel, rgadi@bgumail.bgu.ac.il, Abraham Mehrez, Shai Goren

The problem explored was of 2 machines used, one at a time, to perform a continuous operation where each machine was subject to different types and lengths of maintenance. Operation periods between maintenance periods could also vary in length. All the periods were deterministic in length. When the last period ended, the first began again. The objective was to maximize the portion of time with an operating machine. We saw this as an NP problem. This problem extended previous studies by Kreimer & Mehrez on an n-machine single-type maintenance scheduling problem. The no-interrupt policy, which

was optimal for that problem, was not optimal for this one. Properties of the optimal solution and identification of the state transition mechanism lead to a finite, but exponentially bounded, algorithm that constructed cyclic solutions. Heuristic methods were recommended and tested for small-sized problems. On the average, they achieved more than 99% of the highest objective function value found by the algorithm and equaled that value in 55-80% of the random problems. The most efficient heuristic method consisted of the SPT scheduling rule.

3) Computation of Availability of Real-Time Systems, Joseph Kreimer, Ben-Gurion Univ. of the Negev, Dept. of IE&M, PO Box 653, Beer-Sheva, 84105, Israel, Abraham Mehrez

We propose a new definition of availability (instead of traditional) of a real-time multiserver, such as UAC unmanned air vehicles reconnaissance until and multichannel, such as reconnaissance areas, system involving maintenance. We show that these real-time systems can be treated as finite source queueing models although such systems, by their very nature, do not permit queues. This contradiction is resolved while using a dual approach; namely, considering jobs as servers and servers as jobs. We provide analytical results for computation real-time system availability, when both service and maintenance times are exponentially distributed (birth-and-death process).

MD10 Panel: Publishing in IEEE Transactions on Engineering Management

Sponsor: Technology Management Section
Sponsored Session

Chair: Dundar F. Kocaoglu, Portland State Univ., Eng. Mgmt. Program, Portland, OR 97207-0751, kocaoglu@emp.pdx.edu

1) Panel: Publishing in IEEE Transactions on Engineering Management, Burton V. Dean, San Jose Univ., Dept. of O&M, San Jose, CA 95192-0070, bvdean@aol.com, R. Balachandra, Frederick Betz, Richard C. Dorf, George F. Farris, Cheryl Gaimon

The Editor-in-Chief and Department Editors of IEEE Transactions on Engineering Management will discuss the journal's philosophy and strategies in this panel discussion. A Q&A period will follow the brief presentations.

MD11 Algorithms for the Earliness-Tardiness Problem

Cluster: Combinatorial Models for Manufacturing Scheduling & Routing
Invited Session

Chair: Wieslaw Kubiak, Memorial Univ. of Newfoundland, Fac. of Bus. Admin., St. John's, NFL, A1B 3X5, Canada, wkubiak@morgan.uccs.mun.ca

1) Minmax Earliness-Tardiness Costs with Unit Processing Time Jobs, Gur Mosheiov, The Hebrew Univ., Sch. of Bus., Dept. of Stats., Jerusalem, 91905, Israel, Michal Shadmon

We study a scheduling problem with M identical machines, N jobs with identical, unit, processing time, job-dependent weights and a common due-date for all jobs. We are interested in minimizing the cost of the worst scheduled job, minmax. We discuss the solution of both the non-restrictive, i.e., sufficiently large, due-date case and the restrictive due-date case.

2) A Fully Polynomial Approximation Scheme for the Weighted Earliness-Tardiness Problem, Wieslaw Kubiak, Memorial Univ. of Newfoundland, Fac. of Bus. Admin., St. John's, NFL, A1B 3X5, Canada, wkubiak@morgan.uccs.mun.ca, Mikhail Y. Kovalyov

A fully polynomial approximation scheme for the problem of scheduling n jobs on a single machine to minimize total weighted earliness-tardiness is presented. A new technique is used to develop the scheme. The main feature of this technique is that it recursively computes lower and upper bounds on the value of partial optimal solutions. Therefore, the scheme does not require any prior knowledge of lower and upper bounds on the value of a complete optimal solution. This distinguishes it from all the existing approximation schemes.

MD12 Logistics

Contributed Session

Chair: Yale T. Herer, Tel-Aviv Univ., Fac. of Eng., Dept. of IE, Ramat Aviv, 69978, Israel, yale@eng.tau.ac.il

1) Modeling the Operation of Storages in Electricity Markets Using Dual Evolutionary Programming, John Kaye, Univ. of New South Wales, Sch. of Electrical Eng., Sydney, NSW, 2052, Australia, j.kaye@unsw.edu.au, Iain F. MacGill

A new technique for modeling the management of storages in competitive electricity spot markets is described. Elements of dynamic and evolutionary programming are combined. Populations of future benefit functions are evolved in tournaments to choose bidding and operational strategies that maximize each

participant's total revenue. Numerical case studies are presented.

2) Off-Line Inspections: Parallel Versus Serial Approaches for Finding the First Non-Conforming Unit, Yale T. Herer, Tel-Aviv Univ., Fac. of Eng., Dept. of IE, Ramat Aviv, 69978, Israel, yale@eng.tau.ac.il, Tzvi Raz

With the SERIAL approach, we inspect one unit at a time, thus minimizing the expected number of inspections. With the PARALLEL approach, we inspect several units at once, thus when the inspection delay is significant, the time to find the first non-conforming unit is greatly reduced.

MD13 Ant Colony Optimization

Cluster: Heuristic Programming & Applications
Invited Session

Chair: Marco Dorigo, Univ. Libre de Bruxelles, IRIDIA CP 194/6, Ave. Franklin Roosevelt 50, Bruxelles, 1050, Belgique, mdorigo@ulb.ac.be
iridia.ulb.ac.be/dorigo/dorigo.html

1) Ant Colony Optimization: A New Metaheuristic?, Marco Dorigo, Univ. Libre de Bruxelles, IRIDIA CP 194/6, Ave. Franklin Roosevelt 50, Bruxelles, 1050, Belgique, mdorigo@ulb.ac.be
iridia.ulb.ac.be/dorigo/dorigo.html

I will sketch the main idea behind the ant colony optimization paradigm and discuss its possibilities as a new metaheuristic.

2) Hybrid Ant System for the Sequential Ordering Problem, Luca-Maria Gambardella, IDSIA, Corso Elvezia 36, Lugano, CH-6900, Switzerland, luca@idsia.ch, Marco Dorigo

We present HAS-SOP, a hybrid ant colony algorithm coupled with a local optimizer applied to various instances of the SOP. We compare HAS-SOP with some of the best heuristics available for the SOP. Experimental results show that HAS-SOP is the best performing method for SOPs and is able to improve many of the best known published results.

3) An Ant Colony Optimization Approach to the Quadratic Assignment Problem, Thomas Stuetzle, TU Darmstadt, Comp. Sci. Dept., Intellectics Group, Darmstadt, D-64283, Germany, tom@intellektik.informatik.tu-darmstadt.de

We discuss the application of one specific ant colony optimization approach, MAX-MIN ant system, to the QAP. Artificial ants are used to construct solutions that are subsequently improved by a local search phase. The computational results show that the presented approach is very efficient on real-life QAPs.

4) Ant Colony Optimization in Distribution Management, Bernd Bullnheimer, Univ. of Vienna, Inst. of MS, Bruenner Str. 72, Vienna, A-1210, Austria, bullnhei@indust.bwl.univie.ac.at, Richard F. Hartl, Christine Strauss

Many decision problems in distribution management, a special field of production and operations management, can be formulated as (hard) combinatorial optimization problems, e.g., TSP, VRP, etc. Consequently, metaheuristics have a central importance in distribution management. We focus on the application of ant colony optimization to problems in distribution management.

MD14 Nonlinear Optimization

Invited Session

Chair: Roman A. Polyak, George Mason Univ., Dept. of OR, Math. Sci. Dept., Fairfax, VA 22030-4444, rpolyak@vms1.gmu.edu

1) Semidefinite Estimates for Polynomial & Combinatorial Optimization Problems, Naum Shor, Ukrainian Ntl. Academy of Sci., Inst. for Cybernetics, Kiev, Ukraine

Polynomial problems can be reduced to quadratic problems by introducing new variables which are quadratically dependent of original ones. The Boolean variables can be represented in real variables by quadratic equations of the type $y^* \{2\} - y = 0$. So, the polynomial programming problems in real and/or Boolean variables can be reduced to the problems with quadratic or linear objective function and constraints.

2) A Product Form Cholesky Factorization for Interior Point Methods for Linear Programs, Donald Goldfarb, Columbia Univ., IE/OR Dept., 331 Mudd Bldg., New York, NY 10027-6699, Katya Scheinberg

We present a product form Cholesky factorization method for solving the system of equations that arises in each step of an interior point method for LP. Our method is numerically stable and allows dense columns in the constraint matrix to be handled in a way that does not destroy the method's ability to take

advantage of sparsity in the rest of the matrix...

3) Log-Sigmoid Transformation in Constrained Optimization, *Roman A. Polyak*, George Mason Univ., Dept. of OR, Math. Sci. Dept., Fairfax, VA 22030-4444, rpolyak@vms1.gmu.edu

The log-sigmoid function is used to transform constraints in a constrained optimization problem with inequality constraints. The Lagrangean for the equivalent problem-log-sigmoid-Lagrangean, LSL, is our main tool. Sequential unconstrained minimization of the LSL followed by the Lagrange multipliers update leads to a particular multiplier method which has many attractive properties...

MD15 Stochastic Networks

Cluster: **Applied Probability**

Invited Session

Chair: **Karl Sigman**, Columbia Univ., Dept. of IE/OR, Mudd Bldg. 500 West 120th St., New York, NY 10027-6699

1) Steady-State Delay Asymptotics for Tandem Queues with Subexponential Service Times, *Karl Sigman*, Columbia Univ., Dept. of IE/OR, Mudd Bldg. 500 West 120th St., New York, NY 10027-6699

A tandem queue with 2 stations in series is considered in which one or both of the service time distributions is heavy-tailed (subexponential). Exogenous arrivals are assumed renewal. We study the asymptotics of the tail of stationary delay at the second node, and in particular, find that they are different from known results for the classic GI/GI/1 single-server model. Some conjectures are given.

2) On the Stability of the Kumar-Seidman Policy in Multiclass Queueing Networks with Setups, *Jim Dai*, Georgia Inst. of Tech., Sch. of ISyE, Atlanta, GA 30332-0205, *Otis B. Jennings*

In a multiclass queueing network where setup times are significant, it is tempting to use a setup avoidance, also called exhaustive, dispatch/setup policy. It is known that many such policies are inefficient in the sense that the queueing network cannot realize the maximum throughput possible. Kumar & Seidman (1990) introduced a dispatch policy that is proved to be efficient when arrival times and service times are deterministic. Using a fluid limit model approach, we prove that the Kumar-Seidman policy is efficient in stochastic multiclass queueing networks.

3) Linear Stochastic Fluid Networks, *Offer Kella*, Hebrew Univ., Mount Scopus, Jerusalem, 91905, Israel, *Ward Whitt*

We introduce open stochastic fluid networks that can be regarded as continuous analogs or fluid limits of open networks of infinite-server queues. Random exogenous input may come to any of the queues. At each queue, a CDF-valued stochastic process governs the proportion of the input processed by a given time after arrival. The routing may be deterministic or proportional. This stochastic fluid network with deterministic CDFs governing processing at the queues arises as the limit of normalized networks of infinite-server queues with batch arrival processes where the batch sizes grow. In this limit, one can think of each particle having an evolution through the network, depending on its time and place of arrival, but otherwise, independent of all other particles. A key property associated with this independence is the linearity. The workload associated with a superposition of inputs, each possibly having its own pattern of flow through the network, is simply the sum of the component workloads. Explicit formulae for the LST of the steady-state distribution, mean vector and covariance matrix is obtained in the case of a multi-variate Levy input process.

MD16 Flexible Manufacturing

Cluster: **Flexible Manufacturing Systems**

Invited Session

Chair: **Ulrich A. Tetzlaff**, George Mason Univ., Sch. of Mgmt., MS 5F4, Fairfax, VA 22030-4444, tetzlaff@som.gmu.edu

1) Manufacturing Flexibility After Installing Flexible Manufacturing Systems, *Marcio Zukin*, PUC Rio, Dept. of IE, Rua Marques de Sao Vicente 225, Rio de Janeiro, 22453-900, Brazil, marzukin@rdc.puc-rio.br, *Paulo R. T. Dalcol*

We describe 2 case studies from ongoing research on firms of the consumer electronics industry in Brazil which installed FMSs in their factories. These studies analyze some aspects of the manufacturing flexibility of the firm, such as variety of products, after the introduction of FMSs.

2) Capacity Balancing of Manufacturing Systems Based on the Concept of "Operation Types", *Andras Farkas*, Intl. Mgmt. Ctr., Nador Utca 11, Budapest, 1051, Hungary, farkas@imc.hu, *Tamas Koltai*, *Kathryn E. Steckle*

Although an MPS is used to schedule production for a short run, capacity over and under utilization may frequently occur. Reallocating orders within a feasible

time frame may improve the workload balance of machines and increase system throughput. An iterative algorithm is developed to perform this function based on the concept of "operation types."

3) Optimal Control of Assemble-to-Order Systems Under Heavy Traffic, *Ulrich A. Tetzlaff*, George Mason Univ., Sch. of Mgmt., MS 5F4, Fairfax, VA 22030-4444, tetzlaff@som.gmu.edu, *Harold J. Kushner*

We perform a heavy traffic analysis for the optimal control of a classic manufacturing and inventory process known as assemble-to-order. Demand consists of 1 or more final products while control is exercised by idling production or external supply sources. The general limit problem is combined singular/impulsive. New issues in heavy traffic analysis arise.

4) New FMS Practices in the Production of Complex Goods, *Koty Lapid*, Hungarian Academy, PO Box 3317, Beer Sheva, Israel, kolap@magnet.hu

During recent years, demand for customized products has risen sharply. This has caused manufacturers to change their practices. We deal with that and many aspects of customized, standardized manufacturing practices.

MD17 Tandem Queues & Applications II

Cluster: **Queues**

Invited Session

Chair: **Benjamin Avi-Itzhak**, Rutgers Univ., RUTCOR, Fac. of Mgmt., PO Box 5062, New Brunswick, NJ 08903

Co-Chair: **Tayfur Altioek**

1) Decomposition for Multiple-Part-Type Tandem Flow Lines, *Joseph E. Nemeec*, MIT, Lab. for Mfg. & Productivity, Dept. of ME, Cambridge, MA 02139, *Stanley B. Gershwin*

We extend existing decomposition methods for the analysis of tandem production lines to account for multiple part types. We assume a strict priority scheme in which a machine can work on a Type I part only if it is operational and its downstream Type I-1 buffer is full or its upstream Type I-1 buffer is empty.

2) On Approximation Techniques for the Analysis of Non-Homogeneous Production Lines with Unreliable Machines & Finite Buffers, *Herve Le Bihan*, Univ. Pierre et Marie Curie, Lab. Info. de Paris 6, 4 Place Jussieu, Paris, 75252, France, *Yves P. Dallery*

We consider non-homogeneous production lines with unreliable machines and finite buffers. We compare 2 approaches that have been proposed to analyze such systems: a direct decomposition method and a 2-step approximation method involving the transformation of the original line into an approximately equivalent homogeneous line which is then analyzed using a decomposition method.

3) Look-Back Policies for 2-Stage, Pull-Type Production/Inventory Systems, *Tayfur Altioek*, Rutgers Univ., Dept. of IE, Piscataway, NJ, *Melike Gursoy*

A 2-stage, pull-type P/I system with a known service mechanism at the first stage is considered. Setups and startups are involved in the second stage. Using a semi-Markov decision model, we propose an operating policy for the second stage with the class of (R,r) continuous-review policy that delays the second stage if the buffer lacks sufficient raw material. We present an approximation algorithm for the suboptimal policy.

4) Last Come First Served M/M/c with Reneging, *David Jagerman*, Rutgers Univ., Piscataway, NJ 08854

The LCFS queueing model with Poisson input and exponentially distributed server times is investigated for the case that customers can renege from the queue. The exact Laplace transforms of waiting time distributions, i.e., time in queue, time to reach service, time to renege, etc., are found for an arriving customer who finds the servers busy. An approximation is found for the transform which permits its practical inversion. A numerical illustration is provided. Consideration of this model was motivated by its application to the study of overload control for the No. 1 ESS. A typical example was used for the numerical example.

MD20 The West Bank Economy

Contributed Session

Chair: **Benson L. Honig**, St. Andrews Univ., Dept. of Mgmt., The Scores, St. Andrews, Fife, KY169AL, Scotland, UK, blh@st-and.ac.uk

1) Small Scale Manufacturing in the West Bank: Adjustments to a Change in Governance, *Benson L. Honig*, St. Andrews Univ., Dept. of Mgmt., The Scores, St. Andrews, Fife, KY169AL, Scotland,

UK, blh@st-and.ac.uk

We examine the performance of microenterprises in Ramallah and study the influence of human capital, SES, religiosity and financial capital of the owners of small-sized (less than 20 employees) manufacturers, as well as exploring their growth patterns, major problems, constraints and opportunities during a period of rapid change of governance.

2) Palestinian Businesses on the West Bank: An Exploratory Study of SME Exporting Activities, Motivation, Needs & Barriers, Samir Abuznaid, Hebron University, Israel, Isobel Doole, Nicola Stokell

A survey is to be carried out across the West Bank among a sample of SMEs to ascertain their perceptions to the motivations and barriers firms developing their markets internationally. This area is of particular interest at a time when the world community has been investing heavily in money and time in the region. We discuss the findings of the study and discuss the implications...

3) Profile of the Palestinian Entrepreneur from a Multi-Dimensional Perspective, Usamah Salim Shahwan, Hebron University, Sch. of Finance & Mgmt., PO Box 40, Hebron West Bank, Israel

We investigate whether the personality of the Palestinian entrepreneur is congruent with the prevailing stereotype image projected in the literature and whether a discrepancy exists between the public perception of the Palestinian entrepreneur and his/her true personality. The results could serve as an instructive tool to educate prospective Palestinian entrepreneurs...

Tuesday 08:30-10:00

TA01 MCDM Tools & Applications

Cluster: MCDM

Invited Session

Chair: Herbert Moskowitz, Purdue Univ., CMME, Krannert Grad. Sch. of Mgmt., W Lafayette, IN 47907

1) Quality Function Deploy for Manufacturing Planning & Strategy, Herbert Moskowitz, Purdue Univ., CMME, Krannert Grad. Sch. of Mgmt., W Lafayette, IN 47907

QFD is a cross-functional planning tool principally used to ensure that the "voice of the customer" is systematically integrated into the new product development and design process. We have formulated the QFD concept as a fuzzy multiobjective optimization problem and developed a novice-friendly DSS prototype, QFD Optimizer, as an implementation tool. The DSS interacts with the user to develop a pictorial representation of a problem in the form of a House of Quality and to then arrive at an optimal robust design to maximize customer value. We have recently deployed QFD Optimizer in a novel way to help a company establish a manufacturing strategy for a new plant to be located in a foreign location. We describe the process involved, including formulation and data collection, as well as results obtained. A lesson learned from this application is that QFD is a highly effective organizational tool for manufacturing planning and strategy, by relating competitive priorities and capabilities to manufacturing programs and activities as well as inter-relationships among the latter.

2) From Cognitive Maps to Multicriteria Models Toward a Formal Procedure for the Transition, Leonardo Ensslin, Univ. Federal de Santa Catarina, EPS CP 476, Florianopolis, SC, 88040-970, Brazil, ensslin@eps.ufsc.br, Gilberto Montibeller Neto

Cognitive maps allow a reasonable representation of how the organizational situation is perceived and understood by decision makers so they can be used to aid multicriteria model structuring. We propose a formal procedure for the transition from cognitive map to multicriteria model.

3) A Self-Sustaining System Applied to a Telecommunications Company, Carlos Antonio Bana e Costa, Univ. Tecnica de Lisboa, Instituto Superior Tecnico, CESUR, Lisboa, Portugal, Italo Jose J. Zanella, Sandro M. Noronha, Leonardo Ensslin

A cellular telephone company decided to expand its service to improve its position in the market. A previous MCDA model had supported the decision makers and with the changes in the decisional context, they decided to update the model. A new MCDA model is being developed to help them identify the most convenient set of actions in this new environment.

TA02 Electronic Commerce & Interorganizational Systems

Cluster: Global Information Technology & Management

Invited Session

Chair: Theodore Clark, HKUST, Dept. of ISM, Clear Water Bay, Kowloon, Hong Kong, tclark@ust.hk

1) Market Process Redesign Using Electronic Auction Systems

at AUCNET, Ho Geun Lee, Yonsei Univ., Dept. of Bus. Admin., Sch. of Bus. & Econ., Seoul, 120-749, Korea, hlee@base.yonsei.ac.kr, J. Christopher Westland

AUCNET is an electronic auction system for second-hand car transactions in Japan that separates product flows from market transaction processes by using computer and telecommunication technologies. On one hand, redesign of market transaction processes increases market efficiency. On the other, decoupling of product movement from market transactions creates new risks for market participants.

2) Electronic Railways: Remapping Space & Time in the Digital Age, J. Christopher Westland, HKUST, Dept. of ISM, Clear Water Bay, Kowloon, Hong Kong, westland@ust.hk, Theodore Clark

A revolution in commerce, with far reaching implications for competitive strategy over the next two decades, is taking place on multiple fronts using many technologies. Investment in the technologies of the global electronic market, as a percent of GDP, has now exceeded investment in its turn of the century networking counterpart - the railways. In the new competitive order, the scarce resource is customer attention - businesses are competing for "eyeballs." Each new information technology remaps the "distances" between people and places. We present a historical framework for understanding remapping of business via electronic markets.

3) Reengineering Financial Services & Banking Using the World Wide Web, Theodore Clark, HKUST, Dept. of ISM, Clear Water Bay, Kowloon, Hong Kong, tclark@ust.hk, Ho Geun Lee

Financial services pioneers are paving the way for a revolution in the way we will perform traditional banking and commerce functions in the future. Electronic commerce innovations have the potential to dramatically change the industry, but there are important barriers and challenges that will limit the potential for internet-banking alone to meet customers needs unless combined with traditional banking infrastructure. We examine both opportunities and barriers for on-line banking to transform the financial services industry.

4) Global Software Development Teams: Promises, Problems & Solutions, Erran Carmel, American Univ., Kogod Coll. of Bus. Admin., Mgmt. of Global Info. Tech., Washington, DC 20016-8044, ecarmel@american.edu

Global software development teams are composed of programmers and designers collaborating across international boundaries on the same project. Software development becomes even more complex when combined with the 3 problems inherent in global teams: culture (inclusive of language), distance and time-zones. Yet, software organizations are rushing into global development.

TA03 Service Sector Performance

Invited Session

Chair: Shawna Grosskopf, Southern IL Univ., Dept. of Economics, Carbondale, IL 62901-4515, shawnag@siu.edu

1) A Parametric Stochastic Distance Function Approach for Malmquist Estimation: The Case of Spanish Insurance Companies, Sergio Perelman, Univ. of Liege, CREPP, Liege, Belgium, sergio.perelman@ulg.ac.be, Hugo Fuentes, Emili Grifell-Tatje

We use stochastic frontier approach to estimate a Malmquist productivity index for a panel of Spanish insurance companies. Several radial distance functions are estimated to calculate and decompose a Malmquist index. Low rates of growth and technical change are estimated in spite of the deregulation process initiated in the mid 1980s.

2) Efficiency in Nursing Homes: A Comparative Study of Norwegian Municipalities & US Metropolitan & Non-Metropolitan Regions, Finn R. Forsund, University of Oslo, Dept. of Econ., SNF, Oslo, Norway, Natalie J. Webb

This study compares productivity between Norwegian and American nursing homes in 1995. We compare efficiency of care in 470 municipalities in North American counterparts. For both data sources, we have a number of clients, a measure of severity of need, net throughput of short-term clients, full-time equivalent employment and current expenses.

3) Incentives for Cost Efficiency & Quality of Care in Behavioral Health Care Delivery: A Malmquist Productivity Approach, Patricia Byrnes, OH State Univ., Sch. of Public Policy, 1775 College Rd., Columbus, OH 43210-1399, byrnes.3@osu.edu, Mark A. Freeman, Shawna Grosskopf

Cost efficiency incentives provided by managed care may conflict with quality of care. We use a Malmquist productivity index that incorporates quality of care to track behavioral health clients over time with outcomes assessment measures.

4) Allocative Inefficiency & School Composition, Kathy Hayes,

SMU, Dept. of Economics, Dallas, TX 75275-0496, *Shawna Grosskopf, Lori Taylor, Bill Weber*

We examine the extent to which competition for students influences the distribution of public school inefficiency in Texas. We use a Shephard input distance function to model educational production and use bootstrapping techniques to test for allocative inefficiencies. We find evidence of substantial inefficiency in the Texas school system.

5) Performance in Teaching Hospitals, Shawna Grosskopf, Southern IL Univ., Dept. of Economics, Carbondale, IL 62901-4515, shawnag@siu.edu, *Dimitri Margaritis, Vivian Valdmanis*

We extend our earlier work which compares frontiers of teaching and nonteaching hospitals in the US. First, we update our results with the most recent AHA data. Next, we include stochastic frontier estimates which allow us to address the issue of physician-resident substitutability.

TA04 Computational Methods for Queueing Systems

Cluster: Performance Analysis of Computer/Communication Systems
Invited Session

Chair: Beatrice Meini, Univ. of Pisa, Dept. of Math, via Buonarroti 2, Pisa, 56127, Italy, mein@unipi.it

1) Structure of Non-Skip-Free M/G/1 & G/M/1 Type Markov Chains, H. R. Gail, IBM, TJ Watson Research Ctr., Yorktown Heights, NY 10598, rgail@watson.ibm.com, *Sidney L. Hantler, B. A. Taylor*

Much work has recently been done modeling multiplexors and switches as M/G/1 or G/M/1 type Markov chains with n phases and m boundary levels. The usual techniques for solving these chains require reblocking the system so that it has 1 boundary level and mn phases or finding mn eigenpairs of a matrix valued function which may have eigenvalues of high multiplicity. These methods of solution may introduce numerical difficulties not inherent in the original formulation. We introduce a new iterative algorithm for solving such chains which does not require reblocking the system or finding eigenvalues and eigenvectors. We give examples of telecommunication systems which can be analyzed in this way and corresponding numerical results.

2) A New Fast Algorithm for Solving Non-Skip-Free M/G/1-Type Markov Chains, Dario Bini, Univ. of Pisa, Dept. of Math, via Buonarroti 2, Pisa, 56127, Italy, bini@dm.unipi.it, *Beatrice Meini*

We propose a new quadratically convergent algorithm for solving non-skip-free M/G/1-type Markov chains. This algorithm consists in applying the cyclic reduction technique to the reblocked M/G/1-type Markov chain and in exploiting the inner and outer Toeplitz structure. The algorithm, implemented by using FFT and Karatsuba's technique, is fast and reliable.

3) Parallel Computational Methods for Markov Modeling: The Case of Generalized Quasi-Birth-Death Processes, Françoise Le Gall, LAAS-CNRS, 7 ave du Colonel Roche, Toulouse Cedex 4, 31077, France, legall@laas.fr

We consider numerical iterative methods for the resolution of Markov chains. SOR, aggregation-disaggregation method of Takahashi and iterative Arnoldi method combined with a state reduction technique, are implemented on a Paragon machine and a cluster of workstations for the resolution of generalized quasi-birth-death processes.

4) An Efficient Algorithm for the Solution of Markov Chains with Banded Structure, Michela Meo, Politecnico di Torino, Dipt. di Elettronica, c.so Duca degli Abruzzi 24, Torino, 10129, Italy, michela@polito.it, *Marco Ajmone Marsan, Edmundo de Souza e Silva*

We propose an efficient algorithm for the computation of the steady-state solution of ergodic Markov chains in which the corresponding generator matrix is banded. Such structures often originate from queueing models of computer and communication systems. Advantages of the algorithm, such as its lower computational complexity when compared to other direct methods, are discussed as well as its disadvantages. The algorithm can be generalized to cope with infinite matrices with the considered banded structure.

TA05 Service Operations

Cluster: Service Operations Management
Invited Session

Chair: Sal R. Agnihotri, Binghamton Univ., School of Mgmt., Binghamton, NY 13902-6015, agni@binghamton.edu

1) Models for Process Flexibility in a Service Center, Robert Shumsky, Univ. of Rochester, Simon School, Rochester, NY 14627

We describe queueing models which examine the operational and financial tradeoffs between specialists and full-service employees in a telephone service center. We develop both exact and approximate models and derive insights into

the costs and benefits of flexibility.

2) Quality Metrics in Food Supply Chains, Jack C. Hayya, PA State Univ., 303 Beam BAB, University Park, PA 16802, *Xin Xin He, Ranga V. Ramasesh*

A goal of the food industry is delivery of quality products and to insure that freshness delivery must be made within a narrow time frame. Processing and distribution are key and the industry must be viewed as a supply chain. We examine how the measures of quality along the chain could be improved.

3) Measuring Hospital Efficiency: Parametric vs. Non-Parametric Approaches, Liam O'Neill, Univ. of IA, Div. Health Mgmt. & Policy, 2700 Steindler Bldg., Iowa City, IA 52242-1008

We examine the current state-of-the-art in the measurement of hospital efficiency. We apply both parametric and non-parametric approaches to measure the technical and allocative efficiency of 60 rural hospitals. The advantages and caveats of each method are discussed along with recommendations for the appropriate use of these techniques in health services research.

4) Improving Quality of Service in a Call Center, Sal R. Agnihotri, Binghamton Univ., School of Mgmt., Binghamton, NY 13902-6015, agni@binghamton.edu, *James Spring*

Because of increasing importance for customer service, more and more companies are establishing call centers, a clearinghouse for customer questions and complaints. We show how the undergraduate admissions office at the Binghamton University improved the quality of customer service and reduced incoming calls by understanding the causes for the telephone calls and eliminating these causes.

TA06 Operations Management & Quality

Invited Session

Chair: Benjamin H. Eichhorn, 17 N Ivy Ln., Cherry Hill, NJ 08002-1611, eichhorn@rider.edu

1) Computer-Aided Sales Training Using the Tag Along Trainer, William Strahle, Rider Univ., 2083 Lawrenceville Rd., Lawrenceville, NJ 08648, strahle@rider.edu, *Dale R. Fox*

The Tag Along Trainer is a windows-based program to help enhance salespeople's call planning and tour routing. The package is unique to each client's marketing situation and database needs. It provides an opportunity to apply the decision rules specific to a corporation through a series of simulated field situations.

2) Forecasting Generic Drug Use After Brand Patent Expiration, Lewis William Coopersmith, Rider Univ., 2083 Lawrenceville Rd., Lawrenceville, NJ 08648, coopersmith@rider.edu, *Jehoshua Eliashberg*

After a drug brand's patent expires, pharmaceutical companies make decisions related to marketing the generic product that rely on forecasts of the rate at which generic prescriptions co-exist or replace brand prescriptions. We discuss forecasting and managerial issues from the standpoint of the firm whose patent is due to expire.

3) The Quality Revolution of the 1980s & 1990s in the US: New Assumptions & Their Impact on the Use of Statistical Methods, Sanford Temkin, Rider Univ., 2083 Lawrenceville Rd., Lawrenceville, NJ 08648, temkin@rider.edu

Within just a few years, US companies have moved from statistical quality control narrowly applied to manufacturing to TQM and reengineering broadly focused on both goods and services. New variables are now important. The hierarchy of statistical methods is being reshuffled not by statisticians but by managers.

4) Screening & Relationships-Specific Investment in Supplier Management, Moti Levi, Univ. of Penn., The Wharton Sch., 1341 SH-DH, Philadelphia, PA 19104-6366, *Paul R. Kleindorfer*

We build on Seshadri (1995) in simultaneously solving the joint problem of screening an appropriate number of suppliers and investing in the quality of the resulting longer-term relationships with these suppliers. The results of this theoretical investigation are contrasted with empirical trends on supplier base size and structure.

TA07 Debt Valuation & Dividend Policy, the Term Structure of Interest Rates, Market Micro Structure

Cluster: Finance

Invited Session

Chair: Jaeyoung Sung, Univ. of IL, Dept. of Finance, MC 168, 601 S Morgan St., Chicago, IL 60607-7124, jsung@uic.edu

1) Debt Valuation, Strategic Debt Service & Optimal Dividend

Policy, Suresh Sundaresan, Columbia Univ., 415 Uris Hall, 3022 Broadway, New York, NY 10027-6902, msundare@research.gsb.columbia.edu, *Hua Fan*

The valuation of corporate securities, reorganization boundaries and firm's optimal dividend policies are studied in a framework where we model strategic interactions between debt holders and equity holders in a game theoretic setting. We distinguish between strategic defaults and liquidity induced defaults precipitated by covenants and characterize how each can occur.

2) **withdrawn - author request of 5/29, Ioulia Ioffe**, York Univ., Schulich Sch. of Bus., 4700 Keele St., North York, Ontario, M3J 1P3, Canada, iioffe@bs.yorku.ca, *Eliezer Z. Prisman, Alexandra E. MacKay*

3) **Specialist's Participation in Securities Markets, Jaeyoung Sung**, Univ. of IL, Dept. of Finance, MC 168, 601 S Morgan St., Chicago, IL 60607-7124, jsung@uic.edu, *Oleg Bondarenko*

We present a microstructure model to examine the specialist's optimal trading strategies when there are noise traders, limit order traders and an insider. We argue that the specialist adjusts his inventory by following the market when there are low noises in market orders and by using a contrarian strategy when there are high noises.

TA09 Supply Chain Logistics

Cluster: **Supply Chains**
Invited Session

Chair: **Kamalini Ramdas**, Univ. of VA, Darden Grad. Sch. Bus. Admin., PO Box 6550, Charlottesville, VA 22906, ramdask@darden.gbus.virginia.edu

1) **Multilocation Inventory Models with Transshipment & Decentralized Ordering Decisions, Nils Rudi**, Univ. of PA, The Wharton Sch., Dept. of OPIM, Philadelphia, PA 19104-6366, rudi@opim.wharton.upenn.edu, *Sandeep Kapur*

Inventory models with transshipment have been widely studied in the case of centralized decision making. In real world settings, however, the quantity and transshipment decisions are typically made locally. We model and analyze this setting and compare it to the case of centralized decision making.

2) **Analysis of Operational Decisions in Support of Time-Based Manufacturing, Elliott N. Weiss**, Univ. of VA, The Darden Sch., PO Box 6550, Charlottesville, VA 22906-6550, weiss@arden.gbus.virginia.edu

We evaluate the transition of a production process from make-to-stock to make-to-order. The operational issue we address is the management and location of the buffer point between which the production process switches from make-to-stock (buffer push) to make-to-order (market pull). Our framework identifies key operational issues that differ depending on whether decisions affect pre- or post-buffer operations. Questions that we address include where to invest in setup reduction, where to buffer, where to add capacity and how to manage and control the factors that affect the buffer points.

3) **An Architecture for the Concurrent Design of Product, Processes & Supply Chains: Integrality vs. Modularity, Morris A. Cohen**, Univ. of Pennsylvania, Wharton Sch., OPIM Dept., 3209 SH-DH, Philadelphia, PA 19104-6366, cohen@wharton.upenn.edu, *Charles H. Fine*

A framework for concurrent design of products, processes and supply chains is developed. Case studies, drawn from various industries, highlight interactions among these decisions and indicate how coordination can yield consistency and performance improvements, leading to competitive advantage. We present a model which illustrates the tradeoffs associated with these design decisions.

4) **Integrating Alternative Delivery Channels in Financial Services, Zeynep Oya Aksin**, INSEAD, Tech. Mgmt. Area, Blvd. de Constance, Fontainebleau Cedex, 77305, France, aksin@insead.fr

The recent decade has evidenced a rapid growth of alternative distribution channels, i.e., ATMs, call centers, PC- and Web-based banking, etc., for the delivery of financial services. We identify and model some operational issues concerning the integration of these new channels. Empirical evidence will be presented to motivate the problem.

TA10 Performance Evaluation & Optimization of Production Systems I

Cluster: **Queueing Models in Manufacturing & Service Systems**
Invited Session

Chair: **Baris Tan**, KOC University, Economics & Admin. Sci., Cayir Cad No. 5 Istinye, Istanbul, 80860, Turkey, btan@ku.edu.tr

1) **On the Performance of Various Operating Policies for Multi-Stage Make-to-Stock Production Systems, Fikri Karaesmen**, Univ. Pierre et Marie Curie, Lab. d'Info. de Paris 6, 4 Place Jussieu, Paris, 75252, France, kikri.karaesmen@rp.lip6.fr, *Yves P. Dallery*

Using a 2-stage make-to-stock production system, we investigate the desirable properties of production control mechanisms from the cost optimization point of view. We provide qualitative and quantitative results on the performance of various operating policies such as base stock, kanban, generalized kanban and extended kanban.

2) **Effects of Buffer Location & Sizing on Production Lines, Stanley B. Gershwin**, MIT, Lab. for Mfg. & Productivity, Dept. of ME, Cambridge, MA 02139-4307

Numerical evaluation and optimization experiments are performed on production lines with none, one or more well-defined bottlenecks; on systems in which machine event frequencies are similar and systems in which they differ markedly; and other cases of interest. Rules of thumb will be suggested on buffer placement and size.

3) **Buffer Capacity Allocation for a Desired Throughput in Production Lines, Hideaki Yamashita**, Sophia Univ., Dept. of Mech. Eng., Tokyo, Japan, *Tayfur Altioik*

We discuss finding the minimum-total-buffer allocation for a desired throughput in production lines with phase-type processing times. We have implemented a DP algorithm that uses a decomposition method to approximate the system throughput at every stage. We provide numerical examples to show the buffer allocation and compare corresponding simulated throughput and its bounds with the desired throughput.

4) **A Genetic Algorithm for Buffer Allocation in Reliable Production Lines, H. T. Papadopoulos**, Univ. of the Aegean, Dept. of Math, Karlovassi, Samos Island, 832 00, Greece, hpap@aegean.gr, *F. Karayannis*

We describe a GA approach for solving the buffer allocation problem in reliable production lines. The problem entails the determination of near optimal buffer allocation plans in large production lines with the objective of maximizing their average production rate. The latter is calculated utilizing a decomposition method. The allocation plan is calculated subject to a given amount of total buffer slots in a computationally efficient way.

TA11 Scheduling & Routing

Cluster: **Combinatorial Models for Manufacturing Scheduling & Routing**
Invited Session

Chair: **Moshe Dror**, Univ. of AZ, Coll. of Bus. & Public Admin., Dept. of MIS, Tucson, AZ 85721, mdror@bpa.arizona.edu

Co-Chair: **Gerd Finke**

1) **Integrated Production-Distribution Model in Manufacturing, Gerd Finke**, Leibniz-IMAG, 46 Ave. Felix Viallet, Grenoble, 38031, France, gerd.finke@imag.fr, *Clarisse Flipo*

We are interested in a multi-facility and multi-period industrial problem where production and distribution are both very important in terms of costs. We model the combined production-distribution problem in the form of a network flow problem with only a few 0-1 variables describing the linking constraints between the periods. Real-size problems are solved this way using CPLEX.

2) **AGV Routing Strategies in Flexible Flow Lines, Marie-Laure Espinouse**, Lab. Leibniz - IMAG, 46 Ave. Felix Viallet, Grenoble, 38031, France, marie-laure.espinouse@imag.fr, *Jacek Blazewicz, Gerd Finke, Grzegorz Pawlak*

We consider flowshops with AGVs as the material handling system. The AGVs are used for the transfer of parts between machines in classic flowshops and between stages in hybrid flowshops. We summarize the existing literature and present 2 approaches: a global routing algorithm and a procedure based on priorities rules.

3) **Heuristics for the Inventory Routing Problem with Satellite Facilities, Moshe Dror**, Univ. of AZ, Coll. of Bus. & Public Admin., Dept. of MIS, Tucson, AZ 85721, mdror@bpa.arizona.edu, *Jonathan F. Bard, Patrick Jaillet, Lucy Huang*

We discuss a decomposition scheme for solving the inventory routing problem in which a central supplier must restock customers on an intermittent basis. Customer demand is unknown and routing decisions taken over the short run might conflict with the long run goals of cost minimization. The routing aspect of the problem contains satellite facilities where vehicles can be reloaded and customer deliveries continued until the closing time is reached. Solutions are obtained with 3 heuristics: randomized Clarke-Wright, GRASP and modified sweep. Test results are presented for data sets generated from field experience with a national liquid propane distributor.

4) Redistribution of Electric Cars: A Case of Pick-Up & Delivery, Catherine Roucairol, Univ. de Versailles, PNN Parallelisme, 45 ac. des Etats-Unis, Versailles Cedex, 78035, France, catherine.roucairol@prism.uvsq.fr, Moshe Dror, Dominique Fortin, Philippe Michelin

For a large urban area, an alternative to public transportation and private cars is considered in the form of a "free" use of electric cars. We examine in detail the electric car redistribution problem. The problem is modeled as that of less than truck load pickup and delivery with nonsimple paths allowing for split pickups and deliveries. We propose a solution approach which results in a more "convenient" mathematical description facilitating the application of various mixed-integer solution methodologies.

**TA12 Manufacturing
Contributed Session**

Chair: Yehonathan Hazony, Boston Univ., Dept. of Mfg. Eng., College of Eng., Boston, MA 02215, hazony@enga.bu.edu

1) A Comparison of Throughput Between Dual-Blade & Single-Blade Semiconductor Cluster Tools, Srilakshmi Venkatesh, Applied Materials, 2151 Mission College Blvd., Mail Stop 2554, Santa Clara, CA 95054, venkatesh_s@amat.com

We present an analysis of steady-state throughput in a cluster tool with a dual-blade robot, along with a comparison with a single-blade robot. The analysis indicates that a dual-blade tool performs at least as good as an equivalent single-blade tool. Expressions derived for throughput can be easily used by practicing engineers to estimate cluster tool throughput.

2) Alternative Job Designs & Their Implication on Productivity in Flexible Assembly Lines, Leonora Fuxman, St. John's Univ., Mgmt. Dept., CBA, Jamaica, NY 11439, fuxmanl@stjohns.edu

We investigate several alternative job design strategies in labor intensive mixed-model assembly lines. Task-sharing strategies and equipment-sharing strategies are being considered. Productivity implications of these job design strategies are evaluated. The impact on scheduling and control issues is discussed.

3) Tools for Deterministic Process Cell Design, Yehonathan Hazony, Boston Univ., Dept. of Mfg. Eng., College of Eng., Boston, MA 02215, hazony@enga.bu.edu

A deterministic modeling-platform has been developed for integrated design/implementation of process calls, employing deterministic networks of entities and rules. Rule-based models are amenable to automatic implementation of process controllers. The modeling-platform is built on an "algebra of nested arrays" which was originally developed for large-scale and complex data bases...

TA13 Heuristic Search Methods for Mobile Radio Applications

Cluster: Heuristic Programming & Applications
Invited Session

Chair: Heinz Muehlenbein, GMD Forschungszentrum Info., Sankt Augustin, D-53754, Germany, muehlenbein@gmd.de

1) An Introduction to Optimization Problems in Mobile Radio Applications, Heinz Muehlenbein, GMD Forschungszentrum Info., Sankt Augustin, D-53754, Germany, muehlenbein@gmd.de

Capacity and service quality are the main performance factors of a mobile communication network. For the design of a network, complex software is used, from simulation of propagation prediction to optimization of particular aspects. Two major optimization problems have been identified so far - the positioning of sites and the assignment of frequencies.

2) A Practical Frequency Assignment Problem & Its Heuristic Solution, Christine Crisan, GMD Forschungszentrum Informationstechnik, Sankt Augustin, D-53754, Germany, crisan@gmd.de

In the FAP, each antenna defines a cell, which is the area of the network which will be served by the corresponding antenna. The number of required frequencies by an antenna is given by the expected amount of traffic in the corresponding cell and the interferences to other cells. Based on data supplied by DeTeMobil, we describe the FAP and give a mathematical description of the resulting optimization problem.

3) Effect of Constraints on Minimum Span Frequency Assignment, Steve Hurlley, Univ. of Wales Cardiff, Dept. of Computer Science, PO Box 916, Cardiff, CF2 3XF, Wales, steve@cs.

cf.ac.uk, P. J. Durrant, D. H. Smith

When assigning frequencies to base stations, network operators often use an interference, or constraint, matrix to model the minimum channel separation required between pairs of base stations. We will present assignments, obtained using SA, that only require an acceptable signal-to-interference ratio to be satisfied. These assignments will be compared to those obtained using binary constraints.

**TA14 Dynamic Programming & Control
Invited Session**

Chair: Adi Ben-Israel, Rutgers Univ., RUTCOR, Piscataway, NJ 08854-8003, bisrael@rutcor.rutgers.edu

1) Optimal Search on a Stochastic Tree with an Application to Multi-Phased R&D Scheduling, Uriel Rothblum, Technion, Dept. of IE & Mgmt., Haifa, 32000, Israel, rothblum@ie.technion.ac.il, Eric V. Denardo, B. Curtis Eaves

We consider the problem of determining a path of feasible edges from the root of a directed tree to any one of its endpoints so as to minimize the expected search cost. Each edge in the tree is characterized by an exploration cost and a feasibility distribution. When an edge is explored and found infeasible, all paths using this edge become infeasible too, and other paths must be looked for. An algorithm for solving the problem is provided. The obtained solution exhibits the dynamic aspect of searches in this setting. In particular, one may encounter repeated jumping between different parts of the tree.

2) Stochastic Dynamic Programming with Risk Aversion, E. G. Read, Univ. of Canterbury, MS Dept., Christchurch, New Zealand, g.read@mang.canterbury.ac.nz, John Kaye

We consider a classic stochastic DP problem, in which the decision maker wishes to maximize the expected utility derived from the total profit, say, collected over the entire planning horizon. This problem cannot be decomposed in the normal fashion because the incremental utility which will ultimately be derived from each period's profit depends on the profits achieved in all past and future periods...

3) Modeling Risk Attitude in Stochastic Dynamic Programming, Adi Ben-Israel, Rutgers Univ., RUTCOR, Piscataway, NJ 08854-8003, bisrael@rutcor.rutgers.edu

Markov decision processes are usually solved by using the Bellman optimality principle recursively to maximize the expected value of the discounted sum of future profits. This approach assumes risk neutrality. An alternative approach, with explicit modeling of risk is proposed. It uses the certainty equivalents of Ben-Israel & Ben-Tal (1977). Applications to problems of maintenance, inventory control and finance will be shown...

TA15 Scheduling

Cluster: Applied Probability
Invited Session

Chair: Esther Frostig, Univ. of Haifa, Dept. of Stats., Haifa, Israel

1) Optimal Release Times in Transfer Lines: An Optimal-Control Perspective, Yorai Y. Wardi, GA Inst. of Tech., Sch. of Elect. & Comp. Eng., Atlanta, GA 30332

Consider the problem of minimizing a cost measure related to products' earliness and tardiness, as a function of parts' release times, in a transfer line. Optimal-control techniques are applied for solving this optimization problem. Based on the concept of the costate, optimality conditions are derived and a numerical algorithm proposed.

2) Job Shop: An Application of Fluid Approximation, Michal Penn, Technion Israel Inst. of Tech., Fac. of IE & Mgmt., Technion City, Haifa, 32000, Israel, mpenn@ie.technion.ac.il, Tamy Itman, Gideon Weiss

We consider the job shop scheduling problem where one seeks for minimum makespan. This problem is NP-hard. We show it can be crudely approximated by a continuous deterministic fluid scheduling problem, with buffers of fluid representing the jobs waiting for each operation. We describe a heuristic which imitates the fluid solution. At any time when a machine finishes processing an operation, we show how to decide, based on the fluid solution, which of the buffers waiting for this machine is the one from which to take the next job to be processed.

3) Machine Repairman Problems with Fixed Repair Time, Esther Frostig, Univ. of Haifa, Dept. of Stats., Haifa, Israel

Consider a reliability system consisting of n components in series. We assume that the time until failure is exponentially distributed with rate λ_i . There is one repairman and the repair time is fixed and equal to r . No preemptions are permitted during a repair. We assume that the repairman has a list of components and when he is available he repairs the failed component which is

closest to the top of the list. We prove that when the components in the list are ordered in an increasing order of the components' failure rate, the expected time until all the components work is minimized.

4) Scheduling in the Service Sector: Theory & Applications, Michael L. Pinedo, NYU, Stern Sch. of Bus., New York, NY 10027

We focus on 3 classes of models. The first deals with interval scheduling problems which come up in reservation systems. The second class is referred to as time tabling models and the third deals with workforce scheduling. With regard to all classes, we discuss the theory as well as heuristics.

TA16 Panel: Management Education

Invited Session

Chair: David Feldman, The Interdisciplinary Ctr., PO Box 167, Herzlia, 46150, Israel, dfeldman@idc.ac.il

1) Panel: Management Education, Amir Barnea, The Interdisciplinary Ctr. Herzlia, Finance Faculty, PO Box 167, Herzlia, 46150, Israel, barnea@idc.ac.il, **Reuven Behar, Morris A. Cohen, Jehoshua Eliashberg, Benjamin Melamed, Israel I. Zang**

How to best prepare management students for the challenges of the "real world"? Should programs be "hard" or "soft"? Are undergraduate programs preferred? What is the message in the business school rankings? Is interdisciplinary education effective? Panelists will discuss aspects of these questions and the Wharton experience in developing a Marketing-Operations major.

TA17 Fluid Models & Large Deviations in Queuing I

Cluster: Queues

Invited Session

Chair: Alexander L. Stolyar, Motorola, Arlington Heights, IL 60004, stolyar@cig.mot.com

1) Large Delays in Systems with LIFO & Priority Disciplines, E. A. Pechersky, Inst. for Problems of Info. Transmission, Moscow, Russia

The probabilities of large delays in systems with several queueing disciplines are analyzed using the large deviations techniques. It is shown that in the case of LIFO discipline, large delay is more probable than in the case of FIFO discipline. The priority discipline is also discussed.

2) The Stability of a Virtual Circuit Merge Point with the "Cut-Through" Feature, Alexander L. Stolyar, Motorola, Arlington Heights, IL 60004, stolyar@cig.mot.com

We consider a queueing model of a merge point of a multipoint-to-multipoint multicast tree. The model is a single-server polling system with several independent ON-OFF fluid sources. When a source is ON, it generates fluid at some fixed rate which is strictly less than 1. The server can process fluid at the maximum rate 1. We always assume that the system is NOT inherently overloaded...

3) Tree & Tandem ATM Multiplexing Networks: Queueing Analysis & Simulation, Michael Shalmon, Univ. of Quebec, INRS-Telecom, 16 Place du Commerce, Verdun, Quebec, H3E 1H6, Canada, shalmon@inrs-telecom.quebec.ca

We discuss the end-to-end queueing analysis for several service disciplines and the efficiency of stochastic simulation techniques for the case of sources with ON periods generally distributed and possibly long-tailed (subexponential).

TA18 Technology Roadmapping: Strategic & Operational Considerations & Experiences

Cluster: Technology & Productivity

Invited Session

Chair: Michael Radnor, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., 2001 Sheridan Rd., Evanston, IL 60208, m-radnor@nwu.edu

1) Technology Roadmapping: The Whys, The Whens, The Hows & The Risks, Michael Radnor, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., 2001 Sheridan Rd., Evanston, IL 60208, m-radnor@nwu.edu

Reasons for current interest and practice and the conceptual basis for the NCMS project work on roadmapping are provided as an introduction to the presentations and the following workshop.

2) Roadmapping & Roadmaps, Richard E. Albright, Lucent Technologies (Bell Labs), 600 Mountain Ave., Rm. 3D-574, Murray Hill, NJ 07974, ralbright@lucent.com, **John W. Peterson**

Methods for linking business strategies to technology investment, driven by

customer needs will be described. Based on the experience of Lucent and other companies, best practice processes and tools for implementation, decision making and organizational buy-in will be provided.

3) Organizational Learning Knowledge & the Technology Roadmapping Process, Thomas A. Kappel, Northwestern Univ., IE/MS Dept. Kellogg Grad. Sch., 2001 Sheridan Rd., Evanston, IL 60208, tkappel@nwu.edu, **Daniel Z. Levin**

Technology roadmapping encompasses all stages of organizational learning: knowledge acquisition, transfer, storage and use. It provides a structure to acquire knowledge on market drivers, technology trends and strategies; creates a forum and common language for R&D, business unit engineering and marketing to transfer and communicate knowledge; enables participants to capture and store much of this knowledge...

4) Roadmapping, the Intellectual Property Requirements & Opportunities, David H. Sitrick, Sitrick & Sitrick, 8340 N Lincoln Ave., Ste. 201, Skokie, IL 60077, sitrick@aol.com

Drawing on experience from a variety of corporations, the centrality of incorporating patent and other forms of intellectual property protection in roadmaps will be laid out. Tools for enabling this and avoiding typical errors, as well as the types of benefits to be gained from properly managed IP roadmapping processes, are described.

5) Practical Experience with Implementing a Technology Roadmapping Process, Alec McMillan, Rockwell Automation, 1 Allen-Bradley Dr., Mayfield Heights, OH 44124-6118, alec.mcmillan@ab.com

Rockwell's experience in designing and implementing a technology roadmapping process and its evolution over a 4-year period will be described. Lessons learned and contextually relevant implementation guidelines are provided.

TA19 Continuous Location Problems

Cluster: Location Analysis

Invited Session

Chair: Zvi Drezner, CA State University, Dept. of MS/IS, Fullerton, CA 92834, zdrezner@fullerton.edu

1) Anticoverage Model for Hazardous Material Transportation, Vladimir Marianov, U Catolica de Chile, Dept. Ing. Electrica, Casilla 6177, Correo 22, Santiago, Chile, marianov@ing.puc.cl, **Charles ReVelle, Sam J.S. Shih**

We formulate a new shortest-path-minimum-coverage model that considers the increasing, decreasing or just different effects of consecutive exposures of a town or population node when there is multiple exposition of the same population to a hazardous material. It is not possible to reformulate this model as a multiple-criterion-shortest-path formulation. Computational experience is provided.

2) Generalized Spatial Interaction Location Models, Oded Berman, Univ. of Toronto, 105 St. George St., Rotman School of Mgmt., Toronto, Ontario, M5S 3E6, Canada, berman@mgmt.utoronto.ca, **Dmitri Krass**

A major assumption of spatial interaction locations models is that the whole available market is split up between the facilities. Thus, the problem of locating facilities is relevant only in the presence of existing facilities. The above assumption is relaxed, allowing to model both competing and non-competing facilities.

3) On Assessing the Attractiveness of Facilities, Tammy Drezner, CA State University, Dept. of Mktg., Fullerton, CA 92834, tdrezner@fullerton.edu, **Zvi Drezner**

Existing methods for the determination of facility attractiveness are based on the assumption that the attractiveness of a facility is a composite of many attributes. Such attributes are listed and estimated, and a composite attractiveness level for each facility is constructed. Such procedures require extensive research and analysis. We take the reverse approach...

TA20 Developing Economies

Contributed Session

Chair: C. Kenneth Jones, American Univ. in Cairo, College of Bus., PO Box 2511, 113 Kasr El Aini St., Cairo, 11511, Egypt, kenjones@acs.auc.eun.eg

1) Management of Applied Research: The Practice of an International Contract Research Organization, Dieter R. Fuchs, Fraunhofer-Gessellsc, Germany

The Fränhofer-Gesellschaft maintains more than 70 institutes and branch labs of applied research and development in Germany, as well as subsidiaries, resource

centers and representative offices in the US and Asia. Situated at a focal interface between basic research, publicly funded applied research and directly contracted technology input for industry, experiences in handling such business illustrate specific management challenges in this context. The performance is characterized by well-balanced central/de-central strategies and decision making highly delegated scientific and financial responsibilities as well as pragmatic, client-oriented project management.

2) **Portfolio Selection and Signal Processing**, *C. Kenneth Jones*, American Univ. in Cairo, College of Bus., PO Box 2511, 113 Kasr El Aini St., Cairo, 11511, Egypt, kenjones@acs.auc.eun.eg

We formulate a portfolio selection model in a mean-variance framework using digital signal processing. The risk in each securities return signal is decomposed into risk power spectra and cross correlation spectra. The signal processing portfolio selection model maximizes portfolio return subject to a set of linear constraints.

Tuesday 10:15-11:45

TB01 MCDM in Managing Telecommunications Networks

Cluster: MCDM

Invited Session

Chair: To be announced

1) **On the Theoretical Background of Multi-Layer Telecommunication Network Design**, *Michal Piore*, Warsaw Univ. of Tech., Inst. of Telecommunications, Nowowiejska 15/19, Warsaw, 00-665, Poland, mpp@telepw.edu.pl michal.piore@tts.lth.se

The multi-layer telecommunication design problems are, in general, too complex to be solved straightforwardly for networks of realistic size; therefore, some kind of their decomposition and simplification must be applied in the engineering practice. The basic approach is based on the iterative use of adequate instances of single-layer design tasks for the consecutive network resource layers, from top to bottom. For each task, solved for a particular layer, the demand is specified by the current capacities of the next upper layer links, while the link marginal cost coefficients and link availability coefficients are determined by the current configuration of the next lower layer. We present certain theoretical issues which are helpful in understanding the nature of a practical (heuristic) iterative design scheme applied in the multi-layer design. We consider a flow network with 3 layers and formulate a 3-layer robust design problem. Then using the dual optimization technique, we prove a basic theorem on the problem decomposition. Then, we show how extensions of the theorem can be used in practice. Finally, we discuss multicriteria extensions of the basic robust design problem.

2) **withdrawn - author request of 5/18**, *David Brittain*, Univ. of Bristol, Design Information Group, 83 Woodland Rd., Bristol, UK, david.brittain.bristol.ac.uk

3) **Mathematical Modeling in the Design of Telecommunication Networks**, *J. Granat*, Warsaw Univ. of Tech., Inst. of Control & Comp. Eng., ul. Nowowiejska 15/9, Warsaw, 00-665, Poland, *A. P. Wierzbicki*

Due to increasing diversity in services and advances in telecommunication technology, telecommunications operators are looking for new advanced tools for the design of telecommunications networks. Recent advances in mathematical modeling can be applied to solving telecommunications problems. We present various approaches to mathematical modeling and how they can be used in the design of telecommunication networks. We stress the possibility of applying multicriteria analysis.

TB02 Impact of Information & Telecommunication Technology in the Global Marketplace

Cluster: Global Information Technology & Management

Invited Session

Chair: Olivia R. Liu Sheng, Univ. of AZ, MIS Dept., Coll. of BPA, Tucson, AZ 85721, oliviasheng@bpa.arizona.edu

1) **A Consumer's Trust in an Online Internet Merchant: A Multi-Country Study**, *Sirkka Jarvenpaa*, Univ. of TX, Dept. of MSIS, CBA 5.202, Austin, TX 78712-1175, *Noam Tractinsky*

We develop and empirically test a theoretical model from the consumer viewpoint on the determinants of online store and merchant trustworthiness and how trustworthiness and other consumer characteristics affect the consumer's risk perception and the risk perception affects the shopper's willingness to buy from merchants located in his home town vs. those located in his home country vs. those located in international locations. Data will be reported from Australia, Israel, the US and Finland.

2) **Comparison of the Public Telecommunication Sector in Asia-Pacific Economic Cooperation Countries & Regions**, *Olivia R. Liu*

Sheng, Univ. of AZ, MIS Dept., Coll. of BPA, Tucson, AZ 85721, oliviasheng@bpa.arizona.edu, *Zehai Zhou*

APEC is a regional forum set up in 1989 for high level government-to-government dialogue on trade and economic issues. We explore the productivity of public telecommunication sectors in APEC countries and regions. Several different efficiency concepts will be employed to find the major differences in productivity and the effect of several major factors will be investigated. Suggestions are made to improve the productivity of the public telecommunication sector in the developing countries in this area.

3) **Physicians' Acceptance of Telemedicine Technology: A Theory Comparison Approach**, *Paul Jen-Hwa Hu*, Univ. of South FL, Dept. of IS & DS, Coll. of Bus. Admin., Tampa, FL, *Olivia R. Liu Sheng*, *Patrick Y. K. Chau*, *Kar Yan Tam*

Telemedicine is an IT-based innovation that has considerable impacts on individual physicians and health care organizations. We tested and compared the explanatory and predictive power of technology acceptance models and theory of planned behavior for physicians' technology acceptance by surveying physicians practicing at public tertiary hospitals in Hong Kong.

4) **Teleworkers' Email Use & Work Productivity**, *Olivia R. Liu Sheng*, Univ. of AZ, MIS Dept., Coll. of BPA, Tucson, AZ 85721, oliviasheng@bpa.arizona.edu, *Bongsik Shin*, *Kunihiko Higa*

An empirical study was performed to understand the role of individual-, contextual-, and social-level factors on the media choice behaviors of remotely scattered teleworkers. We then examined how the media choice and other individual and social factors affect teleworkers' perception on information-carrying capability and productivity of email.

TB03 Attitude Modeling: Issues & Measurement

Invited Session

Chair: Naresh K. Malhotra, GA Inst. of Tech., DuPree Sch. of Mgmt., Ivan Allen College, Atlanta, GA 30332-0520, naresh.malhotra@mgt.gatech.edu

1) **An Integrated Model of Attitude & Affect**, *James Agarwal*, Univ. of Regina, Fac. of Admin., Rm. 456, Education Bldg., Regina, Saskatchewan, S4S 0A2, Canada, agarwalj@leroy.cc.uregina.ca, *Naresh K. Malhotra*

The affect (feelings and emotions) and attitude (evaluative judgment based on brand beliefs) streams of research are combined to propose an integrated model of preference, intention and choice. The proposed integrated model is tested on a product category (sneakers) as well as a service category (insurance). The model fit is tested and compared to other alternative models...

2) **Attitude Measurement & Attitude Models: Problems & Alternatives**, *Richard P. Bagozzi*, Univ. of Michigan, Bus. Sch., 701 Tappan St., Ann Arbor, MI 48109-1234, bagozzi@umich.edu

Expectancy-value attitude models are commonly used in marketing for representing preferences and predicting choice and intentions to purchase a product or service. Four problems can be identified with expectancy-value models. An alternate approach is proposed based on cognitive schemas where values, goals or motives and linkages among these, determine preferences, choice and intention.

3) **A Model of Attitude-Behavior Discrepancy**, *Jagdish Sheth*, Emory Univ., School of Bus., Atlanta, GA 30322, Jagdish_Sheth@bus.emory.edu

Behavior discrepancy is identified and explained in terms of underlying factors. A conceptual model is presented and several hypotheses are discussed.

4) **Modeling Advertising Effectiveness: A Motivation-Emotion-Matching Approach**, *Mark Peterson*, Univ. of TX, Dept. of Mktg. Coll. of Bus., POB 19469, Arlington, TX 76019-0469, markpete@utarl.g.uta.edu, *Naresh K. Malhotra*

Prime theory serves as the meta-theoretical framework for the MEM model which takes a cognitive perspective. A model is developed and tested with encouraging results. In an empirical investigation comparing 4 models of advertising effectiveness, the MEM model returned comparative fit indices superior to all 4 models. It also provides new copytesting techniques for scholarly and applied research of affective TV ads.

TB04 Performance Models & Solution Techniques in Communication Systems I

Cluster: Performance Analysis of Computer/Communication Systems

Invited Session

Chair: Edmundo de Souza e Silva, Federal Univ. of Rio de Janeiro, NCE, Rio de Janeiro, Brazil, edmundo@nce.ufrj.br

1) Performance Evaluation of Mobile Location Update Protocol with Dynamic Location Area Assignment, John C.S. Lui. The Chinese Univ. of Hong Kong, Dept. of Computer Science, Shatin, NT, Hong Kong, cslui@cs.cuhk.hk

Currently, many location update protocols have been proposed for mobile terminal tracking in cellular networks. These protocols, such as the time-based and the distance-based protocols, try to minimize the system overhead for locating a mobile user in the network. Performance analyses are carried out to evaluate these protocols. In these analyses, however, the models used are too simple to capture important movement characteristics so that the performance of these protocols under real deployments may not be accurately analyzed. We derive a novel mathematical model to analyze different protocol. This model can capture many important features of user movements, such as geographically dependent movement, directional movement and non-exponential distribution of cell dwell times and at the same time, can dynamically assign the registration area to each mobile user based on his/her movement pattern. Since the location prediction is much more accurate under this scheme, the protocol is more efficient, thereby making the overall system more cost-effective.

2) Design & Performance Evaluation of a Distributed Congestion Control Mechanism for Wireless Local Area Networks, Lorenzo Donatello. Univ. of Bologna, Dept. of Computer Science, Piazza di Porta S. Donato, 5, Bologna, 40127, Italy, donat@cs.unibo.it, **Luciano Bononi, Marco Conti**

We propose and analyze, from a performance viewpoint, a distributed congestion control mechanism for wireless LANs. The proposed mechanism integrates the standard MAC protocol 802.11 guaranteeing fairness property with no overhead. Results indicate that our distributed congestion control mechanism significantly improves the maximum throughput of the IEEE 802.11 MAC protocol.

3) Calculating Traffic Descriptors from Markovian Models of Multimedia, Edmundo de Souza e Silva, Federal Univ. of Rio de Janeiro, NCE, Rio de Janeiro, Brazil, edmundo@nce.ufrj.br, **Rosa M.L.R. Carmo, Sidney C. de Lucena**

Multimedia networks must support a variety of services with distinct traffic characteristics. To properly tune the network resources, it is necessary to develop accurate models of the traffic submitted to the network. Markovian models constitute a class of such models that can represent dependencies between interarrival times. Several traffic descriptors have been proposed to guide the design process. However, analytical expressions for the descriptors only exist for very simple Markovian models. We obtain expressions for several traffic descriptors from general Markov models based on transient analysis. We also present a few examples that illustrate the results obtained.

TB05 Marketing Strategy & Signaling

Invited Session

Chair: Talia Rymon, The Interdisciplinary Ctr., PO Box 167, Herzlia, 46150, Israel

1) Competitive Interplay & the Potential for Pricing Bluffs: An Empirical Study, Talia Rymon, The Interdisciplinary Ctr., PO Box 167, Herzlia, 46150, Israel, **Jehoshua Eliashberg, Thomas Robertson**

Our objective is to understand 2 phenomenon: under what conditions is it plausible for a sender to bluff when making announcements? And when should a receiver believe a competitor's announcement? We invoke a gaming perspective and focus specifically on price increase announcements. Experiments were conducted with practicing managers to assess these questions under various scenarios...

2) Product Preannouncement, Market Cannibalization & Price Competition, Delphine Manceau, Groupe ESCP, 79 ave. de la Republique, Paris, 75011, France, manceau@escp.fr, **Francis Bloch**

We develop a theoretical model to analyze the firms' incentives to preannounce their new products. Through a 2-period model, we study the consequences of an early announcement for incumbent firms and new entrants on a market.

3) Signaling Strategies in Competitive Interaction, Jaideep Prabhu, Tilburg Univ., PO Box 90153, Tilburg, 5000 LE, The Netherlands, j.prabhu@kub.nl, **David Stewart**

No abstract supplied.

TB06 Marketing Research I

Contributed Session

Chair: Oded Lowengart, Ben-Gurion Univ., Sch. of Mgmt., P.O. Box 653, Beer-Sheba, 84105, Israel, odedl@bgumail.bgu.ac.il

1) Improving Market Simulations By Use of Multiple Data

Sources, Markus C. Feurstein, Vienna Univ. of Econ. & BA, Pappenheimgasse 35/3, Vienna, 1200, Austria, markus.feurstein@wu-wien.ac.at, **Martin Natter**

Based on different data sources, i.e., AC Nielsen Brand Track data, conjoint interview data and AC Nielsen POS scanning data, we develop a microsimulation model for nondurable products. We evaluate the microsimulation model on weekly prices and sales known from weekly shop data.

2) Satisfaction Guaranteed as A Surplus Extracting Device, Gila E. Fruchter, Technion-Israel Inst. of Tech., Fac. of Indust. Eng. & Mgmt., Technion, Haifa, 32000, ISRAEL, iernf102@tx.technion.ac.il, **Eitan Gerstner**

"Satisfaction guaranteed" is any guarantee policy assuring that no customer obtains negative surplus from a purchase transaction. We show that the most profitable guarantee policy can be a satisfaction guaranteed policy that exactly compensates dissatisfied customers for all the costs involved in an unsatisfactory transaction. Conditions under which satisfaction guaranteed is more profitable than selling without such a policy are derived...

3) Extreme Value Reference Price Modeling, Oded Lowengart, Ben-Gurion Univ., Sch. of Mgmt., P.O. Box 653, Beer-Sheba, 84105, Israel, odedl@bgumail.bgu.ac.il, **Sanjoy Ghose**

The notion of reference price is well established in the marketing literature and is mainly used to model price effects on consumers' choice. We introduce a new way of conceptualization and operationalization of internal reference price and overcome some of the drawbacks inherent in current reference price modeling.

4) Equilibrium Price Communication by Competing Supermarkets, Ram C. Rao, Univ. of TX at Dallas, Sch. of Management, PO Box 830688, MS JO51, Richardson, TX 75083-0688, **Niladri Syam**

We address how competing retailers might advertise prices of goods they carry. Following Lal & Matutes, a model of supermarket competition is developed in which 2 retailers compete for consumers located on a linear market and who desire to buy 2 goods carried by each retailer. Retailers are assumed to be able to advertise only one good in keeping with the fact that in real life, they cannot advertise the entire product assortment they carry. Consumers are assumed to have rational expectations of unadvertised prices in the manner of Lal & Matutes and Lal & Rao. These expectations are fulfilled in equilibrium. The competition is modeled as a multi-stage game, and the equilibrium concept invoked is the sub-game perfect equilibrium under rational expectations of consumers. In the first stage, each retailer decides which good to advertise and what its price should be. In the second, stores choose the price of the unadvertised good and consumers decide which store(s) to visit and what good(s) to buy at each store, based on the advertised prices and expectations of prices of unadvertised goods. After visiting a store and learning the price of the unadvertised goods, in the third stage, consumers may revise their original plan of purchase made in the second stage. Given their rational expectations, such an outcome does not obtain in equilibrium, though the game allows this in order to be able to analyze off-equilibrium outcomes. The presentation obtains the surprising result that in equilibrium, stores may want to have unadvertised specials, i.e., have prices of unadvertised goods below the reservation price of consumers. This equilibrium is part of a mixed strategy equilibrium in which each store advertises the price of each good with probability 0.5. If, in the first stage, both stores advertise the same good, there is no unadvertised special. The other good's price is at the reservation price. This is identical to the result of Lal & Matutes. If, on the other hand, the stores advertise the price of opposite goods, they offer unadvertised specials such that all consumers buy both goods at one store or the other. Although there exists 2 (pure strategy) equilibria in which both stores advertise the same good as in Lal & Matutes, whenever the mixed strategy equilibrium exists, it is superior from the viewpoint of both retailers. Finally, we show that as the number of products in the assortment increases, the probability of unadvertised specials increases, and in the limiting case of an infinite number of products, each retailer acts as a monopolist over "its" half of the market. This is a counterpart of the celebrated result due to Diamond for the single product in which there is no role for advertising.

TB07 Market Entropy & Efficiency

Cluster: Finance

Invited Session

Chair: Michael Stutzer, Univ. of IA, Pappajohn Sch. of Bus. Admin., Iowa City, IA 52242, michael-stutzer@uiowa.edu

1) Efficiency & Virtual Efficiency, Michael Dothan, Willamette Univ., Atkinson Grad. Sch. of Mgmt., Salem, OR 97301, mdothan@willamette.edu

We examine the relationship of the martingale model of market efficiency to the intuitive meaning of market efficiency. We argue that the martingale model does not fully capture the intuitive meaning of market efficiency and proposed to

replace it with a new model of "virtual efficiency."

2) **Entropy, Likelihood & Uncertainty: A Guided Tour with a Social Accounting Matrix**, *Amos Golan*, American Univ., Dept. of Economics, 4400 Massachusetts Ave. NW, Washington, DC 20016, agolan@american.edu

An informational comparison of entropy and likelihood approaches is made. Given aggregated and noisy data, a framework for estimating the entries of a SAM (matrix balancing) is developed. Information measures, inference and diagnostics are developed. This new statistically and computationally efficient estimator is viewed as a generalized maximum likelihood estimator.

3) **Entropic Interpretation of the Market Price of Risk**, *Michael Stutzer*, Univ. of IA, Pappajohn Sch. of Bus. Admin., Iowa City, IA 52242, michael-stutzer@uiowa.edu

Entropy maximizing risk-neutral probabilities have received much attention. Here, large deviations theory is used to establish a connection between these risk-neutral probabilities and the market price of risk. By-products of this connection include a simplified derivation of the Black-Scholes option pricing model and a nonparametric correction to that model that incorporates the effects of return non-normalities.

TB08 Portfolio Management

Contributed Session

Chair: Dong X. Shaw, Purdue Univ., Sch. of IE, W Lafayette, IN 47907, shawdx@ecn.purdue.edu

1) **On a Neighborhood Structure for Portfolio Selection Problems**, *Fernando J. Catanas*, Imperial Coll., Ctr. for Quant. Finance, London, SW7 2BX, UK, catana@k.ac.uk

The PSP, in its basic formulation, consists of the determination of the proportions of wealth to allocate to each of a set of securities. In the most common assumption, the PSP can be formulated as a quadratic programming problem for which exact algorithms are known. However, often the objective function suffers from pathologies such as non-linearities and non-convexity...

2) **On the Notion of the Best (Mean, Variance) Portfolio**, *Leonid Churilov*, Univ. of Melbourne, Dept. of Math & Stats., Parkville, Victoria, 3052, Australia, churil@ms.unimelb.edu.au, *Moshe Sniedovich*

We discuss a notion of the best, subject to investor's system of preferences, (mean, variance)-portfolio. The discussion is based on quantifying the investment options via introduction of the composite utility function for the (mean, variance)-pair. Composite programming techniques are used for handling the resulting decision making model.

3) **Optimal Investment Under Risk: A Linear Programming Application**, *Edwin S. Shapiro*, Univ. of San Francisco, 2130 Fulton St., San Francisco, CA 94117, shapiroe@usfca.edu

An investor wishes to allocate money among several investments whose returns are independent discrete random variables. He wishes to maximize expected gain while having the probability that the gain is at least a certain amount be at least a prescribed value. An LP formulation of the problem is presented.

4) **A Branch & Bound Algorithm for a Discrete Quadratic Programming In Portfolio Optimization**, *Dong X. Shaw*, Purdue Univ., Sch. of IE, W Lafayette, IN 47907, shawdx@ecn.purdue.edu

A fundamental problem in the index fund management is to decide a portfolio with a small group of stocks to track a popular index, say S&P500. This problem can be formulated into a discrete quadratic programming. A sharp lower bound and a related B&B algorithm are developed.

TB09 Supply Contracts in Supply Chains

Cluster: Supply Chains

Invited Session

Chair: Meir J. Rosenblatt, Technion & Washington Univ., CB 1133, 1 Brookings Dr., St. Louis, MO 63130-4899

1) **A Review of Research on Contracts in Supply Chains**, *Steven Nahmias*, Santa Clara Univ., Dept. of DIS, Santa Clara, CA 95053, *Naren Agrawal*, *Andy Tsay*

No abstract supplied.

2) **Flexible & Risk Sharing Sourcing Contracts in Volatile Price Environments**, *Panos Kouvelis*, Washington University, Olin Sch. of Business, 1 Brookings Dr., St. Louis, MO 63130-4899, *Chung-Lun Li*

We study supply contracts for deterministic demand but in an environment of uncertain prices. We study contracts with flexibility in timing of purchase, in quantity of purchase and choice of supplier. Risk sharing features are also

studied. We illustrate how the careful structuring and exploitation of flexibility in sourcing contracts can effectively reduce the sourcing costs in environments of price uncertainty.

3) **Mitigating the Adverse Effects of Batch Ordering through Various Supply Chain Coordination Mechanisms**, *Yossi Aviv*, Washington Univ., Campus Box 1133, One Brookings Dr, St. Louis, MO 63130-4899

In a simple decentralized supply chain, consisting of a single retailer and single supplier, we show how delivery costs charged by the supplier can adversely affect the supplier through a distortion of demand information. We investigate the severity of this phenomenon in several settings pertaining to various coordination mechanisms in the supply chain. Extension to multiple retailers will be discussed.

4) **The Supplier's Perspective on Supply Contracts**, *Joseph Milner*, Washington Univ. & Technion, CB 1133, One Brookings Dr., St. Louis, MO 63130, *Meir J. Rosenblatt*

As the value added by firms decreases, the importance of purchasing management grows. Increasingly, firms are turning to negotiated supply contracts as a means of reducing the costs and variability of the demand process within a supply chain. We compare various existing supply contracts and discuss how they affect a supplier's operations. In particular, we discuss how suppliers may determine which supply contracts are the best from their perspective.

TB10 Performance Evaluation & Optimization of Production Systems II

Cluster: Queuing Models in Manufacturing & Service Systems

Invited Session

Chair: Baris Tan, KOC University, Economics & Admin. Sci., Cayir Cad No. 5 Istinye, Istanbul, 80860, Turkey, btan@ku.edu.tr

1) **Approximate Analysis of a Continuous Material Model of an Unreliable Transfer Line with Rework Loops & Scrapping of Bad Parts**, *Stefan Helber*, Ludwig-Maximilians Univ., Muenchen, D-80805, Germany, helber@bwl.uni-muenchen.de

We analyze a continuous material model of an unreliable transfer line with limited buffer capacity. Machines differ with respect to processing times, random failures and random repairs. We assume that parts can be bad and need to be reworked or scrapped at dedicated machines. Reworked parts can be sent back into the main line. This leads to loops in the flow of material. A numerical technique is used to determine production rate and inventory level estimates.

2) **Decomposition of Continuous-Flow Production Lines with Heterogeneous Workstations**, *Sencer Yeralan*, Univ. of FL, Dept. of ISE, 303 Weil Hall, Gainesville, FL 32611

Unequal workstation flow rates complicate the generic decomposition approach since the line output rate may, in the worst case, be any one of the station flow rates depending on the buffer states. We present a flow switching model, which at the limit, generates the solution to the original line.

3) **On the Distribution of Throughput of Lines**, *Cemal Dincer*, Bilkent Univ., Dept. of IE, Ankara, 06533, Turkey

An analytical method for deriving the distribution of the throughput of transfer lines is proposed. The transient and steady-state behaviors of these systems are determined by the evolution of the stochastic processes under consideration. The methodology developed is extended to the more complex systems with non-exponential distributions and multiple-part types.

4) **Variance of the Output as a Function of Time: Production Line Dynamics**, *Baris Tan*, KOC University, Economics & Admin. Sci., Cayir Cad No. 5 Istinye, Istanbul, 80860, Turkey, btan@ku.edu.tr

We consider Markovian models of discrete materials flow production systems. The mean and variance of the number of parts produced in a given time period conditioned on an arbitrary initial condition is determined by using a Markov reward model. Numerical experiments that investigate the relationships between the system parameters, production line dynamics and due-time performance are included.

TB11 Metaheuristics & Scheduling

Cluster: Combinatorial Models for Manufacturing Scheduling & Routing

Invited Session

Chair: Safia Kedad Sidhoum, Ecole Centrale Paris, Lab. Productique Logistique, Grande Voie des Vignes, Chatenay Malabry, 92 295, France, kedad@pl.ecp.fr
leis.pl.ecp.fr/users/kedad/page.html

1) **New Bounds for the Unrelated Parallel Machine Scheduling**

Under Constraints, Safia Kedad-Sidhoum, Ecole Centrale Paris, Lab. Prod. Log., Grande Voie des Vignes, Chatenay Malabry, 92 295, France, kedad@pl.ecp.fr, **Mounib Mekhilef**

This work deals with scheduling tasks on parallel unrelated machines. Time windows constraints, dependencies on sequences, machine eligibility constraints as well as capacity restrictions are taken into account. On the basis of state variables and binary exclusion relations, we define 2 particular graphs representing the problem constraints, namely spatial and temporal exclusions. In addition to suggesting a new formulation of the problem, we point out that the search of a solution for the decision problem under consideration is related to the stability number of a new graph called incompatibility graph. We compute lower and upper bounds for this number. Computational results on test problems are presented.

2) Project Scheduling: Agent-Based Representation of Activities & Simulation Results, Gary Knotts, Univ. of AZ, MIS Dept., Tucson, AZ 85721, **Moshe Dror, Bruce C. Hartman**

We expand on our initial work in which we applied agent technology to the resource-constrained project scheduling problems, Knotts, et al., 1997. We propose a rich and flexible approach to this problem based on a metaphor derived from digital circuit design. Specifically, activities are represented by autonomous agents consisting of standard digital elements such as AND, OR, NAND and NOR gates. We proceed and test numerous simple rules of interaction between the autonomous agents and a centralized entity, i.e., central bank, which controls the allocation of project resources to agents. Our testing includes both deterministic and stochastic project durations. Extensive simulation results are reported and the insight gained from our analysis is presented.

3) Simulated Annealing: Theory & Practice, Harry Cohn, University of Melbourne, Dept. of Statistics, Parkville, Victoria, 3052, Australia

Much of the theory of SA centers on the notion of convergence, which corresponds to some logarithmic cooling schedule. However, in practice, other cooling schedules prove to be more effective. We will give theoretical justifications for the performance of algorithms by relating the behavior of various temperatures schedules to the asymptotics of inhomogeneous Markov chains. Then, a number of applications are given to various size TSPs to illustrate that the optimal algorithm is problem-dependent, which is in perfect agreement with the theory. Statistics are used to assess the reliability of the results.

TB12 Project Management

Invited Session

Chair: Avraham Shtub, Tel Aviv Univ., Dept. of IE, Ramat Aviv, Tel Aviv, 69978, Israel, shtub@eng.tau.ac.il

1) Bayes Sequential Decision Making in Project Management, Zvi Covaliu, George Washington Univ., MS Dept., Sch. of Bus. & Public Mgmt., Washington, DC 20052, covaliu@research.circ.gwu.edu, **Refik Soyer**

We propose and illustrate a framework for optimal, sequential decisions on scheduling and "crashing" of activities in PM. It explicitly models dependence among uncertain resources and activities, and makes Bayesian inference about future activities based on accumulated observations. Graphical tools are used to model several typical PM situations.

2) Managing Projects to Maximize Earned Value, R. Etkar, Avraham Shtub

3) Project Control in the Israel Construction Industry, S. Francis, Avraham Shtub

4) Teaching Project Management in Large Organizations, E. Masad, Avraham Shtub

No abstract supplied.

5) The Project Management Simulator: A New Approach for Teaching & Implementing Project Management, Y. Ventura, Avraham Shtub

No abstract supplied.

TB13 Algorithms for Cutting & Packing

Cluster: Combinatorial Optimization

Invited Session

Chair: David Pisinger, DIKU, Univ. of Copenhagen, Universitetsparken 1, Copenhagen, 2100, Denmark, pisinger@diku.dk www.diku.dk/~pisinger

1) A New Branch & Cut Method for the Orthogonal Two-Dimensional Cutting Problem, Eleni Hadjiconstantinou, Imperial

College, Mgmt. Sch., 53 Prince's Gate, Exhibition Rd., London, SW7 2PG, UK, eah@ic.ac.uk

We develop new exact methods for the non-guillotine and the guillotine cutting problems. Lower bounds based on LP and Lagrangean relaxations of 2 0-1 integer programming formulations are investigated for both. A procedure for lifting Gomory's mixed integer cuts is implemented as part of B&C algorithms. Computational results are presented.

2) Two- & Three-Dimensional Bin Packing Problems, Silvano Martello, University of Bologna, DEIS, Viale Risorgimento, 2, Bologna, 40136, Italy, smartello@deis.unibo.it

We consider the problem of orthogonally packing a given set of rectangular-shaped items into the minimum number of rectangular bins. Two- and 3-dimensional cases are considered. We discuss recent results on lower bounds, approximation algorithms and exact B&B approaches. Extensive computational results are presented.

3) An Efficient Approach to the Multi-Pallet Loading Problems, Jan Riehme, Dresden Univ. of Tech., Inst. of Numerical Math., Mommsenstr. 13, Dresden, D-01062, Germany, riehme@math.tu-dresden.de, **Guntram Scheithauer, Johannes Terno, Uta Sommerweiss**

We present an approach to solve the distributor's multi-pallet loading problem, taking into account special restrictions to the generated packing patterns, i.e., order demands, placement and weight conditions, stability, visibility, etc. Our aim is to load a whole cargo with a volume up to 25 pallets on a minimal number of pallets to save transportation costs. First, we use a new heuristic to get an upper bound \bar{k} for the number of pallets. The associated packing patterns form a first permissible solution of the problem. Then, we use a splitting procedure to generate a set of $k = \bar{k} - 1$ sub-cargos, which we can pack independently by relaxing some geometrical attributes of the pieces. To overcome the problems of the geometric relaxation, we use a set of alternative loading strategies. In the case of success, we reduce k by one and start again with the splitting procedure. We solved instances with up to 50 different products on up to 25 pallets in less than 10 minutes on a PC Pentium Pro (200 MHz). The average volume utilization of our solutions is 85 - 90%.

4) The Container Loading Problem, David Pisinger, DIKU, Univ. of Copenhagen, Universitetsparken 1, Copenhagen, 2100, Denmark, pisinger@diku.dk www.diku.dk/~pisinger

We consider the container loading problem where a number of rectangular boxes should be loaded into a container of fixed dimensions. A heuristic algorithm is developed based on the decomposition into a number of strips and layers. Every strip may be optimally filled by solving a knapsack problem, and an m-cut B&B approach is used to search several widths of the strips and depths of the layers. Computational experiments involving up to 120 boxes are reported, showing that several loading problems are solved to optimality in reasonable time, losing less than 10% of the available volume.

TB14 Optimization in German Industrial Research Groups

Invited Session

Chair: Christoph Moll, SIEMENS AG, ZT SE 4, Muenchen, D-81730, Germany, christoph.moll@mchp.siemens.de

1) Automated, Optimized Design of Radio in the Local Loop Networks, Ulrich Lauther, Siemens AG, ZT SE 4, Muenchen, D-81730, Germany, ulrich.lauther@mchp.siemens.de, **Andreas Hefner, Frank-Oliver Malisch, Dieter Olpp**

To avoid the high cost of civil works of cable-based networks, the radio in the local loop technology connects subscribers via wireless communication to base stations, using DECT devices. We present a tool for finding number and positions of base stations needed to connect all subscribers at minimum cost.

2) Combinatorial Optimization of IBM Heidelberg, Gerhard Schrimpf, IBM Global Services, Wissenschaft und Technik, Heidelberg, D-69115, Germany, schrimpf@heidelberg.ibm.com

An overview of the activities at the Decision Technology Department is given. Special attention is paid to the application of optimization for the design of wide area networks.

3) Applications of Modern Mathematical Methods in Process & Production Control, Walter Griem, Mannesmann DV, Mathematisch/Technische Syst., Ratingen, D-40885, Germany, walter.griem@it-mannesmann.de

We show the efficiency of solutions techniques constraint propagation combined with other modern and classic methods in the area of steel plants. The aims are to improve and optimize the production planning, off- and on-line, in different applications in Europe, South and North America.

TB15 Stochastic Modeling of Communication Systems

Cluster: Applied Probability

Invited Session

Chair: Wilfried Seidel, Univ. der Bundeswehr Hamburg, Fachbereich Wirtschafts & Org., Hamburg, 22039, Germany, w_jever@unibw-hamburg.de

1) **Performance Analysis & Optimization of Automatic Call Distributor Systems**, *Andreas Brandt*, Univ. of Berlin (Humbolt), Fac. of Econ, Inst. of OR, Berlin, D-10178, Germany, brandt@wiwi.hu-berlin.de, *Manfred Brandt*

An ACD with s agents, k waiting places ($s+k$ lines) and an integrated voice-mail-server is considered. The stability condition and an efficient approximation for the mean sojourn time in the voice-mail-server is derived. Numerical results for computing the cost-optimal dimensioning are presented.

2) **On the BMAP/G/1 Queue with Level Dependent Arrivals**, *Jens Hofmann*, Univ. of Trier, Inst. of Comp. Science, Trier, D-54286, Germany, hofmann@uni-trier.de

This BMAP/G/1 queue system can be used for stochastic modeling of telecommunication systems with load dependent arrivals. We derive stability conditions and present analytical results for the stationary queue length at service completion times and at an arbitrary time, which also give rise to numerical algorithms.

3) **On Taylor Series Expansions for Waiting Times in Tandem Queues**, *Wilfried Seidel*, Univ. der Bundeswehr Hamburg, Fachbereich Wirtschafts & Org., Hamburg, 22039, Germany, w_jever@unibw-hamburg.de, *Kai V. Kocemba*, *Klaus Mitreiter*

We present an algorithm for calculating the coefficients of a Taylor series expansion for expected stationary waiting times in tandem queues. It works quite efficiently if the random vector of service times of all servers is concentrated at a small number of atoms. The approximation error is investigated.

4) **On the Tail of Stationary Waiting Time Distributions in Networks with Sub-Exponential Service Times**, *Francois Baccelli*, INRIA, Centre Sophia Antipolis, Valbonne, F-06565, France, baccelli@sophia.inria.fr, *Sabine Schlegel*, *Volker Schmidt*

For tandem queues with sub-exponential service times, we show that the tail of the stationary waiting time until the beginning of service at any server behind the server with the heaviest service times, asymptotically behaves like the tail of the stationary waiting time in a single-server queue.

TB16 Knowledge Management

Contributed Session

Chair: Yoshitomo Ikkai, Osaka University, Faculty of Eng., Yamadaoka 2-1, Suita, Osaka, 565, Japan, ikkai@ise.eng.osaka-u.ac.jp

1) **High-Tech Knowledge Sharing: Employees' Dilemma**, *Edward W. Rogers*, Cornell University, Sch. of Ind. & Lbr. Relations, 393 Ives Hall, Ithaca, NY 14853, ew5@cornell.edu, *Hyeon Jeong Park*, *Nathan D. Ainspan*

We explore an indirect relationship between knowledge sharing measures and organizational performance for high-technology companies. Using IPO prospectus data and surveys, we consider information privacy measures as the inverse of knowledge sharing and utilization likelihood. This model considers knowledge utilization as a critical success factor for high-technology firms.

2) **Recursive Type Knowledge Acquisition for Multi-Phased Planning**, *Yoshitomo Ikkai*, Osaka University, Faculty of Eng., Yamadaoka 2-1, Suita, Osaka, 565, Japan, ikkai@ise.eng.osaka-u.ac.jp, *Takenao Ohkawa*, *Norihisa Komoda*

To acquire useful knowledge for planning without human experts, we propose the recursive type learning method using inductive learning. The planning process is divided into stages, then a phase is a bundle of stages. Planning knowledge for phases are acquired from the last phase.

TB18 Managing Learning & Experimentation in R&D

Invited Session

Chair: Stefan Thomke, Harvard Business School, Morgan Hall T63, Soldiers Field, Boston, MA 02163

1) **Learning, Experimentation & the Changing Economics of R&D**, *Stefan Thomke*, Harvard Business School, Morgan Hall T63, Soldiers Field, Boston, MA 02163

In many fields, the economics of R&D are being radically affected by the use of new and greatly improved experimentation modes such as computer simulation and combinatorial chemistry. Using empirical findings from automotive and

pharmaceutical drug development, I will examine these changes and discuss implications for research and managerial practice.

2) **Learning Through R&D Activities & National Innovation Systems**, *Walter Kummerle*, Harvard Bus. School

An increasing number of firms are establishing multiple R&D sites abroad. We examine which factors in different countries' national innovation systems support effective firm learning through R&D sites abroad. We also analyze findings from a survey of 40 firms and institutions in the pharmaceutical industry.

3) **Web-Based Learning of Decision Support Technologies**, *Oliver Gunther*, Humboldt Univ., Berlin, Germany

The growth of the WWW has generated considerable interest in the electronic exchange of information goods and services. Related work has mostly focused on static information services such as digital libraries and electronic newsstands. We will focus on interactive information services in commerce and learning using decision support technologies.

4) **withdrawn - author request of 5/4**, *Alan D. MacCormack*, Harvard Bus. Sch., Morgan Hall T17, Soldiers Field Park, Boston, MA 02163, *Marco Iansiti*

5) **A Search Model of Engineering Design**, *Christoph H. Loch*, INSEAD, Blvd. de Constance, 77305 Fontainebleau, France

We model engineering design of a new product as a search tree. Searching the tree, the engineer learns about the product design. We compare search strategies, and information exchange strategies among concurrent activities. We examine how such strategies are influenced by new engineering technologies, such as CAD or simulation.

TB19 Current Topics in Location Analysis

Cluster: Location Analysis

Invited Session

Chair: Mark S. Daskin, Northwestern Univ., Dept. of IE/MS, Evanston, IL 60208-3109, daskin@iems.nwu.edu

1) **Hierarchical Location-Allocation Models for Congested Systems**, *Vladimir Marianov*, U Catolica de Chile, Dept. Ing. Electrica, Casilla 6177, Correo 22, Santiago, Chile, marianov@ing.puc.cl, *Daniel Serra*

We address locating hierarchical facilities in the presence of congestion. The hierarchical model is a referral model where requests are attended first by lower level servers, then some of the served customers are referred to higher level servers. The objective is to find the minimum number of servers and their locations that will cover a given region with a distance or time standard...

2) **Transportation Networks & the Location of Human Activities**, *Peeters Dominique*, *Jacques-Francois Thisse*

Using the simple plant location problem, we investigate the impact of transportation networks on the location of human activities in the case of a few idealized networks. The case of 2 economies characterized by different network configurations that form a custom union is also analyzed.

3) **Surviving in a Spatially Competitive Environment: The Threshold Location Model**, *Daniel Serra*, Univ. Pompeu Fabra, Dept. of Econ. & Bus., Barcelona, 08005, SPAIN, serra@upf.es, *Charles ReVelle*

Most retail location models ignore the fact that for an outlet to survive, it needs a minimum demand level to cover costs. We present a decision model for a firm that wishes to enter a spatial market where there are several competitors already located. This market is such that for each outlet, there is a demand threshold level that has to be achieved in order to survive...

4) **A Reliability Approach to Scenario-Based Location Modeling**, *Mark S. Daskin*, Northwestern Univ., Dept. of IE/MS, Evanston, IL 60208-3109, daskin@iems.nwu.edu, *Susan M. Hesse*, *Charles ReVelle*

We present a scenario-based location model which minimizes a location plan's regret for an endogenously determined subset of the scenarios. The subset is selected so that the total probability associated with the chosen scenarios exceeds some reliability level. Tradeoffs between the reliability level and the regret are computed. Extensions are outlined.

TB20 Models of the Firm I

Contributed Session

Chair: Igor Jemric, Ntl. Bank of Croatia, Rackoga 5, Zagreb, 10000, Croatia, igor.jemric@nbh.hr

1) **An Assessment of Firm-Level Risks During Transition**, *David Wilemon*, Syracuse University, Sch. of Mgmt., Syracuse, NY 13244-

2130, dwilemon@som.syr.edu, *Dipinder S. Randhawa*

What risks do enterprises in liberalizing developing economies confront during the transition to market-based economies? Drawing upon recent developments in the theory of firm behavior in liberalizing economies, we construct a taxonomy of risks that firms confront during the transition. The resultant managerial implications are presented.

2) **The Use of Impression Management Strategies by International Managers**, *Nurit Zaidman*, Ben Gurion Univ., Sch. of Mgmt., PO Box 653, Beer-Sheva, 84105, Israel, zaidman@bgumail.bgu.ac.il

The creation of an effective impression is an important element in successful business interactions between international managers. Three issues are explored: how international managers perceive and apply various impression management strategies; international managers susceptibility and adaptation to the others impression management code...

3) **An Experimental Study of Market Entry Games with Fixed Capacity**, *Rami Zwick*, HKUST, Dept. of Mktg., Clear Water Bay, Kowloon, Hong Kong, China, mkamnon@ust.hk, *Amnon Rapoport*

The current study examines the emergency of coordination in a simple market entry game. The aggregate proportions of entry are accounted for by mixed-strategy equilibrium with non-linear utilities. Individual level analysis shows no evidence for mixing. We attempt to account for both aggregate and individual results by adaptive learning mechanism.

4) **Relative Efficiency of Croatian Banks**, *Igor Jemric*, Ntl. Bank of Croatia, Rackoga 5, Zagreb, 10000, Croatia, igor.jemric@nbh.hr, *Luka Neralic*, *Boris Vujcic*

The relative efficiency of Croatian banks is analyzed by using the CCR model of DEA. The data for all banks operating in the market are included, in the further step, the banks are grouped according to their size and the same model is used for each group.

Tuesday 13:00-14:00

TS02 Keynote: Data Mining
Invited Session

Chair: Jacob Zahavi, Tel Aviv Univ., Recanati Grad. Sch. of BA, Fac. of Mgmt., Tel Aviv, 69978, Israel

1) **Keynote: Data Mining**, *Jacob Zahavi*, Tel Aviv Univ., Recanati Grad. Sch. of BA, Fac. of Mgmt., Tel Aviv, 69978, Israel

Recent developments in hardware and software technology have made it all the more easy for organizations to collect and store massive amounts of data. Yet, raw data have no direct benefits unless tapped, analyzed and converted into useful information and knowledge to support decision making. A new generation of computerized methods is emerging in recent years to help the endeavor of extracting information from mountains of data. These methods are collectively known as data mining. Data mining is a process that evolves from the intersection of such files as databases, statistics, optimization, machine learning, AI, expert systems, visualization and others. Applications of data mining, which cut across many industries, include targeting, financial analysis, market basket analysis, fraud detection, credit assessment, churn management, etc. We provide an overall view of data mining and its applications. Specific examples will be given from the area of database marketing.

TS03 Keynote: The Management of Higher Education - Models, Perspectives & Illustrations
Invited Session

Chair: Abraham Mehrez, Ben-Gurion Univ. of the Negev, Dept. of IE&M, POB 653, Beer-Sheva, 84105, Israel

1) **Keynote: The Management of Higher Education; Models, Perspectives & Illustrations**, *Abraham Mehrez*, Ben-Gurion Univ. of the Negev, Dept. of IE&M, POB 653, Beer-Sheva, 84105, Israel

We will focus on the evolution of the past 10 years in the Israeli system of higher education, which has increased from 10 institutions to about 200. During the same period, the number of students has doubled and the institutions' production has become very heterogeneous. Private and public institutions, branches of foreign universities in Israel, private and public independent colleges, regional campuses and Israeli universities constitute the system. Our purpose is twofold: to analyze the quality of students in the system through micro- and macro-game models and to derive the distribution of students in the system under various scenarios.

TS07 Keynote: Correlated Equilibria & Weather Forecasting - It is All a Matter of Approach
Invited Session

Chair: Sergiu Hart, The Hebrew Univ. of Jerusalem, Ctr. for Rationality, Dept. of Math. & Economics, Jerusalem, 91905, Israel, <http://www.ma.huji.ac.il/~hart>

1) **Invited Keynote: Correlated Equilibria & Weather Forecasting - It is All a Matter of Approach**, *Sergiu Hart*, The Hebrew Univ. of Jerusalem, Ctr. for Rationality, Dept. of Math. & Economics, Jerusalem, 91905, Israel, <http://www.ma.huji.ac.il/~hart>

How can one measure the accuracy of the TV weatherperson who announces, "There is a 60% chance that it will rain tomorrow"? How can one beat the weatherperson at their own game? How can simple adaptive rules of behavior lead to sophisticated ways of playing games? Answers to these and other questions, using Blackwell's approachability theorem, will be presented.

TS09 Invited Tutorial: Set-Partitioning, Linear Programming & Combinatorial Problems in Supply Chain Management
Invited Session

Chair: David Simchi-Levi, Northwestern Univ., Dept. of IE & Mgmt. Services, 2225 N Campus Dr., Evanston, IL 60208-3119, levi@iems.nwu.edu

1) **Invited Tutorial: Set-Partitioning, Linear Programming & Combinatorial Problems in Supply Chain Management**, *David Simchi-Levi*, Northwestern Univ., Dept. of IE & Mgmt. Services, 2225 N Campus Dr., Evanston, IL 60208-3119, levi@iems.nwu.edu

A classic and recently popular method for solving many hard combinatorial problems is based on formulating these problems as set-partitioning models. This is done commonly for crew scheduling, vehicle routing, graph partitioning, machine scheduling and many other examples. We explain the excellent empirical performance of the set-partitioning technique for a number of problems including vehicle routing, bin-packing and parallel machine scheduling problems. We then apply the set-partitioning method to tactical problems in supply-chain management involving inventory and transportation. In particular, we consider the problem of integrating inventory policies and transportation strategies so as to minimize system-wide costs by taking advantage of the shipping cost structure. We identify structural properties of the resulting formulation which lead to the development of a new algorithm. Preliminary computational results suggest that the algorithm is very effective.

TS13 Invited Tutorial: Post-Solution Analysis in Linear Programming from an Interior Solution
Invited Session

Chair: Harvey J. Greenberg, CO Univ., Mathematics Dept., Denver, CO 80111, hgreenbe@carbon.cudenver.edu

1) **Invited Tutorial: Post-Solution Analysis in Linear Programming from an Interior Solution**, *Harvey J. Greenberg*, CO Univ., Mathematics Dept., Denver, CO 80111, hgreenbe@carbon.cudenver.edu

We emphasize the use of the optimal partition, obtained by most interior point methods for sensitivity analysis and debugging. The information is different than that of a basic solution (unless unique), and this demonstrates circumstances under which the partition contains preferred information. We begin with terms and concepts, assuming knowledge of LP but not of interior point methods or of the solutions they generate.

TS14 Invited Tutorial: Some Future Directions in Vehicle Routing Research
Invited Session

Chair: Bruce L. Golden, Univ. of Maryland, Coll. of Bus. & Mgmt., College Park, MD 20742, bgolden@umdacc.umd.edu

1) **Tutorial: Some Future Directions in Vehicle Routing Research**, *Bruce L. Golden*, Univ. of Maryland, Coll. of Bus. & Mgmt., College Park, MD 20742, bgolden@umdacc.umd.edu

Recently, a variety of metaheuristics have been used by researchers to solve VRPs. For the most part, high-quality solutions have been obtained, but the algorithms are often slow and involve many parameters. We examine where we are and where we ought to go from here.

TS18 Industry Roadmapping Workshop
Invited Session

Chair: Michael Radnor, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., 2001 Sheridan Rd., Evanston, IL 60208, m-radnor@nwu.edu

1) Industry Roadmapping Workshop, Michael Radnor, Northwestern Univ., Kellogg Grad. Sch. of Mgmt., 2001 Sheridan Rd., Evanston, IL 60208, m-radnor@nwu.edu

Roadmaps for industries such as chemicals, electronics, internet, manufacturing controls, rapid prototyping, various materials areas and other industries, developed in conjunction with an NCMS program, will be presented by industry experts. Lessons learned and other implications for small as well as large firms will be discussed in an open session by participants and speakers.

TS19 Invited Tutorial: On Equitable Resource Allocation Problems - A Lexicographic Minimax Approach
Invited Session

Chair: Hanan Luss, AT&T Labs., 101 Crawfords Corner Rd., Rm. 3K-321, Holmdel, NJ 07733, hluss@att.com

1) Invited Tutorial: On Equitable Resource Allocation Problems - A Lexicographic Minimax Approach, Hanan Luss, AT&T Labs., 101 Crawfords Corner Rd., Rm. 3K-321, Holmdel, NJ 07733, hluss@att.com

We review a variety of resource allocation problems in which it is desirable to allocate limited resources equitably among competing activities. A resource allocation solution is called equitable if no performance function value can be improved without either violating a constraint or degrading an already equal or worse-off performance function value associated with a different activity. Applications for such problems are found in diverse areas, including distribution, production planning, workforce management, emergency services and telecommunications. The problems reviewed include large-scale allocation problems with multiple resources, multi-period allocation problems and problems with substitutable resources. Efficient algorithms for many models will be described. Hopefully, this presentation will help practitioners to formulate and solve diverse resource allocation problems and motivate researchers to explore new models and algorithmic approaches.

Tuesday 14:00-15:30

TC01 Negotiating & Making Decisions Over the WWW

Cluster: MCDM
Invited Session

Chair: Hannele Wallenius, Helsinki Univ. of Tech., Inst. of Industrial Mgmt., Espoo, 02150, Finland

1) Attribute Weighting Experiment in the Internet, Mari Poyhonen, Helsinki Univ. of Tech., Systems Analysis Lab., Itakaari 1 M, 02150 Espoo, Finland, marip@sepa.tuelft.nl, **Raimo P. Hamalainen**

Five multiattribute weighting methods were compared in an Internet experiment. This was the first experiment where the subjects interactively formulated the test tasks for themselves. We will present some of the main results showing why the methods lead to different weights and discuss some pros and cons of using the Internet in behavioral research.

2) An Approach to Global Nondifferentiable Multiobjective Optimization, Kaisa Miettinen, Univ. of Jyväskylä, Dept. of Math., PO Box 35, Jyväskylä, 40351, Finland, **Marko Makela**

Nonconvexity in nonlinear and nondifferentiable problems means that the solutions generated by traditional methods are only locally optimal. The idea is to apply modern evolution strategies of global optimization together with an interactive nondifferentiable multiple optimization system known as NIMBUS. In this way, we can produce globally Pareto optimal solutions for the DM. The implementation of the system via the Internet is freely available.

3) An Investigation of Web-Based Negotiations & Support Tools for Business Transactions, Jeffrey E. Teich, NM State Univ., Box 30001, Dept. 3DJ, Las Cruces, NM 88003-0001, **Jyrki Wallenius, Hannele Wallenius**

With mass use of the Internet for the now commonplace tasks of e-mail and file transfer, together with increasing usage of WWW applications such as home pages, chat, internet phone, audio and visual and web broadcasting systems, a simultaneous increase in the use of the Web for electronic commerce has been observed. An important, yet relatively undeveloped component of electronic commerce, is the negotiation of contracts and the resolution of disputes. Potentially, our research will lead to the development of a negotiation site for public use. Uses of the site include finding business contacts and aiding in locating mutually beneficial outcomes utilizing a variety of communication options, as well as analytical plug-in negotiation support tools.

TC02 Information Business & Learning on the Internet

Cluster: Global Information Technology & Management
Invited Session

Chair: Karl R. Lang, HKUST, Dept. of ISM, Clear Water Bay, Kowloon, Hong Kong

1) Reengineering Distance Learning Through Electronic Commerce, Karl R. Lang, HKUST, Dept. of ISM, Clear Water Bay, Kowloon, Hong Kong

Internet-based electronic commerce will change the education sector, including distance learning programs. We examine the conventional distance learning models, investigate the automation of the distance learning processes and analyze how electronic commerce technologies can support the revolutionary changes in the distance learning industry.

2) Information Business on the Internet, Olivia R. Liu Sheng, Univ. of AZ, MIS Dept., Coll. of BPA, Tucson, AZ 85721, oliviasheng@bpa.arizona.edu

The Internet has a profound impact on the information provider businesses. We analyze the different business models and challenges facing the domestic and global information businesses in comparison with other Internet businesses. The goal is to draw implications for research and education in information management.

3) Centanet: The Case of Free Information on the Internet in Hong Kong, Ho Geun Lee, Yonsei Univ., Dept. of Bus. Admin., Sch. of Bus. & Econ., Seoul, 120-749, Korea, hlee@base.yonsei.ac.kr, **Olivia R. Liu Sheng, E. Law**

The most important asset of a property agency is the market information that its employees possess. The management of Centaline, a leading real estate sales agency in Hong Kong, has decided that they will radically turn this proprietary market knowledge into free information on its Web site, Centanet, to the public, making the property market more "transparent." We examine the impact of Centanet on Centaline and its consumers.

TC03 Panel: The OR-MS/WWW Interface

Invited Session

Chair: Harvey J. Greenberg, CO Univ., Mathematics Dept., Denver, CO 80111, hgrenbe@carbon.cudenver.edu

Co-Chair: Moshe Sniedovich

1) Panel: The OR-MS/WWW Interface, Hemant K. Bhargava, Naval Postgrad. Sch., Code SM-BH, 555 Dyer Rd., Rm. 214, Monterey, CA 93943, bhargava@cs.nps.navy.mil <http://131.120.39.67>, **Robert Fourer, Ramayya Krishnan, Ramesh Sharda**

This panel discussion will address technical and organizational issues pertaining to the challenges and opportunities associated with the OR-MS/WWW interface. Topics will cover areas such as teaching, research, publications, membership services and electronic commerce. More details on this session can be found at <http://www-math.cudenver.edu/~hgrenbe/sessions/informs98.html>.

TC04 Performance Models & Solution Techniques in Communication Systems II

Cluster: Performance Analysis of Computer/Communication Systems
Invited Session

Chair: Edmundo de Souza e Silva, Federal Univ. of Rio de Janeiro, NCE, Rio de Janeiro, Brazil, edmundo@nce.ufrj.br

1) Quantitative Evaluation of Communication Networks: Reliability, Performability, Vulnerability, Gerardo Rubino, ENSTB & IRISA Rennes, IRISA, Campus de Beaulieu, Rennes, 35042, France, rubino@irisa.fr

We review some recent work on the evaluation of reliability and performability measures of communication networks. We also discuss the situation when no statistical data is available and only the topology is known. This leads to vulnerability metrics. We exhibit a measure having similar properties as the stochastic-based ones.

2) Sync Classes: A Framework for Optimal Scheduling of Requests in Multimedia Storage Servers, Leana Golubchik, Univ. of MD, Dept. of Computer Science, A.V. Williams Building, Rm. 4129, College Park, MD 20742, leana@cs.umd.edu, **Sherry Marcus, V.S. Subrahmanian**

Efficient storage systems are of central importance to the advent of large-scale multimedia systems. We present both a theoretical framework and practical algorithms for optimal handling of multiple clients' requests in a multimedia storage server under the assumption that access to storage devices is a costly operation.

3) **Linear Programming Deriving Bounds for Queueing Network Models**, *Carlos Humes, Jr.*, Univ. of Sao Paulo, Comp. Sci. Dept., Inst. of Math & Stats., Sao Paulo, Brazil, humes@ime.usp.br

We present a summary of recent results in the area; moreover, we illustrate the advantages and disadvantages of such an approach compared, for instance, with fluid model results.

TC05 Telecommunications Network Design

Cluster: **Teletraffic for Future Networks**

Invited Session

Chair: Alan Hartman, IBM, Haifa Research Lab. Ltd., MATAM - Advanced Tech. Ctr., Haifa, 31905, Israel, alan_hartman@vnet.ibm.com

Co-Chair: Michal Penn

1) **withdrawn - author request of 5/6**, *J. Bang-Jensen, H. N. Gabow, Tibor Jordan, Zoltan Szigeti*

2) **Splitting Off Edges in Graphs Preserving K-Edge-Connectivity & Other Properties**, *Tibor Jordan*, Odense Univ., Denmark

The first splitting off theorem due to Lovasz asserts that edges incident to a vertex s in a k -edge-connected graph G can be split off in pairs in such a way that the resulting graph is k -edge-connected (provided that $d(s)$ is even and $k > 2$). This theorem gives no information on the structure of the new edges obtained by the splittings. What can we say if certain additional properties of G must also be preserved by the splittings? Does there exist a complete splitting preserving that property? Questions of this type were investigated recently in the case of the following basic graph properties: simplicity, bipartiteness, planarity, etc. In some cases, it is possible to characterize those configurations in the graph which exclude such a complete splitting while the question is NP-complete for some other properties. A survey of these recent results and their applications to connectivity augmentation problems will be presented.

3) **A Combinatorial Algorithm to Increase the Node-Connectivity of a Digraph**, *Frank Andras*, Eotvos Univ., Budapest, Hungary

We describe a combinatorial algorithm to find a minimum number of new edges whose addition to a given k -connected digraph results in a $k+1$ connected digraph. The algorithm actually works on an abstract framework and, as another special case, algorithmically solves an extension of Gyori's theorem on generating a system of paths.

4) **ANDIT - An ATM Network Dimensioning & Design Tool**, *Alan Hartman*, IBM, Haifa Research Lab. Ltd., MATAM - Advanced Tech. Ctr., Haifa, 31905, Israel, alan_hartman@vnet.ibm.com, *Nicolas Lavaud, D. Oats, R. Slosiar, M. Stewart, B. A. Taylor*

We describe a tool used primarily for dimensioning the Australian National ATM backbone network. The design, specification and implementation of the tool is a joint project of the Telstra Research Laboratories and the Teletraffic Research Centre at Adelaide University. The primary problem of mathematical interest solved by the tool is the determination of an optimal set of capacities on the links given a fixed topology, a set of traffic streams and an upper bound on the expected cell loss in the presence of any single link failure. A routing of the traffic streams over the links is also a byproduct of the computation. The practical issues of software design for a continuously evolving tool are addressed, as are the difficulties of validating the results and calibrating the tool.

TC06 Marketing Research II

Contributed Session

Chair: Pandora L. Patton, Univ. of the Nations, P.O. Box 30001-5280 NMSU, Las Cruces, NM 88003, ppatton@nmsu.edu

1) **Divide & Prosper: Effects of Partitioned Prices on Consumers' Price Recall & Demand**, *Vicki G. Morwitz*, NYU, Stern Sch. of Bus., 44 West 4th St., MEC 8-89, New York, NY 10012-1126, vmorwitz@stern.nyu.edu, *Eric Greenleaf, Eric J. Johnson*

Many firms divide a product's price into 2 mandatory parts, e.g., base price of mail order shirt and shipping and handling, rather than charging a combined all-inclusive price. We call this strategy partitioned pricing and test hypotheses of how consumers process partitioned prices and how partitioned pricing affects price recall and demand.

2) **Consumer Intransitive Choice: The Effects of Incomplete Information**, *Ran Kivetz*, Stanford Univ., 535 Everett Ave., Apt. #213, Palo Alto, CA 94301, rkivetz@leland.stanford.edu, *Itamar Simonson*

In this experimental research, we demonstrate that when some attribute values are missing, consumer choices are often intransitive. We show that effect both between and within respondents and examine moderating factors and possible debiasing procedures. We also investigate the process by which missing attribute values induce intransitivity, and affect subsequent choices with full information.

3) **Psychic Distance: A Psychometric Scaling for Cross Cultural Transfer**, *Pandora L. Patton*, Univ. of the Nations, P.O. Box 30001-5280 NMSU, Las Cruces, NM 88003, ppatton@nmsu.edu

We propose newer dimensions to the concept of psychic distance (Johanson & Vahlne, 1992) than in previous research. Using cognitive dissonance multiple intelligence theory, the psychic distance concept is broadened into a new measuring scale. This scale is tested with branding data from 5 multinational corporations in 8 countries.

4) **Can Genuinely New Product be Forseen By The**, *Jacob Goldenberd*, Hebrew Univ., School of Business Admin., Jerusalem, 91905, Israel, msmazur@olive.mscc.huji.ac.il, *David Mazursky*

The relations between products and their markets consist of natural selection mechanisms: products which fail to fulfill the needs of the customer disappear while products that satisfy customers survive until the next change occurs in market demands. According to this axiom, markets can be viewed as imposing an environmental pressure which forces products to constantly evolve...

TC07 Information & Returns, IPOs, Closed End Funds

Cluster: **Finance**

Invited Session

Chair: Matthew Spiegel, Univ. of CA, Haas Sch. of Bus. S545, Student Services Bldg. #1900, Berkeley, CA 94720-1900, spiegel@haas.berkeley.edu

1) **Market Information Aggregation & the Conditional Skewness of Security Returns**, *Joshua D. Coval*, Univ. of MI Bus. Sch., Finance Dept., 701 Tappan St., Ann Arbor, MI 48109-1234, coval@umich.edu, *David Hirshleifer*

The combination of transaction costs and investor uncertainty about signal quality leads investors to require validating price movements before trading on private information. This results in security returns which exhibit time-varying second and third moments/returns which are prone to large corrections and subsequent increases in volatility.

2) **Demand for Stocks: An Analysis of IPO Auctions**, *Avi Wohl*, Bar-Ilan Univ., Grad. Sch. of Bus., Ramat-Gan, 52900, Israel, wohlav@ashur.cc.biu.ac.il, *Shmuel Kandel, Oded Sarig*

We analyze non-discriminatory auctions, Israeli IPOs. The whole demand schedules are described and analyzed. The average demand elasticity at the auction-clearing price is high: 37. We find a significant average abnormal return of 4.5% on the first trading day and a positive correlation between this return and the elasticity of demand.

3) **Closed-End Fund Discounts in a Rational Agent Economy**, *Matthew Spiegel*, Univ. of CA, Haas Sch. of Bus. S545, Student Services Bldg. #1900, Berkeley, CA 94720-1900, spiegel@haas.berkeley.edu

We show that a rather close version of the standard frictionless rational agent financial markets model can explain the existence of closed-end fund discounts. Furthermore, the same parameter values that lead to systematic discounts also lead to other pricing characteristics that resemble many empirically documented regularities.

TC08 Pricing Models

Contributed Session

Chair: Arieh Gavious, Ben-Gurion Univ., Sch. of IE&M, Beer-Sheva, 84105, Israel, ariehg@bgumail.bgu.ac.il

1) **Pricing Options on Real Distributions: A Wavelet Transform Approach**, *Arik Reiss*, Imperial College, Ctr. for Quant. Finance, 2 Queens Gardens, Hendon, London, NW4 2TR, UK, reissa@btcec2.agw.bt.co.uk

We propose an option pricing model which doesn't make assumptions about the distribution of the underlying security. A wavelet decomposition and multi-resolution analysis of historical underlying data provides a risk-neutralisation transformation. The distribution of the resulting approximate martingale is used in a numerical expectation operation to price the option.

2) **A Double Auction Mechanism for Trading Network Capacity**, *Yu-Li Chou*, IBM, TJ Watson Research Ctr., PO Box 218, Yorktown Heights, NY 10598, jyouchou@watson.ibm.com, *Amit Garg*

Attributes of network capacity include bandwidth, available time window, origin-destination points, etc. This is an unconventional commodity because 2

types of commodities in this market can be aggregated to yield a third type. We propose a double auction mechanism for clearing trades in such commodities.

3) The Transfer Pricing Problem: A Mixed Mechanism Approach, Arieh Gavious, Ben-Gurion Univ., Sch. of IE&M, Beer-Sheva, 84105, Israel, ariehg@bgumail.bgu.ac.il, **Yair Tauman**

We consider a decentralized firm with 1 selling division and 1 buying division with asymmetric information about the cost functions of the 2 divisions. We show that there is a mechanism which achieves efficiency, truth-telling via dominant strategies, individual rationality and achieves almost budget balancing for a large class of cost structures.

TC09 The Effects of Prices Capacity & Information on the Performance of the Supply Chain

Cluster: **Supply Chains**
Invited Session

Chair: **Yehuda Bassok**, Univ. of WA, Dept. of MS, Seattle, WA 981959, yehuda@u.washington.edu

1) Optimal Production & Emergency Shipment Policies for a Multi-Stage System with Setup Costs & Random Capacities, Juhwen Hwang, Ntl. Dong Hwa Univ., Institute of Bus. Mgmt., Hualien, 974, Taiwan, **Medini R. Singh**

Consider a multi-stage production system where capacity is uncertain at each stage. A recourse, in the form of emergency shipment, exists to compensate for any unpredictable shortfall in production; that is, production output at any stage can be supplemented by emergency supply, albeit at a significantly high cost. The decision to produce at any stage incurs a set-up cost. The final stage faces an uncertain one-time demand for the finished product. Due to limited time, there is only one opportunity to produce at each stage. How much should one plan to produce? When is an emergency shipment desirable? We explore answers to these questions.

2) The Impact of Pricing in a Grocery Supply Chain, Iyer V. Ananth, Purdue University, Krannert Grad. Sch. of Mgmt., Krannert Bldg., W Lafayette, IL 47906, **Jianming Ye**

We model a grocery supply chain with stores that are supplied inventory from a warehouse whose inventory is managed by a vendor. We use a dataset of sales of canned tomato soup to model the promotional environment and determine optimal store price promotions. We evaluate the impact of market share constraints, wholesale price changes and scanner-based vendor promotions on the manufacturer and the retailer.

3) The Role of Information in Multi-Echelon Systems, Kamran Moinzadeh, University of Washington, Sch. of Business, Dept of MS, Seattle, WA 98105, **Yehuda Bassok**

We study the effects of information on the performance of a supply chain. We present 3 different information structures and characterize the optimal procurement policy for each. We show how the costs of the buyer, supplier and supply chain are affected and show that there are transfer prices that are incentive compatible and achieve channel coordination.

4) Proxying Demand by Sales Information: Inaccuracies Encountered, Ricardo Ernst, Georgetown Univ., Sch. of Bus. - G-4 Old North, 37th & O Sts NW, Washington, DC 20057

Future demand is possibly the most important piece of information in every business. Traditionally, the main source of information for the estimation of future demand has been historical sales. We develop an analytical model to quantify the impact of using sales as a proxy for future demand instead of more rigorous methods of estimation.

TC10 Fixed Cycle Time Policies in Stochastic Manufacturing Systems

Cluster: **Queueing Models in Manufacturing & Service Systems**
Invited Session

Chair: **Refik Gullu**, Middle East Tech. Univ., IE Dept., Ankara, 06531, Turkey, gullu@rorqual.cc.metu.edu.tr

1) Approximate Policies for the Multi-Item Cycle Partitioning Problem, Refik Gullu, Middle East Tech. Univ., IE Dept., Ankara, 06531, Turkey, gullu@rorqual.cc.metu.edu.tr, **Nesim K. Erkip**

We consider N non-identical items manufactured on a common facility. Demands and the processing times of the items are random variables. Under a fixed sequence of the items, the production facility starts processing the same item every T units of time. Our aim is to construct realistic partitioning policies for the common cycle time T such that a certain service level for the items is achieved and inventory holding and set-up costs are minimized.

2) Determining Production Schedules Under Base-Stock Policies in Single Facility Multi-Item Production Systems, Ziv Katalan,

Univ. of Pennsylvania, The Wharton Sch., 1314 SH-DH, Philadelphia, PA 19104-6366, katalan@wharton.upenn.edu, **Awil Federgruen**

We address periodic base-stock policies for stochastic economic lot scheduling problems and derive effective heuristics for the design of a periodic item-sequence minimizing system-wide costs. This sequence is constructed based on desirable production frequencies for the items, obtained as the solution of lower bound mathematical programs. An extensive numerical study gauges the quality of the proposed heuristics.

3) Cyclical Production Planning in the Process Industries Without Losing Flexibility, Jan C. Fransoo, Eindhoven Univ. of Tech., Dept. Op. Planning & Control, PO Box 513, Pav. F12, Eindhoven, 5632DD, The Netherlands, j.c.fransoo@tm.tue.nl, [tm.tue.nl/tm/vakgr/lbs/lbst.htm](http://tm/vakgr/lbs/lbst.htm)

Cyclical production planning has been used widely in industry, but research from a production control perspective has been very limited so far. We present an approach towards cyclical production planning which can be applied to make-to-order and make-to-stock situations in process industries. A case study from process industries and a simulation study based on the implementation at the company will be presented.

4) Cyclic Policies for Stochastic Demand Serial Systems, Nesim K. Erkip, Middle East Tech. Univ., METU, Industrial Engineering Dept., Ankara, 06531, Turkey, erkipn@rorqual.cc.metu.edu.tr, **Melike Tekinalp, Refik Gullu**

We consider a restricted but implementable class of cyclic policies, namely powers-of-2, for a stochastic demand serial system. A heuristic algorithm is constructed to find variables of interest. Special cases are compared with the available exact solutions. For the general case, empirical results are compared with alternative approaches.

TC11 Scheduling in Computer Systems

Cluster: **Combinatorial Models for Manufacturing Scheduling & Routing**
Invited Session

Chair: **Maciej Drozdowski**, Poznan Univ. of Tech., Inst. of Computer Sci., ul. Piotrowo 3A, Poznan, 60-965, Poland, maciej_d@sol.put.poznan.pl

1) A Duoprocessor Task Scheduling, B. Paolo Dell'Olmo, IASI-CNR, Viale Manzoni 30, Rome, 00185, Italy, **Stefano Giordani, Grazia M. Speranza**

We consider the problem of scheduling tasks on a set of dedicated processors, where each task requires a subset of 2 processors which have to be simultaneously available for a given processing time. The objective is to determine a nonpreemptive schedule with minimum completion time.

2) Task Scheduling with Communication Delays in Processor Networks, Klaus H. Ecker, T.U. Clausthal, Inst. for Informatics, Clausthal, 38678, Germany, ecker@informatik.tu-clausthal.de

We deal with deterministic task scheduling in a distributed or parallel computer system under consideration of communication delays. The different conditions under which communication takes place in the network, such as circuit- or packet-switched transmissions, are of essential impact to the design of optimal algorithms for this problem.

3) Scheduling Divisible Tasks in Regular Toroidal Mesh Architectures, Maciej Drozdowski, Poznan Univ. of Tech., Inst. of Computer Sci., ul. Piotrowo 3A, Poznan, 60-965, Poland, maciej_d@sol.put.poznan.pl

Divisible task can be divided into parts of arbitrary size and executed in parallel by different computers. In other words, divisible task is a parallel application with fine granularity and without data dependencies between the grains of parallelism. We present methods of scheduling such applications in regular mesh architectures.

TC13 Applications of Integer & Combinatorial Optimization

Cluster: **Combinatorial Optimization**
Invited Session

Chair: **Karen Aardal**, Utrecht Univ., Dept. of Comp. Science, PO Box 80089, Utrecht, 3508 TB, The Netherlands, aardal@cs.ruu.nl

1) Routing & Capacity Installation in ATM Backbone Networks, Robert L.M.J. Van de Leedel, Maastricht Univ., POB 616, Maastricht, 6200 MD, Netherlands, r.vandeleensel@ke.unimaas.nl, **Stan P.M. Van Hoesel**

Given a network configuration and commodity between pairs of nodes, the

problem of planning edge capacities and routing schemes simultaneously is discussed. We also consider reliability models in which additional capacity is installed such that the network can handle node failures. Computational results of a B&C framework will be discussed.

2) **Assigning Frequencies in Cellular Phone Networks with Frequency-Division Multiple Access**, *Andreas Eisenblatter*, Konrad-Zuse Zentrum für Info., Takustrasse 7, Berlin-Dahlem, D-14195, Germany, eisenblatter@zib.de

Several cellular phone networks use an FDMA scheme. The need for high quality connections makes it inevitable to control interference between base stations by a careful frequency assignment. We present a mathematical formulation for this frequency assignment problem and report on computational results for real-world instances.

3) **Online Dispatching in Storage Yards**, *Thomas Winter*, Technische Univ. at Braunschweig, Abteilung Math. Optimierung, Pockelsstraße 14, Braunschweig, D-38106, Germany, t.winter@tu-bs.de, *U. Zimmerman*

In storage yards, each arriving vehicle has to be assigned immediately to a position and to a roundtrip of the next schedule period. Usually, the arrival order differs from the planned schedule so that the assignment is based on incomplete information whereas shunting should be minimal with respect to operational constraints.

4) **Solving an Integer Feasibility Problem Arising in Video Signal Processing**, *Karen Aardal*, Utrecht Univ., Dept. of Comp. Science, PO Box 80089, Utrecht, 3508 TB, The Netherlands, aardal@cs.ruu.nl, *A.K. Lenstra*, *C.A.J. Hurkens*

We develop an algorithm, based on lattice basis reduction, for solving an integer feasibility problem arising in video signal processing. The problem consists of determining whether there exists a vector satisfying a diophantine equation and lower and upper bound constraints. We present computational results.

TC14 Graph Theory

Invited Session

Chair: Uri N. Peled, Univ. of IL, Math., Stats. & Computer Sci., 851 S Morgan St., MC 249, Chicago, IL 60607-7045, uripeled@uic.edu

1) **A Polynomial Approximation Algorithm for the Minimum Fill-In Problem**, *Assaf Natanzon*, Tel Aviv Univ., Dept. of Computer Science, Tel Aviv, 69978, Israel, natanzon@math.tau.ac.il, *Ron Shamir*, *Roded Sharan*

In the minimum fill-in problem, one must add the fewest possible edges to a graph in order to make it chordal (triangulated). This problem has been studied intensively since the early 70s due to its application to numerical algebra. The problem was shown by Yannakakis to be NP-hard and was recently proven to be fixed parameter tractable by Kaplan, Shamir & Tarjan.

2) **Restricted Unimodular Chordal Graphs**, *Uri N. Peled*, Univ. of IL, Math., Stats. & Computer Sci., 851 S Morgan St., MC 249, Chicago, IL 60607-7045, uripeled@uic.edu, *Julin Wu*

A bipartite is known as an RU if all its cycles have lengths divisible by 4. It is called balanced if in each cycle whose length is not divisible by 4 there is some chord. The vk bipartite graph $vk(G)$ of a graph G is the bipartite graph of incidences between the vertices and the maximal cliques of G . G is called RU chordal or balanced chordal if G is chordal and $vk(G)$ is RU or balanced, respectively.

3) **User Optimized Travel Cost from Minimal Network Data**, *Regina Hunter Madineo*, Rider Univ., 2083 Lawrenceville Rd., Lawrenceville, NJ 08648-3099, mladineo@rider.edu

Consider a congested traffic network with multiple OD pairs. The link costs are, in general, unmeasured but are assumed to be asymmetric. Theoretical results due to M. Frank have shown that OD costs (user travel times) are functions of the independent OD demands and the equilibrium flow on a single (arbitrary) link. An actual network from a New Jersey county is used to illustrate how the volume counts and speeds on one link can be used to predict the total travel time on any OD path.

TC15 Statistical Design of Experiments in Simulation

Cluster: Statistical Methodology for Simulation Modeling

Invited Session

Chair: Jack P. C. Kleijnen, Tilburg Univ., Dept. of IS & Auditing, Ctr. for Economic Research, Tilburg, 5000 LE, The Netherlands, kleijnen@kub.nl

1) **Design of Experiments for Sensitivity Analysis, Optimization & Validation of Simulation Models**, *Jack P. C. Kleijnen*, Tilburg

Univ., Dept. of IS & Auditing, Ctr. for Economic Research, Tilburg, 5000 LE, The Netherlands, kleijnen@kub.nl

We survey the use of statistical designs for what-if analysis in simulation, including sensitivity analysis, optimization and validation/verification. Sensitivity analysis is divided into 2 phases: the pilot/screening stage; a novel technique is sequential bifurcation and regression analysis to approximate the input/output behavior of the simulation...

2) **Marketing Sensitivity Analysis to Users of Complex Models**, *Andrea Saltelli*, Inst. for Systems, Info. & Safety, European Commission Joint Res., TP 360, Ispra, 21020, Italy, andrea.saltelli@ei.jrc.it <http://www.jrc.org/isis>

It is a sad fact in modeling practice that the more complex a model is, the dimmer the chances that it will ever undergo a rigorous SA. This is counterintuitive as clearly the more complex the model, the higher the need for SA to ensure that factors' influence on model output is sound, to apportion model output variation to different parts of the model and to ensure that the model is relevant...

3) **Robust Design Methods for Analyzing Simulation Experiments**, *Susan M. Sanchez*, Univ. of MO, Sch. of Bus. Admin., 8001 Natural Bridge Rd., St. Louis, MO 63121-4499, susan@whimsy.umsl.edu [umsl.edu/~ssanchez](http://www.umsl.edu/~ssanchez)

We describe a framework for analyzing systems and processes via discrete event simulation. The framework incorporates a robust design philosophy into a response surface metamodeling approach, making use of the increased level of control the analyst has in a simulation setting relative to industrial experimentation. Results illustrate that system optimization and improvement efforts can be carried out efficiently and effectively...

4) **Deterministic vs. Stochastic Sensitivity Analysis with an Application to Investment Problems**, *Willem J. H. Van Groenendaal*, Tilburg University, Dept. of IS & Auditing, Ctr. for Economic Research, Tilburg, 5000 LE, The Netherlands, *Jack P. C. Kleijnen*

Usually, a model's inputs and parameters, or factors, are uncertain. This uncertainty should be accounted for in the analysis of model output. In practice, however, many analyses, especially for large models, are deterministic because of insufficient information on the joint distribution of the factor values. Nevertheless, it's possible to analyze the importance of factors without making assumptions on this distribution...

TC16 Collaborative Technologies

Contributed Session

Chair: Alex Bordetsky, CA State Univ., TELCOT Ctr. for Research, Hayward, CA 94542, bord@ntmail.sbe.csuhayward.edu

1) **Group Supporting Mechanisms for a Project Analysis & Evaluation Group Support System**, *Paulo A. Melo*, Univ. of Coimbra, INESC, Faculdade de Economia, Av. Dias da Silva, 165, Coimbra, 3000, Portugal, pmelo@inesc.pt, *Secundino Lopes*, *Paulo O. Costa*

We present the AGAP group DSS, intended for project evaluation by small, time and space distributed, groups. We pay special attention to the underlying mechanisms supporting communication, information interchange and social choice and decision processes.

2) **Adaptive Management of Collaborative Environments: Feedback Controls via Intelligent Agents**, *Alex Bordetsky*, CA State Univ., TELCOT Ctr. for Research, Hayward, CA 94542, bord@ntmail.sbe.csuhayward.edu

We address issues of adaptation and learning in managing collaborative teleconferencing environments. By means of multipoint multimedia communication, the technology enables collaborators to access knowledge resources at any time. Adaptive management enables us to coordinate multipoint collaboration by capturing feedback relationships into case memory and delivering feedback controls via agents-facilitators.

3) **Intermediaries in Electronic Commerce**, *Amit Basu*, Vanderbilt Univ., Owen Grad. Sch. of Mgmt., Nashville, TN 37203, amit.basu@owen.vanderbilt.edu vanderbilt.edu/Owen/basu

We examine the various roles that organizations can play as intermediaries in an open electronic commerce environment. Both existing and new models for implementing these roles are analyzed and critical success factors are identified.

TC17 Approximation Methods for Large-Scale Probability Modeling

Cluster: Queues

Invited Session

Chair: Carl M. Harris, George Mason Univ., Sch. of Info. Tech. & Eng., Fairfax, VA 22030

1) Approximating by Enhanced Interpolation in Queueing Analyses, Martin J. Fischer, MRJ Technology Solutions, Fairfax, VA 22030, Carl M. Harris

We show that the mathematics of interpolation have very broad applications in deriving approximate results for complex queueing models. We study the properties of interpolation approximations for the G/G/c queue and develop a desired analytic framework for such approximations. This structure is then used to derive a simple approximation for the mean queue delay for G/G/c...

2) An M/Ms Queue with a Special Customer, Percy H. Brill, Univ. of Windsor, PO Box 33830, Windsor, Ontario, N9A 6V1, Canada, brill@server.uwindsor.ca, Myron Hlynka

A special customer C_p arrives at an M/M/s queue in equilibrium. If C_p must wait, C_p enters service just after the next service completion, with probability $p(0 < p < 1)$. We derive the cdf of the waiting time of C_p , when p is fixed while C_p is waiting. We also give an algorithm for computing the cdf when p may vary depending on the system state while C_p is waiting. System characteristics and applications are discussed.

TC18 Military R&D

Contributed Session

Chair: Aron Pinker, ANSER, 1215 Jefferson Davis Highway, Suite 800, Arlington, VA 22202, pinkera@anser.org

1) Multiple Moving Target Identification Problem in Naval Operations, Adalet Öner, Turkish Naval Academy, Deniz Harp Okulu, Oğretim Baskanligi, Tuzla, Istanbul, 81704, Turkey, adalet@bm.com.tr, Sinan Kayaligil, Deniz R. Dumlu

There are multiple surface units (targets) detected earlier by radar in a particular sea area. An observer (an air vehicle) will try to identify those moving targets by passing them within the specified identification range of its sensors to maximize the flow rate of information coming from identification. A B&B algorithm is proposed to optimize the flight path of the observer.

2) A Model for Optimal Allocation of Funds to Research on Proliferation of Weapons of Mass Destruction, Aron Pinker, ANSER, 1215 Jefferson Davis Hwy, Ste 800, Arlington, VA 22202, pinkera@anser.org, Edieal J. Pinker

A model for optimal allocation of resources to areas of different relative importance is formulated as a linearizable integer programming problem and the utility of the model is illustrated. The model can also be used for determination of hiring, promotion or salary inequities and their optimal resolution.

TC19 Location Problems

Cluster: Location Analysis

Invited Session

Chair: Richard L. Francis, Univ. of FL, 303 Weil Hall POB 116595, ISE Dept., Gainesville, FL 32611-2083, francis@ise.ufl.edu

1) withdrawn - author request of 5/6, Wolfgang Domschke, Technische Hochschule Darmstadt, Fachbereich 1, Hochschulstr 1, Darmstadt, 64289, Germany, Gabriela Krispin**2) A Minisum Model with Forbidden Regions for Locating a Semi-Desirable Facility in the Plane, Henrik Juel, Jack Brimberg**

A semi-desirable facility provides a benefit of service to society, while adversely affecting social costs. We model service costs using a standard minimum objective. Social costs are imputed by specifying around each demand point, a convex forbidden region. A general solution algorithm is suggested, then applied to circular forbidden regions.

3) Aggregation Methods for Multi-Facility Location Problems: Strategies for Containing Error, Richard L. Francis, Univ. of FL, 303 Weil Hall POB 116595, ISE Dept., Gainesville, FL 32611-2083, francis@ise.ufl.edu, Timothy J. Lowe, Gerard Rushton, Brenda R. Rayco

We discuss strategies for reducing error caused by representing dispersed demand by aggregated demand points. Criteria for evaluating demand point aggregation algorithms are presented and discussed. For the p-median problem with q aggregate demand points, we indicate that the choice of the parameter q/p greatly influences the average relative error.

TC20 Models of the Firm II

Contributed Session

Chair: Yaron Timmor, Tel Aviv Univ., Arba Aratzot 7 St., Tel Aviv, Israel, timmor@post.tau.ac.il

1) Signal Interpretation in Competitive Interaction, Jaideep Prabhu, Tilburg Univ., PO Box 90153, Tilburg, 5000 LE, The Netherlands, j.prabhu@kub.nl

We study how firms should signal to reveal or conceal information and develop desired reputations. Using theories of judgment and decision making, we develop hypotheses about how managers interpret and respond to various market contexts. We test these hypotheses in 3 studies involving an entry pricing game.

2) Privatization Risk Analysis, Samuel E. Bodily, Univ. of VA, Darden Grad. Sch. of Bus., Box 6550, Charlottesville, VA 22906-6550, bodily@virginia.edu

Enterprises transitioning from state to private ownership in emerging economies face massive risks. These are itemized and quantified for an example in Central/Eastern Europe using measures of performance for both the buyer and seller. Potential sources of joint buyer/seller gains and risk reduction are evaluated using spreadsheet risk analysis.

3) Exporting Under Private Label Conditions & Influencing Factors, Yaron Timmor, Tel Aviv Univ., Arba Aratzot 7 St., Tel Aviv, Israel, timmor@post.tau.ac.il, Jehiel Zif

The development of the private label business creates new export venture opportunities, mainly for small and medium producers. An empirical investigation is presented based on international marketing approaches and analysis of 100 cases. The conditions and factors influencing exports under private labeling are discussed. Theoretical and managerial implications are provided.

Tuesday 15:45-17:15**TD01 DEA**

Contributed Session

Chair: Sule Karacaer, Hacettepe Univ., Isletme Bolumu, Beytepe, Ankara, Turkey, armo@eti.cc.hun.edu.tr

1) The Concept of Representativeness as a Technique for Ranking Efficient Units in Data Envelopment Analysis, Moez Hababou, York Univ., Schulich Sch. of Bus., Rm. 344, 4700 Keele St., North York, Ontario, M3J 1P3, Canada, mhababou@bus.yorku.ca, Wade D. Cook

We present an alternate approach to prioritize efficient DMU in DEA. This is based on representativeness where one considers that inefficient units are not equally important to the decision maker. Thus, representing an inefficient unit belonging to a specific cluster may be of higher importance than representing a unit belonging to another. An application to bank branches is provided.

2) Measuring Efficiency in the Hospitality Industry: A DEA Application in the Mediterranean Region of Turkey, Sule Karacaer, Hacettepe Univ., Isletme Bolumu, Beytepe, Ankara, Turkey, armo@eti.cc.hun.edu.tr, S. Armagan Tarim

The relative technical efficiency of the 5-star hotels in the Mediterranean region of Turkey is evaluated by means of DEA. After a description of the model and the data, the results of the analysis are discussed and a note is made of certain aspects of the follow-up analysis.

3) Data Envelopment Analysis as Alternative to Linear Programming, Alexander Vaninsky, Netanya Academic Coll., 16 Kibutz Galuot St., Haifa, 42365, Israel, vanisky@netanys.ac.il, Shlomo Maital

When DEA is modified to permit constraints on inputs and/or outputs, and applied to project optimization, it provides major advantages over the conventional LP approach. In particular, DEA permits non-linear objective functions and does not require empirical estimates of its coefficients. The concepts of resource-intensive and resource-extensive efficiencies are introduced and a numerical example provided.

TD02 OR/MS on the Web: Java & Distributed Computing

Cluster: Emerging Information & Networking Systems

Invited Session

Chair: Hemant K. Bhargava, Naval Postgrad. Sch., Code SM-BH, 555 Dyer Rd., Rm. 214, Monterey, CA 93943, bhargava@cs.nps.navy.mil http://131.120.39.67

1) Map-Based Dynamic Planning Systems in Java, Gordon H. Bradley, Naval Postgrad. Sch., OR Dept., Monterey, CA 93943,

bradley@nps.navy.mil

An architecture has been designed and developed to construct dynamic planning systems that access resources, i.e., maps, overlays, data, networks, algorithms, people, etc., over a network of heterogeneous computers such as the Internet. The systems are implemented in Java, thus they executed without modification in a wide range of computing environments.

2) A Java-Based Decision Support System for Scheduling University Courses, Allocating Class Rooms & Assigning Instructors, *Cosimo Spera*, Univ. of Washington, Seattle, Dept. of Management, Seattle, WA, cspera@u.washington.edu, *Marco Gagliardi*

Our Java-based DSS (<http://turing.dmq.unisi.it/allocate.html>) solves combinatorial course scheduling problems. It has 4 embedded algorithms and can solve problems with more than 100 integer variables. We discuss the algorithms, systems design and issues on the effectiveness of the visual user interface.

3) OR/MS & Distributed Computing on the Web, *Hemant K. Bhargava*, Naval Postgrad. Sch., Code SM-BH, 555 Dyer Rd., Rm. 214, Monterey, CA 93943, bhargava@cs.nps.navy.mil <http://131.120.39.67>, *Ramaya Krishnan, Rema Padman*

The Java distributed object model presents several ways to deliver OR/MS content on the Web: Java applets, remote method invocation and integration with distributed object computing technologies such as COBRA. We discuss these alternatives via several stylized applications and introduce technical and managerial metrics to help evaluate the choices.

4) withdrawn - author request of 3/31, *Julio Bucatinsky*, Tech-Mar Consulting Group, Ltd., 123 Pierrepont St., Brooklyn, NY 11201, jbuca@concentric.net

**TD03 Internet-Based Applications
Contributed Session**

Chair: Lawrence L. Schkade, Univ. of TX, Box 19437, Arlington, TX 76019, schkade@uta.edu

1) Multicenter Clinical Trials Communication via the World Wide Web, *Sheryl F. Kelsey*, Univ. of Pittsburgh, 130 DeSoto St., Pittsburgh, PA 15261, kelsey@edc.gsph.pitt.edu, *Stephen Wisniewski, Jeffrey Martin*

To manage clinical trials efficiently, communications are essential to ensure patient safety, uniform protocol implementation and timely, accurate data. The Epidemiology Data Center has developed Web pages to provide access to project documents, i.e., manuals and manuscripts. The Web sites are also used for scheduling meetings, conference calls and patient visits.

2) Promotion On The Internet, *Moshe A. Pollatschek*, Technion, Management, Haifa, 32000, ISRAEL, bani@ie.technion.ac.il

Most commercial enterprises rush to the Web although the resulted increase of sales is expected to be mostly marginal. This can be explained only partly by the relatively low costs involved. We offer another explanation to this phenomenon: the Internet is THE promotion of the electronic age.

3) Infrastructure Design for Electronic Commerce Technology Applications in Emerging Economies Using The Analytic Network Process, *Lawrence L. Schkade*, Univ. of TX, Box 19437, Arlington, TX 76019, schkade@uta.edu, *Mahesh S. Raisinghani*

Effective electronic commerce strategy and infrastructure are vital for emerging nations to succeed in a dynamic global economy. Firms worldwide are restructuring, downsizing and reengineering processes using electronic commerce technologies to gain competitive edge. Analytic network process is applied to design infrastructures that achieve synergistic integration of business and Internet domain strategies.

4) Measurement & Management of Capabilities in R&D Organizations, *Jinho Yoo*, Elec. & Telecom. Res. Inst., Yusong PO Box 106, Taejeon, 305-600, Korea, jhyoo@etri.re.kr, *Moonsik Bae*

We present a new methodological approach to measure the capabilities in R&D organizations. For the R&D capabilities, components of technology innovation, i.e., R&D activities, management, capital and education and training, have been considered. Based on the results, implications for R&D management are discussed with regard to R&D business management.

TD04 Rare Event Simulation

Cluster: Performance Analysis in Computer/Communication Systems
Invited Session

Chair: Victor Nicola, Univ. of Twente, Tele-Info. & Open System, POB 217, Enschede, 7500, The Netherlands, vfn@cs.utwente.edu nicola@cs.utwente.nl

1) Rare Event Simulation with the Importance Splitting Method RESTART: Survey & Application Results, *Carmelita Goerg*, Aachen Univ. of Tech., Communication Networks, Kopernikusstr. 16, Aachen, 52072, Germany, cg@comnets.rwth-aachen.de

RESTART, repetitive simulation trials after reaching thresholds, is a versatile method for rare event simulation which is included in several performance evaluation tools, ASTRO, TimeNET, CNCL. A survey of the general method, theoretical results, run time strategies, parameter settings and several application examples will be given.

2) RESTART Simulation of Rare Event Problems on Reliability & Teletraffic, *Jose Villen-Altamirano*, Politech. Univ. of Madrid, Dept. of Math., c/ Arbolenda s/n, Madrid, 28028, Spain, jvillen@eui.upm.es, *Alfonso Santos-Ramon, Erik Fernandez-Santos*

RESTART is a method to speedup rare event simulations. As reported, it obtains dramatic time savings, is quite general and requires a simple and quite system-independent analysis for its application to each particular case. To show these features, we present applications to several Markovian and non-Markovian systems.

3) Efficient Simulation of Backlogs in Fluid Flow Lines, *D. P. Kroese*, Univ. of Twente, Fac. of Applied Math., PO Box 217, Enschede, 7500 AE, The Netherlands, d.p.kroese@math.utwente.nl, *Victor Nicola*

An importance sampling procedure is described to efficiently estimate overflow probabilities in a continuous flow line with unreliable machines. The input flow to a given buffer in this flow line can be characterized by a Markov modulated fluid source. In general, the modulating process has a non-denumerable state space, with a number of continuous state variables representing the contents of the preceding buffers in the flow line. An optimal change of measure can be determined by generalizing a large deviation approach used for an ordinary fluid queue driven by a finite (discrete) state Markov modulated source. Under the optimal change of measure, machine failure and repair rates are continuous functions of the contents of preceding buffers. This suggests a suitable implementation of importance sampling using uniformization. Empirical results demonstrate the validity and effectiveness of the approach.

TD05 Network Design Issues

Cluster: Teletraffic for Future Networks
Invited Session

Chair: Vladimir Bolotin, AT&T Labs., 101 Crawfords Corner Rd., Rm. 1K-228, Holmdel, NJ 07733, vbolotin@att.com

1) Achieving High Throughput with TAP/PI Over ATM: Experiments & Simulations, *G. H. Petit*, Allocate Bell Manufacturing Co., Corp. Research Center, Fr. Wellesplein 1, Antwerp, B-20118, Belgium, petitg@btmaa.bel.alcatel.be, *J. Nelson, O. Bonaventure*

A few years ago, the TAP/PI protocol suite was barely used outside the academic and research environments. Today, with the overwhelming growth and success of the Internet, the WWW and its related technologies, TAP/PI has reached a very large user base. Many of the performance issues of TAP have recently been discovered as link transmission speeds and delay-bandwidth products have increased by orders of magnitude. We specifically address the performance issues of TAP/PI over terrestrial as well as satellite ATM networks to demonstrate (via experimental and simulational results) the achievable application throughput performance when TAP/PI is supported over various ATM service categories, i.e., VB, BUR, BAR, FR, etc., and finally to propose possible enhancements to the flow control mechanisms at both TAP and ATM levels.

2) The Gaussian Queue: The Fundamental Dimensioning Tool for Multimedia Networks, *Moshe Zukerman*, Univ. of Melbourne, Parkville, Victoria, 3052, Australia, m.zukerman@ee.mu.oz.au, *Ronald G. Addie, Nicolas Lavaud*

It is expected that deep in the network where heavy multiplexing takes place, due to the central limit theorem, traffic will be Gaussian. Because many sources transmit long range dependent, LRD, traffic, the multiplexed traffic will also be LRD. For these reasons, the fractional Brownian motion, FBM, process can be considered as an ideal fundamental dimensioning tool for the core network. Accurate approximation for queueing performance for FBM will be presented. A novel observation of this presentation is that, against popular view, it is the weight of the tail, not the rate of the tail, which is the more significant element in queueing performance evaluation.

3) High-Level Languages, Mathematical Programming Solvers & Visualization Tools for B-ISDN Planning, *Elena A. Medova*, Cambridge University, Judge Inst. of Mgmt. Studies, Trumpington St., Cambridge, CB2 1AG, UK, eam28@cam.ac.uk, *J. E. Scott*

In our current work on a prototype network planning system for British Telecom, we realized that a significant amount of the overall modeling effort

entails a comparison of different problem formulations necessitated by the uncertainty of future technical implementations and management strategies. In addition, data preparation and reports on the obtained solutions require considerable time and special skills. This is particularly important for presentation of routing decisions. We consider a set of mathematical programming models for the analysis of proposed B-ISDN networks according to different users' specifications. Since each model required many hours of analyst and programming time to organize its data into the form required by the mathematical programming optimizers, we use high-level modeling languages such as MODLER, AIMMS and EXPRESS for the compact representation of large and complex models. We also conduct comparative experiments with different solvers such as OSL, CPLEX and MP EXPRESS. Our first system prototype consists of both existing and specially designed components in MAPINFO and interfaces within MODLER for network design. Another prototype has been implemented within the AIMMS modeling system. Since the commercially available modeling languages do not at present provide graphical interfaces, we have developed a visualization tool written in JAVA for presentation of planning solutions.

TD06 Marketing Research III

Contributed Session

Chair: Chaim Ehrman, Loyola Univ., 820 N Michigan Ave., Chicago, IL 60611

1) Using Markov Chains for Estimating Brand Share, Chaim Ehrman, Loyola Univ., 820 N Michigan Ave., Chicago, IL 60611

Scanner data assists marketers in defining brand share estimates for future time periods as well as steady state brand share. A key component, the transition matrix, can be estimated from scanner data. In a direct marketing context, we illustrate how to estimate transition matrix from historical data.

2) A Replacement Problem Under Uncertainty, Saul Fuks, Univ. Fed. of Rio de Janeiro, Av. Epitacio Pessoa, 344 ap. 402 Leblon, Rio de Janeiro, RJ 21945-970, Brazil, saul@pep.ufrj.br, Jack Schechtman

We consider systems that produce services characterized by a rent depending on its qualities. We can take one of the following alternatives: leave the system, repair it or replace it with a new one. It is shown that there are 2 critical decision levels - i_1 and i_2 .

3) The Impact of Promotional Activity on Market Share: A Robust Approach, Francisco F.R. Ramos, University of Porto, RUA Dr. Roberto Frias, 4200 Porto, Portugal, framos@fep.up.pt

I propose a simple method to measure the impact of promotional activities on market share. The main idea is to assume that if promotion has an effect, it generates an additive outlier or a temporary level shift in the market share data. I propose an outlier robust estimation technique that can give estimates of the size of such an additive outlier or temporary level shift relative to an outlier-free time series...

4) withdrawn - author request of 6/1, Andreas C. Soteriou, Univ. of Cyprus, PO Box 537, Nicosia, Cyprus, basotir@atlas.pba.ucy.ac.cy, George Hadjinicola

TD07 Investment Risk Taking, Equilibrium Under Transaction Costs, CAPM Stability

Cluster: Finance

Invited Session

Chair: Meir I. Schneller, VA Polytech. Inst. & State Univ., 1016 Pamplin Hall, Blacksburg, VA 24061-0221, mschnell@vt.edu

1) Gender Differences in Investment Risk Taking, Haim Levy, Hebrew Univ., Sch. of Bus. Admin., Jerusalem, 91905, Israel, mshlevy@mssc.huji.ac.il, Allon Cohen, Efrat Elron

Do men take more risk than women when investing? An experiment in investing, in which real money could be won or lost by the participants, revealed that on average, men both took higher loans and invested in riskier security portfolios. Together, these 2 effects lead to significantly higher average wealth.

2) Portfolio Selection & Equilibrium Stock Returns with Quadratic Transaction Costs, Itzhak Venezia, Hebrew Univ., Mount Scopus, Jerusalem, 91905, Israel, msvenez@pluto.huji.ac.il

We analyze optimal portfolio selection and equilibrium stock returns when there are quadratic transaction costs of deviating from the previously held portfolio. The dynamic setting of the paper also allows us to investigate the effect of investment horizon decisions and pricing.

3) A Stability Test for the CAPM, Meir I. Schneller, VA Polytech. Inst. & State Univ., 1016 Pamplin Hall, Blacksburg, VA

24061-0221, mschnell@vt.edu

The CAPM provides a formula for security weight in the market portfolio. We show that this weight vector is extremely unstable. For large security population sizes, small changes in security variance or the population size cause violent changes in the weight vector. The sensibility of the CAPM is thus questioned.

TD08 Finance

Contributed Session

Chair: Dorota Kuchta, Technical Univ. of Wroclaw, Inst. of IE, Ul. Smoluchowskiego 25, Wroclaw, 50-370, Poland, kuchta@ioz.pwr.wroc.pl

1) Credit Rating of Brazilian Companies, Silvio Roberto Gouvea, Praia de Botafogo 228, 4th Fl., Rio de Janeiro, RJ 22359-900, Brazil, silvio@bmsarj.attmail.com, David Benarroch

A first attempt is made to develop a credit rating system to evaluate commercial risk of Brazilian companies. The system uses the concepts studied in sectorial analysis.

2) Possessive Women & Detached Men: Gender Differences in the Effect of Duration of Ownership on the Valuation of Objects, Michal Strahilevitz, Univ. of Miami, Mktg. Dept., PO Box 248-147, Coral Gables, FL 33124-6554, strahile@sba.miami.edu, George Loewenstein

This is an extension of work accepted by the Journal of Consumer Behavior (forthcoming). In the JCR paper, we did not look at gender or duration of exposure, only at duration of ownership.

3) A Heuristic Algorithm for a Fuzzy Capital Budgeting Problem with Interdependencies Between Projects, Dorota Kuchta, Technical Univ. of Wroclaw, Inst. of IE, Ul. Smoluchowskiego 25, Wroclaw, 50-370, Poland, kuchta@ioz.pwr.wroc.pl

We consider a model and propose a heuristic solution algorithm for a capital budgeting problem in which the projects in question may be dependent on each other and the information about their behaviour in the future may be given in an imprecise form - in that of fuzzy numbers.

4) Understanding Natural Price Points, Kirthi Kalyanam, Santa Clara Univ., Mktg. Dept., Santa Clara, CA 95053, kkalyanam@scu.edu

Natural price points are ultra specific prices at which there are discontinuities in price response. We present evidence regarding natural price points for some electronic products and packaged goods, several approaches to the statistical analysis of price points and implications for pricing products in retail channels.

5) Pattern Recognition in the Credit Scoring Analysis, Maria Teresinha Steiner, Federal University of Parana, Rua Padre Anchieta, 1231 Apt. 31, Curitiba, PR 80730-000, PR, tere@mat.ufpr.br, Celso Carnieri

Recognizing and foreseeing which credit clients will be good or bad payers is an important and difficult task for bank institutions and credit protection services. Using data from approximately 10,000 clients, obtained from a big Brazil private bank, we present a methodology to perform the credit scoring analysis.

TD09 Inventory Management

Cluster: Supply Chains

Invited Session

Chair: Yu-Sheng Zheng, Univ. of PA, OPIM Dept., 1300 SH DH, Wharton Sch., Philadelphia, PA 19104-6366, zheng@wharton.upenn.edu

1) Inventory Optimization with Applicable Cost Rate Functions & Service-Level Constraints, Kaj Rosling, Lund Univ., Dept. of IE, PO Box 118, Lund, S22100, Sweden, kaj.rosling@ie.lth.se

We consider inventory optimization with quasiconvex cost rate functions that have shortage cost coefficients of dimension unit/period, unit and period. Optimal (r,Q) policy can be obtained by a square-root formula. The results generalize to serial system with fixed order quantities and in the process, a new service-level constraint is suggested.

2) Scaling Down Multi-Echelon Inventory Problems, Sven B. Axäter, Lund University, Dept. of IE, PO Box 118, Lund, S221 00, Sweden, sven.axater@ie.lth.se

We suggest a technique for optimizing 2-echelon distribution systems with high-demand. Demand is scaled down so that the system can be approximated by a low-demand system for which efficient algorithms exist. The scaling preserves the coefficient of variation, so the solution can be scaled up to fit the original system.

3) An Intelligent Information System for Perishable Product

Availability, Yu-Sheng Zheng, Univ. of PA, OPIM Dept., 1300 SH DH, Wharton Sch., Philadelphia, PA 19104-6366, zheng@wharton.upenn.edu

The system is designed for a manufacturer, who is scheduled to produce perishable products in thousands of SKUs daily. The products are fresh within time windows. Customer orders for various combinations of products come in with specific delivery dates. A flexible and efficient availability system is critical to the sales and marketing functions.

4) Production/Inventory Systems with Limited Repair Crew Capacity, Izak Duenyas, Univ. of MI, Dept. of IOE, 1205 Beal Ave., Ann Arbor, MI 48109-2117, *Seyed M. R. Iravani, Tava Olsen*

We consider production inventory systems subject to time dependent failures and with limited repair crew capacity. We consider the joint problem of allocating repair crews to failed machines and determining optimal inventory levels to carry to hedge against breakdowns. We show that simple base stock inventory policies along with static preemptive priority policies for repair crew allocation work very well.

TD10 Advances in Polling Systems

Cluster: Queuing Models in Manufacturing & Service Systems
Invited Session

Chair: Yavuz Gunalay, Eastern Mediterranean Univ., IE Dept., Gazi-Magusa, Mersin, 10, Northern Cyprus, gunalay@taylor.ie.emu.edu.tr

1) The Polling System with State-Dependent Changeover Times: The Branching Process with State-Dependent Immigration, Martin Eisenberg, AT&T Labs., Rm. 1K-207, Crawfords Corner Rd., Holmdel, NJ 07733, martineisenberg@att.com

We solve the polling system in which the changeover-time distribution at each stage of the server cycle depends on whether the visited queue has customers waiting. This problem has a counterpart in the theory of branching processes. The solution involves an unusual "2-dimensional" iteration that determines the Laplace-Stieltjes transform of the waiting time distribution at each queue.

2) Networks of Polling Systems: Heuristic Stability Analysis, Graeme M. Warren, Univ. of Pretoria, Dept. of ISE, Pretoria, 0002, South Africa, graeme@iwi.ee.up.ac.za, *Colm A. O'Cinneide, Colin Moodie*

We will describe an approximate 2-moment queueing network analyzer for networks of exhaustive and gated cyclic polling systems. The analyzer employs correlated batch Poisson processes to model network traffic. We briefly report computational experience with the analyzer, then consider our computational experience in the light of stability analysis of fluid models of these systems.

3) Discrete Time-Limited Vacation Models for Applications in Polling Systems, Attahiru S. Alfa, Univ. of Manitoba, Dept. of Mech. & IE, Winnipeg, Manitoba, R3T 5V6, Canada

We present a group of time-limited vacation models in discrete time and show how they can be used to study time-limited polling systems. We consider Markovian arrival process type of input and service times of the phase type. The models are then set-up for matrix-geometric-based approach of analysis.

4) Polling Systems with a Patient Server & State-Dependent Setup Times, Yavuz Gunalay, Eastern Mediterranean Univ., IE Dept., Gazi-Magusa, Mersin, 10, Northern Cyprus, gunalay@taylor.ie.emu.edu.tr, *Diwaker Gupta*

We analyze polling systems in which the server stops cycling upon finding the entire system empty and initiates a setup only when the polled station has at least one customer in the queue. The queue length distributions at polling instants are calculated using a numerical method, based on discrete Fourier transforms.

TD11 Quality Improvement Models

Contributed Session

Chair: Shmuel Stashevsky, Bar-Ilan Univ., Business School, Ramat-Gan, 52900, Israel, stashes1@ashur.cc.biu.ac.il

1) Continuous Improvement & The Learning Curve, Willard I. Zangwill, Univ. of Chicago, Grad. Sch. of Bus., Chicago, IL 60637, willard.zangwill@gsb.uchicago.edu, *Paul B. Kantor*

CI, although a powerful approach for improving the effectiveness of organizations, has so far lacked a mathematical foundation. We relate CI to the learning curve and in doing so, develop a differential equation that not only adds insight into the learning curve, but suggests ways to improve firms even more rapidly.

2) Transfer of TQM-Continuous Improvement Methodology into the Eastern European Manufacturing Companies: Case of

Poland, Tom R. Wielicki, California State Univ., 5245 N. Backer Ave., MS#7, Fresno, CA 93740, tomaszw@csufresno.edu

Eight manufacturing companies underwent training in continuous improvement. We summarize results of the problems solving procedure conducted by over 50 groups. It is apparent that ownership status of the company (state vs. privately owned) has a statistically significant impact on perception of the problems and effectiveness of the proposed solutions.

3) Knowledge Discovery for Quality Improvement, Maytal Saar Tsechansky, NYU, Stern Grad Sch. of Bus. Adm., New York, NY 10006, mtschan@stern.nyu.edu, *Nava Pliskin, Gad Rabinowitz*

Extracting interesting patterns from databases remains a challenge for quality managers. The knowledge discovery system for quality improvement has been prototyped to demonstrate, in the context of hospital databases, how automated extraction and analysis tools from the emerging field of knowledge discovery/data mining can help address this challenge.

4) The Effects of Quantitative Tools vs. Human-Resource Methods on Performance - An Empirical Study, Shmuel Stashevsky, Bar-Ilan Univ., Business School, Ramat-Gan, 52900, Israel, stashes1@ashur.cc.biu.ac.il

TQM combines quantitative and human resource methods. An empirical study was conducted in Israel to examine the relative impact of these methods on individual improvement efforts and performance. The findings indicated that human-resource methods were more effective than quantitative tools in increasing improvement efforts and performance.

TD13 Network Optimization

Cluster: Network Optimization
Invited Session

Chair: To be announced

1) Some Combinatorial Optimization Problems Occurring in Manpower Scheduling, Peter Kleinschmidt, Univ. of Passau, Dept. of Econ. & Bus. Admin., Passau, D-94030, Germany, *Hans Achatz*

The solution of manpower scheduling requires the solution of matching problems with additional constraints coming from dependencies between jobs and people. Several hard and polynomially solvable problems of this kind will be presented along with experience for real world instances.

2) The K-Median Problem on a Tree, Rakesh Vohra, Northwestern University, Kellogg Sch. Mgmt., MEDS Dept., 2001 Sheridan Rd., Evanston, IL 60208-2009, r-vohra@nwu.edu

We survey what is known about the K-median polytope on a tree as well as describe some new results. This joint work with Steven de Vries and Marc Posner.

3) Variations on a Dynamic Programming Algorithm for Some Classes of Traveling Salesman Problems, Egon Balas, Carnegie Mellon Univ., GSIA, Pittsburgh, PA 15213

We discuss a linear time dynamic programming algorithm for solving TSPs with a certain type of precedence constraint arising in practice. When applied to a standard TSP, the algorithm finds in linear time a local optimum over an exponential-size neighborhood defined by the precedence constraints.

4) withdrawn - author request, Ronald L. Rardin, Purdue Univ., Dept. of IE, Grissom Hall 234, W Lafayette, IN 47907-1287, *Elham Ghashghai*

TD14 Transportation Network Analysis

Invited Session

Chair: Nathan H. Gartner, Univ. of MA, Dept. of Civil & Environ. Eng., 1 University Ave., Lowell, MA 01854-2881

1) Modeling Mixed Flow Traffic in Developing Countries, Sarosh I. Khan, Univ. of CO, Colorado TransLab., CB 113, PO Box 173364, Denver, CO 80217-3364

In most developing countries, the traffic stream consists of fast-moving, motorized vehicles as well as slow-moving, non-motorized vehicles. Given the wide range of operating and performance characteristics, models developed for homogeneous traffic conditions do not apply. We discuss non-lane-based, heterogeneous traffic flow models.

2) Dynamic Electronic Modeling of Traffic Assignment Problems with Simultaneous Continuum Flows & Queues, Claude M. Penchina, Univ. of MA, Dept. of Physics & Astron., 411 Hasbrouck Lab., Amherst, MA 01003

Planning, followed by creative price-subsidy management, can optimize operations of the expanding transportation systems in emerging regions. Routes

with possible paradoxical flows should be carefully controlled. Dynamic traffic assignment methods are illustrated using electronic modeling of paradoxes and waves, with continuum and queueing regions treated simultaneously.

3) Integration of Dynamic Traffic Assignment with Real-Time Traffic Adaptive Control, Nathan H. Gartner, Univ. of MA, Dept. of Civil & Environ. Eng., 1 University Ave., Lowell, MA 01854-2881, Chronis Stamatiadis

Advanced traffic management systems use dynamic traffic assignment models to predict future traffic conditions and real-time adaptive control techniques for generating control strategies. We present a framework for the integration of the 2 models into a combined system and provide a practical approach for realizing it.

4) Evaluation of DynaMIT, an On-Line Dynamic Traffic Assignment System, Moshe E. Ben-Akiva, MIT, Intelligent Transport. Program, Rm. 1-181, Cambridge, MA 02139, Michel Bierlaire, Rabi Mishalani, Qi Yang

DynaMIT is a real-time dynamic traffic assignment system which can predict traffic conditions and generate route guidance information over a rolling horizon. The system is evaluated using the MITSIM laboratory, a microscopic traffic simulator representing the actual network and generating surveillance data. DynaMIT's performance is evaluated for several scenarios.

TD15 Efficient Simulation Techniques

Cluster: Statistical Methodology for Simulation Modeling

Invited Session

Chair: Reuven Y. Rubinstein, Technion Israel Inst. of Tech., Fac. of IE & Mgmt., Haifa, 32000, Israel, ierrr01@ie.technion.ac.il

1) Root Finding in Simulation Environment, Philip J. Fleming, Motorola, Inc., 1501 W Shure Dr., Arlington Hts, IL 60004, fleming@cig.mot.com, Burton Simon, Rangan Leelahakriengkrai

We consider the problem of finding a root of a function $f(x)$ defined as the expectation of a function $F(y)$ with respect to a given density function $g(y)$. In other words, the function f is assumed to be a "smoothed" version of F . We use a procedure which is natural in the sense that F is sampled at the root of the most recent estimate of f up to that point in the procedure...

2) The Empirical Transform-Expand-Sample Modeling Methodology: Theory & Applications, Benjamin Melamed, Rutgers Univ., RUTCOR, Fac. of Mgmt., Dept. of MSIS, New Brunswick, NJ 08903, melamed@rutcor.rutgers.edu

TES is a new versatile family of models designed primarily to capture prescribed first-order and second-order statistics. TES generation methods use autoregressive modulo-1 schemes with additional transformations and as such, are non-linear and generally non-Markovian. They are readily implemented on a computer, have a low computational complexity and give rise to a variety of autocorrelation functions...

3) Global Optimization via Boltzmann Distribution, Importance Sampling & Markov Chains, Dmitry Lieber, Technion, Davidson Sch. of Mgmt., Fac. of IE & Mgmt., Haifa, Israel, Arkadi Nemirovsky, Alexander Podgajetsky, Reuven Y. Rubinstein

We present a new method for finding the optimal solution for combinatorial and continuous nonconvex optimization problems with convex bounded domains. To find the optimal solution, we solve a sequence of simple auxiliary smooth optimization problems based on importance sampling, Markov chain and Boltzmann distribution...

TD17 Queues & Applications

Cluster: Queues

Invited Session

Chair: Moshe Haviv, The Hebrew Univ. of Jerusalem, Dept. of Statistics, Jerusalem, 91905, Israel

1) A Queueing Model for a Maintenance Facility for Trains, Ivo J. B. F. Adan, Eindhoven Univ. of Tech., Dept. of Math & Comp. Sci., PO Box 513, Eindhoven, 5600 MB, The Netherlands

We consider a maintenance facility for trains. In the facility, there are several parallel tracks, each track offering space to exactly 2 trains. A track can be entered (and left) on one side only. This implies that when the train at the front is ready, it has to wait until the one at the back is also ready before it can leave the track...

2) Queueing Models for Optimistic Concurrency Control, Jan van der Wal, Eindhoven Univ. of Tech., Dept. of Math. & Comp. Sci., PO Box 513, Eindhoven, 5600 MB, The Netherlands, Simone Sassen

In database systems, one of the service disciplines to support parallelism is OOC. In OOC, services can always start but there is the risk that after completion of a transaction, all work turns out to be useless because another transaction has overwritten one or more data items that were used. We are developing analytical tools to support the design of a real-time database...

3) Queueing in Interfering Resources Environment, Mor Armony, Stanford Univ., Dept. of EES & OR, Terman Eng. Ctr., Stanford, CA 94305-4023, armony@leland.stanford.edu, Nicholas Bambos

We discuss a problem of service control in queueing systems with shared/interfering service resources. We consider a number of parallel queues with interdependent service rates. Specifically, the service mechanism can be in one of N states at any point in time, providing a given service rate to each queue. The issue is how to dynamically choose the service state so as to optimize various measures of the system's performance.

4) Polynomial Time Root Computation of Parametric Polynomial, Uriel Rothblum, Technion, Dept. of IE & Mgmt., Haifa, 32000, Israel, rothblum@ie.technion.ac.il, B. Curtis Eaves

Given a ground field a parametric polynomial is regarded as a polynomial with coefficients in the extension field of semi-terminating formal fractional power series. Roots of parametric polynomials are in the extension field and are termed parametric roots. Using a refinement of the Newton polygon process, a complete set of approximate parametric roots are computed in parallel. Elements in the complete set are truncations of the exact parametric roots, are accurate to prescribed accuracy and are dense in the set of all approximate roots. A complexity analysis over the ground field of arithmetic operations, storage, required time, required number of parallel processors and requested roots of polynomials is provided; polynomial bounds are established in the degree of the parametric polynomial and the prescribed target accuracy. Application to the solution of stochastic games will be discussed.

5) Pricing in Congested Systems, Moshe Haviv, The Hebrew Univ. of Jerusalem, Dept. of Statistics, Jerusalem, 91905, Israel

We suggest 2 approaches for pricing in congested systems. One is based on externalities, i.e., one pays for the added waiting time one imposed on others. The other is based on applying the Aumann-Shapley price mechanism to the time of waiting functions. Examples are given for the M/G/1 queueing system under various entrance disciplines such as first-come first-served, processor sharing and queues with priorities.

TD18 Product Development

Contributed Session

Chair: David Wilemon, Syracuse University, Sch. of Mgmt., Syracuse, NY 13244-2130, dwilemon@som.syr.edu

1) The Role of Contract Type on the Success of R&D Defense Projects Under Increasing Uncertainty, Arik Sadeh, Ctr. for Tech. Ed. Holon, 52 Golomb St., Holon, 58102, Israel, sadeh@barley.cteh.ac.il, Dov Dvir

The impact of contract type (fixed-price vs. cost plus) in the presence of technological uncertainty on the success of defense projects is evaluated. We found that when technological uncertainty at the start of projects is high, cost-plus contracts result in higher success. Fixed-price contracts are better for lower levels of technological uncertainty.

2) Experiences of Cross-Functional Team Members in Product Development Projects, David Wilemon, Syracuse University, Sch. of Mgmt., Syracuse, NY 13244-2130, dwilemon@som.syr.edu, Gloria Barczak

Increasingly, companies are relying on CFTs to develop new products. This research, based on a field study of more than 70 interviews, examines how CRT team members experience their assignments. Issues examined include perceptions of team performance, stress, rewards, conflict, critical issues encountered during the development life-cycle and views regarding effective and ineffective team leaders...

3) Integrating Industrial Product & Automated Process Design, Lilian L. Barros, GSI-UTT, IE Dept., BP 8, St Julien les Villas, 10800, France, barros2@univ-troyes.fr, Leo L. Baptista

There are 2 aspects of the design issue to be discussed. The first is the methodological aspects which link a sophisticated library of technical data to process design decisions linked to automation, command and control, lay-out and logistics concerns. We then discuss the real-life aspects which rely on contact with vendors, suppliers, industrialists in the area, local authorities, etc.

TD19 System Reliability

Invited Session

Chair: Ilya Gertsbakh, Ben Gurion Univ. of the Negev, Dept. of Math. & Comp. Sci., PO Box 653, Beer Sheva, Israel

1) Factorial Life Testing Experiments with Type-II Censored Data, Ilya Gertsbakh, Ben Gurion Univ. of the Negev, Dept. of Math. & Comp. Sci., PO Box 653, Beer Sheva, Israel, [Soren Bisgaard](mailto:Soren.Bisgaard)

We consider 2-level factorial design in which, for each factorial combination, a sample of n items is observed until the r -th failure. Our basic assumption is that the logarithm of the lifetime belongs to a location-scale family. It allows simple data processing and simple estimation of significant factors.

2) Optimal Replacement Policy Under Risk Constraint, Haim Shore, Ben Gurion Univ. of the Negev, Dept. of IE, PO Box 654, Beer-Sheva, 84105, Israel, shore@bgumail.bgu.ac.il

Machine-parts are prone to fail at random, each having its characteristic lifetime distribution. There are replacement and production-stoppage costs; however, in addition, the management requires the probability of unplanned stoppage (due any part failure) not to exceed a given threshold. We present an approximate approach that renders this problem into a mathematically manageable one.

3) Confidence Estimation of System Availability, Evgeny Tartakovsky, Bromine Compounds, Ltd., R&D Dept., PO Box 180, Beer Sheva, 84101, Israel

We present confidence estimation of such indices as stationary availability and the reliability-maintainability measure, for series and parallel systems. These indices depend typically on component mean up and down times and their ratios. Several methods are investigated, among them the classic methods, the maximization and the bootstrapping methods.

4) Simulation of Complex Systems: Theory & Reality, Arie Dubi, Ben Gurion Univ., Dept. of Nuclear Eng., PO Box 653, Beer Sheva, Israel

System engineering has been, in general, an eclectic collection of methods and approaches. Availability, reliability, logistics, performance analysis, spare parts allocation, etc., are treated as separate and largely independent classes. We present a general system transport equation with the above subjects. Application of Monte Carlo methods to the solution of real-life problems is discussed.

TD20 Public Policy

Contributed Session

Chair: Stephen J. Huxley, Univ. of San Francisco, McLaren School of Bus., 2130 Fulton Ave., San Francisco, CA 94117, huxleys@usfca.edu

1) Searching for Economies of Scale in Public Agencies, Stephen J. Huxley, Univ. of San Francisco, McLaren School of Bus., 2130 Fulton Ave., San Francisco, CA 94117, huxleys@usfca.edu

A large state agency maintained 19 field offices scattered about the state with an average of 4 workers each. Would it increase productivity by consolidating to fewer, larger offices? The answer was no.

2) Statistical Thinking & Analysis of Crime Rates, Or Are We Becoming More Violent?, Shams-ur Rahman, Univ. of Western Australia, Graduate Sch. of Mgmt., Nedlands, Perth, WA 6907, Australia, srahman@ecel.uwa.edu.au

Violent crimes recorded by the Western Australia Police Service, WAPS, have been increasing steadily over the past 20 years. In September 1994, the WAPS launched the "Delta Program," a continuous organizational change process aimed at creating more secure Western Australia. Our goal is to determine if there has been a statistically significant change in violent crime since the inception of this program by employing a univariate approach.

3) Application of AHP to Environmental Consciousness Investigation, Liu Zhen, Tohoku Univ., Grad Sch. of Info. Sciences, Aramaki aza Aoba, Sendai, Miyagi Ken, 980-77, Japan, liuzhen@control.is.tohoku.ac.jp, Inooka Hikaru

In order to apply AHP to social investigation, an experimental study of ratio scale is carried out. We wrote a program, DPCME, which will improve the consistency rate of answers and assist decision makers in making consistent judgments. Also, an application to the analysis of an environment-friendly car is given.

4) withdrawn - author request of 5/21, Paolo Rosato, University of Padova, Dip. TESAF, Agripols, via Romea 16, Legnaro, Padova, 35020, Italy, prosato@ux1.unipd.it

Wednesday 08:30-10:00

WA01 Planning & Operation in a Competitive Electricity Industry

Cluster: Energy Applications

Invited Session

Chair: Shmuel S. Oren, Univ. of CA, IEOR Dept., Berkeley, CA 94720-1777, oren@ieor.berkeley.edu

1) Incorporating Wind Generation into Pool Simulation Using Elfin, Chris Marnay, Berkeley Ntl. Lab., 90-4000 Energy Analysis Prog., Berkeley, CA 94720, c_marnay@lbl.gov, **Osman Sezgen, Sarah Bretz**

A method using GIS is developed for estimating a supply curve for wind generation in the California power market after 2005. This supply curve is used in the Elfin simulation model to determine the profitability of 36 promising wind sites identified by previous studies.

2) Developing Local Area Strategies for Integrating Distributed Resources, Charles D. Feinstein, Santa Clara Univ., Sch. of Business, Santa Clara, CA 95053, cfeinstein@scuacc.scu.edu, **Peter A. Morris, Stephen W. Chapel**

We present a new approach for distributed resources planning that reformulates the planning problem as a dynamic optimization problem under uncertainty. The objective of the analysis is to select an investment strategy that minimizes the expected cost of meeting customers' demands in a local area over the indefinite future.

3) Daily Repetition: A Neglected Factor in the Analysis of Electricity Auctions, Michael H. Rothkopf, Rutgers University, RUTCOR, Fac. of Mgmt., PO Box 5062, New Brunswick, NJ 08903-5062, rothkopf@rutcor.rutgers.edu

The daily repetition of electricity auctions affects desirable auction design. We discuss games and nongame theoretic ways of thinking about designing sequential auctions. We find that daily repetition reduces the potential efficiency advantages of progressive auctions over sealed bids, makes collusion a greater potential problem and reduces the problems of using multi-part bids with dispatch models.

WA02 Workflow Technology & Management

Cluster: Internet & Electronic Commerce

Invited Session

Chair: Karl R. Lang, HKUST, Dept. of ISM, Clear Water Bay, Kowloon, Hong Kong

1) withdrawn - author request of 5/26, W. Retschitzegger, Univ. of Linz, Inst. of appl. Comp. science, Altenbergerstr. 69, Linz, A-4040, Austria, werner@ifs.uni-linz.ac.at, **G. Kappel, S. Rausch-Schott**

2) Workflow Management & Computer Supported Distance Learning: A Case Study & Prototype Implementation, Karl R. Lang, HKUST, Dept. of ISM, Clear Water Bay, Kowloon, Hong Kong, **J. Leon Zhao**

We discuss the application of WFMS technologies to distance learning environments and show that the use of WFMS can significantly increase the performance and effectiveness of educational organizations. We present a case study and describe a prototype system that we implemented at a distance learning institution in Hong Kong.

3) withdrawn - author request of 4/1, Bruce A. Reinig, HKUST, Clear Water Bay, Kowloon, Hong Kong, reinig@uxmail.ust.hk

4) Workflow Support for Intra- & Extra-Enterprise Relationships: A Case Study of a Disposal Company for Hazardous Waste, Thorsten Wewers, Univ. of Erlangen-Nuremberg, Martensstr. 3, Erlangen, 91058, Germany, wewers@wiso.uni-erlangen.de, **Christoph Wargitsch, Ruediger Bogdahn**

Starting with a classification of business partner relationships, we examine the interfaces of a German disposal company for hazardous wastes to its business partners. We identify several inter- and extra-enterprise interfaces. An interorganizational IS is subsequently derived from the interfaces' characteristics and the special surrounding of the company.

WA03 Burning OR/MS Issues in Health Care

Invited Session

Chair: Haim Reuveni, Ben Gurion Univ., Fac. of Health Sci., Beer-Sheva, 84101, Israel

1) Burning OR/MS Issues in Health Care, Haim Reuveni, Ben Gurion Univ., Fac. of Health Sci., Beer-Sheva, 84101, Israel

An introduction to a variety of OR/MS issues in health care systems will be presented. In recent years, new challenges in the management of health care systems have risen. We will mainly discuss issues in managed care, disease management, resource and service allocation, the dilemma of providing new technologies within limited budget resources, marketing and advertising in health care systems, quality control and utilization review of services. Coping with the excess of information to patients and to health providers is also a challenge.

2) FORS: Forecasting & Ordering Systems for the Pharmaceutical Retail Industry, Gil Roth, Optigroup Ltd., Technion City, Haifa, Israel, Yosef Blum

FORS is a comprehensive system for forecasting and ordering, adaptable to all levels of the organization. At the local pharmacy level, FORS can be used to forecast demand patterns, choose order cycles and determine ordering quantities. At the warehouse and organization level, FORS can be used to determine global demand patterns and purchasing policy. The forecasting engine of FORS combines "state of the art" hybrid forecasting function with a knowledge base derived from the particular model. The ordering module uses the forecast results, exact modeling of all cost components and exact modeling of the constraints to determine the optimal ordering cycles and quantities policy. We shall present the modeling and forecasting method behind FORS. We will demonstrate the power of the tool by showing results from the implementation of FORS in pharmacies of Israel's largest health care provider, Kupat Holim Clalit.

3) Decision Making on the Preferable Technology for the Evaluation of Obstructive Sleep Apnea Syndrome, Eithan Schweitzer, Kupat Holim Clalit, Planning & Control Dept., 10 Savion St., Tel Aviv, 62098, Israel, Ariel Tarasiuk, Haim Reuveni

Obstructive sleep apnea syndrome is a common disorder. Polysomnography studies are required for diagnosis and are considerably costly. Partial sleep monitoring systems were introduced as a substitute technology, which have cost advantages and improve patient accessibility. However, this assumption was not proven. By applying decision theory and sensitivity analysis methods, we established a practical comprehensive strategy to decide which technology is preferable: polysomnography or partial sleep monitoring systems. Decisions are made after analyzing the financial and operational aspects of diagnosis and therapy. We recommend applying the use of a combination of polysomnography and attended partial sleep monitoring in laboratory. This approach is expected to save 15% of annual expense on diagnosis and treatment.

WA04 Performance in Modern Media

Cluster: Performance Analysis of Computer/Communication Systems
Invited Session

Chair: Gabriel M. Silberman, IBM Toronto Lab., Ctr. for Advanced Studies, 1150 Eglinton Ave. E, North York, Ontario, M3C 1H7, Canada, gabbys@vnet.ibm.com

1) Transmission Rate Selection in Cellular Networks with Multi-Media & Data Services, Zvi Rosberg, IBM Haifa Research Lab., Technion City, Haifa, 3200, Israel, rosberg@vnet.ibm.com, rosberg@haifasc3

New emerging data services in cellular networks introduce variable transmission rates into the system, which raises the problem of controlling the transmission rates. Since in radio channels, a transmission rate is closely related to a signal to interference ratio and later can be controlled by an SIR-based power control, it is natural to couple between the power and the rate controls. We study this problem using 2 different methods. With the first, we present the power and rate control as a linear constrained programming problem with continuous and integer variables. We then derive a distributed IT sub-gradient search algorithm to solve its Lagrangian relaxed problem. With the other method, we consider it as a special instance of a channel removal problem for which we propose a new distributed algorithm combining rate removals and power control in every iteration. The algorithms are evaluated and compared in a hexagonal cellular network.

2) Performance Evaluation of Java-Based Applications, Avi Mendelson, Ntl. Semiconductors Israel, Israel, mendelson@taux01.nsc.com

No abstract supplied.

3) Information Theoretic Prediction Paradigm, Meir Feder, Tel-Aviv Univ., Dept. of Elect. Eng. Systems, Tel Aviv, Israel, meir@eng.tau.ac.il

Predicting the next outcome of an observed sequence has a natural information theoretic reasoning. The suggested prediction paradigm assigns a probability to the next outcome, reflecting the income accumulated from past observations, and assessed by the amount of "surprise" or new information revealed when the outcome does occur. This prediction paradigm, referred to a prediction with

log-loss, or prediction with self-information-loss, is intimately related to the lossless source coding problem and so allows the utilization of the vast amount of results from universal coding theory. We present the resulting algorithms and show applications in stock market prediction and prediction problems associated with efficient computer implementations, such as branch prediction and the pre-fetching problem.

4) The Use of Multi-Database in Global Applications, Jacob Slonim, Dalhousie Univ., Fac. of Comp. Sci., DalTech. Coll., Canada, slonim@cs.dal.ca

Current research projects and database product extensions reflect the importance of unconventional database applications. Unconventional applications differ from the conventional in the nature of transactions and data. The transactions may be complex, long and involve human interaction. The data includes small, structured objects as well as large, unstructured objects. An interoperable system is an extended multidatabase system comprising SDSs and UDSs. It provides an interoperable environment, wherein unconventional applications can be implemented as global transactions that access multiple database systems. However, the incompatibility of SDSs and UDSs raises an important concern about the performance of such global transactions. An SDS deals with structured data objects and employs fine granularity locking for concurrency control. A UDS employs coarse granularity locking because it contains large, unstructured data objects. Coarse granularity locks limit the concurrency at the UDS and reduce the throughput of global transactions in the system.

WA05 Modeling End-to-End Network Reliability & Data Mining for Better Customer Care
Invited Session

Chair: Xiaoyan Ji, AT&T Labs., 101 Crawfords Corner Rd., Rm. 2E-528, Holmdel, NJ 07733, jxy@qpc2.ho.att.com

1) withdrawn - author request of 5/29, Roman Antosik, AT&T Labs., 101 Crawfords Corner Rd., Rm. 2E-528, Holmdel, NJ 07733, antosik@ems.att.com

2) Data Mining in Support of Telecommunications Services, Gary Ulrich, AT&T Labs., 101 Crawfords Corner Rd., Rm. 2H-538, Holmdel, NJ 07733, ulrich@mailnet.ho.att.com

Data mining is becoming an essential technology for telecommunication companies seeking immediate competitive advantage, both in marketing to customers and delivering their services. We present a few applications of data mining to support marketing, service delivery and customer care within telecommunications and cover benefits and lessons learned.

3) A Comparative Visualization of Telephone Billing Data, Arnold Lent, AT&T Labs., 101 Crawfords Corner Rd., Rm. 2J-528, Holmdel, NJ 07733, lent@mailnet.ho.att.com

In the US telephone world, long-distance providers such as AT&T are billed by the local phone companies for access to their networks. Typically, these bills are big (~10,000 entries) and costly (\$100M/month) and require manual checking. We present a visualization of these access bills that permits immediate identification of billing problems.

4) Data Mining for Better Customer Care, Xiaoyan Ji, AT&T Labs., 101 Crawfords Corner Rd., Rm. 2E-528, Holmdel, NJ 07733, jxy@qpc2.ho.att.com, Kenneth W. Church

We propose a new metric, immediate callback rate, as a real-time diagnostic tool for AT&T customer care. The proposed metric can automatically generate a diagnosis without a pre-defined cause set and generate a diagnosis at any time. It is 20 times as powerful as a random process in terms of its resolution.

WA06 Service Quality
Contributed Session

Chair: Dan Trietsch, University of Auckland, Dept. of MSIS, Private Bag 92019, Auckland, New Zealand, d.trietsch@auckland.ac.nz

1) The Effects of Server's Personality on Service Quality, Neng-Pai Lin, National Taiwan Univ., 6F, 50, Ln 44, Sec. 4, Keelung Rd., Taipei, Taiwan, 106, ROC, nengpai@handel.mba.ntu.edu.tw, Hung-Chang Chiu

We investigated the effects of server's personality on service quality using the 5-factor model of personality and the SERVQUAL model of service quality. Empirical data from 143 pairs of servers and customers in Taiwan indicated that server's personality significantly influenced customer's perception of service quality. Results can be applied to the selection of personnel in accordance with the service quality strategy of a company.

2) Capacity Planning for Customer Service: Some Complexities, Dan Trietsch, University of Auckland, Dept. of MSIS, Private Bag 92019, Auckland, New Zealand, d.trietsch@auckland.ac.nz, Victor

Portugal

The deterministic capacity of m resources is essentially given by the (convex) feasible net satisfying m linear inequalities, as in LP. The same applies when specifying a fixed fraction as a safety cushion against stochastic fluctuations. But when we optimize the service level, the feasible set is no longer convex.

3) **withdrawn - author request of 4/28, Seok Hui Ng**, Nl. Univ. of Singapore, Dept. of Bus. Policy, 10 Kent Ridge Crescent, Singapore, 119260, Singapore, fbangsh@nus.edu.sg

WA07 Inequality Aversion, Approximate Stochastic Dominance, Investment Strategies

Cluster: Finance

Invited Session

Chair: Haim Levy, Hebrew Univ., Sch. of Bus. Admin., Jerusalem, 91905, Israel, mshlevy@mscc.huji.ac.il

1) **Inequality Aversion vs. Risk Aversion, Yoram Kroll**, Hebrew Univ., Ruppin Inst., Sch. of Bus., Jerusalem, 91905, Israel, msyk@mscc.huji.ac.il, **Liama Davidovitz**

We present a theoretical and empirical framework which separates inequality aversion from risk aversion. In lab experiments, subjects had to choose between 2 alternatives with the same risk and expected return but with different levels of egalitarianism. Choosing the more egalitarian alternative means inequality aversion.

2) **Approximately Stochastic Dominance, Moshe Leshno**, Hebrew Univ., Sch. of Bus. Admin., Jerusalem, 91905, Israel, msleshno@pluto.mscc.huji.ac.il, **Haim Levy**

While most investors may prefer one uncertain option over another, stochastic dominance rules will not this preference in the case of even a very small violation of these rules. We establish approximately stochastic dominance rules which formally reveal a preference for "most" investors but not for all.

3) **Does Passive Asset Allocation Dominate Dynamic Asset Allocation for All Investors?, Allon Cohen**, Hebrew Univ., Sch. of Bus. Admin., Jerusalem, 91905, Israel, msall@mscc.huji.ac.il, **Haim Levy**

By employing stochastic dominance and convex stochastic dominance, we show that when the returns on stocks are log-normal, passive asset allocation strategies dominate dynamic asset allocation strategies for all utility functions. However, this result does not necessarily hold for certain dynamic "wealth goal" strategies and for declining yield curves.

WA08 Production Planning

Contributed Session

Chair: Pawel Mysz, Univ. of New Haven, 300 Orange Ave., New Haven, CT 06575, mensz@charger.newhaven.edu

1) **A Prioritized Reinsertion Approach to Production Rescheduling, Can Akkan**, Koc Univ., Cayir Cad., No. 5 Istinye, Istanbul, 80860, Turkey, cakkan@ku.edu.tr

Given a pre-schedule, the problem of rescheduling operations on a single work center due to a disturbance is examined. In our approach, a set of operations around disturbance are un-scheduled and re-inserted to minimize both total tardiness and the ripple effect (or disruption). Ten priority rules and a local adjustment heuristic to be used after re-insertion are developed...

2) **Linear Programming Models for Production Planning, Ebbe G. Negenman**, Eindhoven Univ. of Tech., PO Box 513, Paviljoen F10, Eindhoven, 5600MB, The Netherlands, e.g.negenman@tm.tue.nl

We consider an LP model for production planning. A fixed number of final products are produced, all of which may consist of several components. The production system may be a fixture of convergent and divergent systems. We model the use of lead-times for each item and also realistic constraints on the number of items assembled in a time interval.

3) **An Approach for the $n/2$ /Flowshop/aF+bCmax Flowshop Scheduling Problem, Min-Sung Yeh**, National Taichung Inst. of Commerce, PO Box 67-100, Taichung, Taiwan, 408, ROC, wcyeh@fcu.edu.tw

We present an efficient approach to solve a 2-machine flow shop scheduling problem. The objective is to minimize a weighted combination of job flowtime and schedule makespan. We also present extensive computational results on random test problems; our results compare favorably with previously developed algorithms.

4) **System Approach to Production Management, Pawel Mysz**, Univ. of New Haven, 300 Orange Ave., New Haven, CT 06575,

mensz@charger.newhaven.edu

We will examine if system approach manifests itself in recent developments related to production management. We will identify the most feasible features of system approach and describe direction in which existing approaches evolve.

WA09 Production & Forecasting Issues in Supply Chains

Cluster: Supply Chains

Invited Session

Chair: Ramesh Srinivasan, IBM Storage Systems Div., 5600 Cottle Rd., San Jose, CA 95193

1) **Forecasting for Supply Chain Management, Daniel Corsten**, University St. Gallen, Inst. for Tech. Mgmt., St. Gallen, CH-9000, daniel.corsten@item.unisg.ch, **Thomas Schneckenburger**

We will report on applications of different forecasting techniques combined in various industrial supply chain environments. Hard and soft OR methods including supply chain analysis, organizational assessment and formal mathematical modeling were developed, adopted and applied. The objective was to facilitate logistics planning based on more accurate forecasts. The methods have been applied and tested in heterogeneous industrial settings, such as the industrial goods industry (machines) and the consumer goods industry (food). Preliminary results are very encouraging. However, due to the complexity of the subject, further research has to be undertaken.

2) **Simulation of a DRAM Production Supply Chain, Gerry Feigin**, IBM, TJ Watson Research Ctr., PO Box 218, Yorktown Heights, NY 10598, feigin@us.ibm.com, **Kaan Katircioglu**

We describe a detailed simulation of a DRAM production supply chain from raw wafer through SIMM assembly. The simulation has been used to analyze the impact of production and inventory policies, cycle times, yields and demand variability on inventories and service levels.

3) **Challenges & Lessons Learned in Operationalizing a Decision Support System for Production Planning in a Global Supply Chain, Ramesh Srinivasan**, IBM Storage Systems Div., 5600 Cottle Rd., San Jose, CA 95193, **K. Ingalls, C. Pratt, Y. Zeng**

Some key process and systems challenges experienced and lessons being learned in deploying a DSS for production planning in IBM's Storage Systems Division are presented. The supply chain under consideration is multi-tiered and multi-plant in scope with time-phased manufacturing parameters. The solution being deployed performs MRP- and LP-based allocations. Suggestions for the improvement of DSSs for production planning based on this experience are also presented.

WA10 Intelligent Scheduling I

Invited Session

Chair: Eugene Levner, The Hebrew Univ., Jerusalem, 01030, Israel

1) **On Parallel Algorithms & Parallel Intuition, George Adelson-Velsky**, Bar Ilan Univ., Dept. of Math. & Comp. Sci., Ramat Gan, 52900, Israel, velsky@bimacs.cs.biu.ac.il

This is a methodological presentation discussing Arlazarov's Thesis according to which we probably lack a specific parallel intuition which could be used in order to invent certain parallel algorithms for important practical problems, i.e., AI problems. Only recently, some features of parallel intuition have been, maybe, discovered in an algorithm for chess playing. This algorithm is based on the so-called rules-with-exceptions...

2) **An Equivalence Between the Robotic & No-Robot Jobshop Scheduling Problems, Eugene Levner**, The Hebrew Univ., Jerusalem, 01030, Israel, **Vladimir Kats**

We examine the impact of robots on the complexity of the cyclic flowshop and jobshop scheduling models. If a robot is incorporated into a cyclic (no-robot) flowshop model, then generally speaking, this may change the structure and complexity of the scheduling model. In contrast, the robotic and no-robot versions of the cyclic jobshop problem are shown to have the same structure and computational complexity.

3) **A Fuzzy Knapsack Problem & Robotic Applications, Alexander Puskun**, Bauman Technological Univ., Tulskeya ul 139/124, Kaluga, 248013, Russia, incor@kaluga.ru, **Milan Vlach**

We consider a fuzzy knapsack problem arising in the scheduling of tasks in a robotic cell. Using operations over fuzzy numbers in combination with a fuzzy version of the variable reduction scheme, we reduce a fuzzy knapsack to a multicriteria decision making procedure and derive a pseudo-polynomial algorithm producing all Pareto-optimal solutions.

4) **An On-line Algorithm for Scheduling Multiple Products in Robotic Cells, Leonid Meyzin**, Ctr. for Tech. Education, Holon,

Fabrice Chauvet, Jean-Marie Proth

A real-time scheduling algorithm which guarantees an optimal makespan to each part which arrives in a robotized line of chemical baths for surface treatment is proposed. We consider the cases with negligible and non-negligible transportation times. Some numerical examples and case studies are provided.

5) Schedules with Careful Checking: The Heuristic Algorithm for the Linear Ordering Problem, Boris Goldengorin, Univ. of Groningen, Dept. of Econometrics, PO Box 800, Groningen, 9700 AV, The Netherlands, b.goldengorin@eco.rug.nl, Gerard Sierksma

A company produces parts each requiring a number of special operations. Before an operation is carried out by a technician, all previous operations need to be checked by the same technician. There are n operations and n technicians and different technicians need different times for checking and processing operations. The problem is to find a schedule with the least production time.

WA11 Inventory Modeling I
Invited Session

Chair: Israel David, Ben-Gurion Univ., Dept. of IE & Mgmt., Beer-Sheva, 84105, Israel

1) A Comparison of the Nonstationary (s,S) Policy & the Static-Dynamic Uncertainty Strategy in Inventory Control, S. Armagan Tarim, Hacettepe Univ., Dept. of Mgmt., Beytepe 06532, Ankara, 06532, Turkey, armo@eti.cc.hun.edu.tr

The control of the inventory of an item having stochastic demand with an average level that varies with time is examined. Since the average demand rate varies with time, one would expect the optimal (s,S) values to also change with time. Thus, from a theoretical point of view, one is faced with a very difficult nonstationary problem where the 2 control parameters change from period to period. From a practical point of view, the uncertainty in the timing of the replenishments attributes to the system's nervousness. Therefore, the "static-dynamic uncertainty" strategy, where the replenishment times to use are determined at the beginning of the planning horizon considering the interdependency between the stock levels to have available at the start of those periods and their timing, is considered as an alternative to the nonstationary (s,S) policy. The aforementioned policies are tested on randomly generated problems and comments are made on the performance of the static-dynamic uncertainty strategy.

2) Simulation Optimization of Multi-Location Inventory Models, Peter Koechel, Tech. Univ. of Chemnitz-Zwischau, Dept. of Informatics, Chemnitz, 09107, Germany

We consider the problem of finding an optimal policy for the N-location inventory model with transshipments. In general, one cannot expect an analytic solution. Therefore, we propose to combine simulation and evolutionary optimization. Some examples demonstrate the application of the proposed method to the model assuming fixed costs.

3) Analysis of Newsboy Models Under Alternate Optimization Objectives Using Generalized Lambda Distribution, K. K. Achary, Mangalore Univ., Dept. of Stats., Mangalagangothri, 574 199, India, M. Kumaran

Several authors have discussed the analysis of the newsboy model under alternate optimization objectives, such as optimization of the expected total utility, Neuman-Morgenstern utility function or maximizing the probability of attaining a budgeted profit. The analysis of the model under these alternatives needs the knowledge of higher order partial moments of the distribution of the demand. We develop a solution procedure for the model, under the objective of setting a trade-off between the expected value and standard deviation of the profit function, using generalized lambda distribution to approximate the demand distribution. Numerical investigations are carried out for the situation of normal and gamma demand.

4) Classic Asset-Selling Problems with Holding Costs, Israel David, Ben-Gurion Univ., Dept. of IE & Mgmt., Beer-Sheva, 84105, Israel, Offer Levi

In classic asset selling problems, which now regain popularity under YM, there is a stream of bidders to whom n identical assets have to be sold until a given deadline. The bid values are random. We incorporate inventory holding costs for the assets and analyze various models. The incentive to accept lower bids might be the holding costs, revenues discount or the approaching deadline.

5) The Value of Supplier Information to Improve Management of a Retailer's Inventory, Frank Van der Duyn Schouten, Tilburg Univ., Ctr. for Economic Research, Fac. of Econ., Box 90153, Tilburg, 5000 LE, The Netherlands, f.a.vdrduynschouten.kub.nl, Ruud Heuts, Marc Van Eijs

The distribution of lead time demand is essential for determining reorder points in inventory systems. Usually, the distribution of lead time demand is approximated directly, but in some cases, it may be worthwhile to take the

demand per unit time and lead time into account separately, in particular, when some specific information about one or both is available...

WA12 Heuristics

Contributed Session

Chair: Renata Mansini, Univ. of Brescia, Dept. Quantitative Methods, C.da S. Chiara 48/b, Brescia, 25122, Italy, mansini@eco.unibs.it

1) A Scheduling Algorithm for Parallel Computation Using Genetic Algorithms, Kiseok Sung, Kangnung National Univ., Chibyun-Dong, Kangnung, Kangwan, 210-702, Korea, sung@knusun.kangnung.ac.kr, Jeehyuk Park

For parallel computation, a program compiler partitions a loaded program into tasks and allocates and schedules the tasks on multiple processors. We suggest a scheduling algorithm using genetic procedure to find a schedule minimizing the completion time of parallel computation. A result of computational experiment of the suggested algorithm is prepared.

2) withdrawn - author request of 5/8, Po Wing Lee, Univ. of Hong Kong, Dept. of Math, Hong Kong, Hong Kong, h9306535@khucc.hku.hk, Sydney C. K. Chu

3) An Efficient Fully Polynomial Approximation Scheme for the Subset-sum Problem, Renata Mansini, Univ. of Brescia, Dept. Quantitative Methods, C.da S. Chiara 48/b, Brescia, 25122, Italy, mansini@eco.unibs.it, Hans Kellerer, Ulrich Pferschy, Grazia M. Speranza

We present a fully polynomial approximation scheme which solves the subset-sum problem and has better time and space complexity than other known approximation schemes. Computational results show that the proposed scheme allows to solve instances with up to 5000 items with a guaranteed relative error smaller than 1/1000.

WA13 Minimum Cuts

Cluster: Network Optimization
Invited Session

Chair: Michal Penn, Technion Israel Inst. of Tech., Fac. of IE & Mgmt., Technion City, Haifa, 32000, Israel, mpenn@ie.technion.ac.il

1) Modeling All Bottlenecks (Edge Cuts) of a Network with Incremental Maintenance, Yefim Dinitz, Technion, Dept. of Comp. Sci., Haifa, 3200, Israel, dinitz@mpi-sb.mpg.de dinitz@cs.technion.ac.il

We address the problem of determining the (near) minimum edge cuts of a network. It models traffic bottlenecks and most probable communication disconnections due to link failures. When the minimum cardinality cut is at most 4, we develop efficient approaches for showing all bottlenecks efficiently in a single picture (model). We also analyze how the picture changes as edges are added incrementally.

2) The Pseudoflow Algorithm for Maximum Flow, Dorit S. Hochbaum, Univ. of CA, Sch. of Bus., 350 Barrows Hall, Berkeley, CA 94720

We introduce a new algorithm for the maximum flow problem that does not generate flows explicitly. The algorithm also provides a new parametric analysis algorithm for efficiently generating all breakpoints and to a new simplex algorithm that is the fastest known for parametric analysis. Each of these algorithms runs in $O(nm \log n)$ time.

3) An Improved Approximation Algorithm for Multiway Cut, Yuval Rabani, Technion, Dept. of Comp. Sci., Haifa, 32000, Israel, Gruia Calinescu, Howard Karloff

Given an undirected graph with edge costs and a subset of k nodes called terminals, a multiway cut is a subset of edges whose removal disconnects each terminal from the rest. We are interested in the problem of finding a multiway cut of minimum cost. Previously, a very simple combinatorial algorithm due to Dahlhaus, Johnson, Papadimitriou, Seymour & Yannakakis gave a cut of cost at most $2(1-1/k)$ times the optimum. Alon improved this result for $k=4$ and for $k=8$. We present a new LP relaxation for this problem and a new approximation algorithm based on it. The algorithm breaks the threshold of 2 for approximating multiway cut, producing a cut of cost at most $1.5 - 1/k$. This improved the previous result for every value of k including the better bounds of Alon. In particular, for $k=3$, we get a ratio of $7/6 < 4/3$.

WA14 Transportation

Invited Session

Chair: Moshe E. Ben-Akiva, MIT, Intelligent Transport. Program, Rm. 1-181, Cambridge, MA 02139

1) Transportation Projects Selection Process Using Fuzzy Sets Theory, Erel Avineri, Israel Inst. of Tech., Dept. of Civil Eng., Haifa, 32000, Israel, *Joseph Prashker, Avishai Ceder*

We present an efficient algorithm for the selection of transportation projects using fuzzy sets theory. The selection procedure is a multiple criteria process and projects are rated both on a quantitative or qualitative basis, using linguistic variables. To appropriately describe a given transportation policy, fuzzy weighted average and noncompensatory fuzzy decision rules are used.

2) Solution Procedure for the Traffic Assignment Problem with Explicit Linear Capacity Constraints, Tomer Toledo, Israel Inst. of Tech., Dept. of Civil Eng., Haifa, 32000, Israel, *Joseph Prashker*

We present a user traffic equilibrium model which deals with capacities and queuing. Assigned volumes are bounded by capacities and queues are formed when capacity is reached. The solution procedure for the capacity constrained traffic assignment problem is based on the internal penalty function combined with a path-based adaptation of the gradient projection algorithm.

3) Stochastic Network Loading Models that Overcome Path Enumeration, S. Bekhor, Israel Inst. of Tech., Dept. of Civil Eng., Haifa, 32000, Israel, *Joseph Prashker*

We focus on choice models, which are applied in stochastic loading procedures to solve the stochastic traffic assignment problem. We investigate how 3 different logit family models perform stochastic assignment. It is assumed that network loading is performed by allocating to each available route, between an origin-destination pair, the demand share according to the choice model.

4) Analyzing Transportation Air Quality Impacts Using State-of-the-Art Travel Demand Modeling Methods, Yoram Shifan, Israel Inst. of Tech., Transport. Research Inst., Haifa, 32000, Israel, *yxs@tx.technion.ac.il*

State-of-the-art travel demand modeling methods are derived from the demand for activities. We describe activity-based modeling methods for emissions and air quality analysis purposes. We compare 4 different levels of developments in travel demand modeling and the evaluation of the resultant transportation control measures.

WA15 Variance Reduction & Efficient Rare Event Simulation

Cluster: Statistical Methodology for Simulation Modeling
Invited Session

Chair: Philip Heidelberger, IBM, TJ Watson Research Ctr., PO Box 704, Yorktown Heights, NY 10598, *berger@watson.ibm.com*
research.ibm.com/people/b/berger/

1) Permuted Estimators for Regenerative Simulations, Marvin Nakayama, NJIT, Simulation & Modeling Lab., Dept. of CIS, Newark, NJ 07102-1982, *marvin@cis.njit.edu*, *James Calvin*

We construct estimators by first running a regenerative simulation using one sequence of regeneration points, permuting the cycles based on another sequence of regeneration points, computing an estimator for the new path and averaging overall possible permutations. We discuss small- and large-sample properties of the permuted estimators.

2) Adaptive Rare Event Simulation of Telecommunication Networks, Poul E. Heegaard, Norwegian Univ. of Science & Technology, Dept. of Telematics, Trondheim, N-7034, Norway, *poul.heegaard@item.ntnu.no*

To enable the use of importance sampling during simulation of large telecommunication networks, a new adaptive parameter biasing strategy is proposed. Its applicability is demonstrated by simultaneous simulation of both teletraffic and dependability aspects of a network with service interaction between different traffic classes, preemptive priorities and rerouting on overload/failures.

3) Simulation of Fluid Queues with Many Sources, Ad Ridder, Vrije Univ. Amsterdam, Dept. of Econometrics, de Boelelaan 1105, Amsterdam, 1081 HV, The Netherlands, *aridder@econ.vu.nl*, *Michel Mandjes*

We consider a finite-buffer fluid queue fed by multiple traffic sources and emptied at constant rate. We derive an asymptotic expression of the most likely path to buffer overflow and use this for applying importance sampling in simulations of the queue to estimate loss probabilities.

4) Multilevel Splitting for Estimating Rare Event Probabilities, Paul Glasserman, Columbia Bus. School, 415 Uris Hall, 3022 Broadway, New York, NY 10027-6902, *pglasser@research.gsb.columbia.edu*, *Philip Heidelberger, Perwez Shahabuddin, Tim Zajic*

We analyze a multilevel splitting technique for estimating rare event

probabilities. For a particular class of models, this method is asymptotically optimal, provided the splitting factor is properly chosen. However, for more general models, the method is not efficient unless the splitting is consistent with the model's large deviations behavior.

WA16 Panel: Design of Inter-Cultural Computer Supported Cooperative Work

Invited Session

Chair: Dov Te'eni, Bar-Ilan Univ., Ramat-Gan, 52900, Israel

1) Panel: Design of Intercultural Computer Supported Cooperative Work, Kishore Sengupta, Naval Postgraduate School, Code SM/SE, Monterey, CA 93943-5103, *Munir Lutfi, David Schwartz*

The world is growing into a smaller place, a village in which electronic commerce and cooperation will thrive. This panel critically examines what technology can and cannot do to bridge difficulties in intercultural communication with a view to improve cooperation by novel designs of computer supported cooperative work.

WA17 Queuing Models I

Contributed Session

Chair: So Young Sohn, Yonsei Univ., Dept. of ISE, Seudemungu, Shinchondong, Seoul, Korea, *sohns@bubble.yonsei.ac.kr*

1) Bank Teller Queue Size Analysis & Service Quality Improvement, M.C. Musongole, Univ. of Cape Town, Dept. of Statistical Sci., Rondebosch 7700, Cape Town, South Africa, *musongol@maths.uct.ac.za*, *R. Guo*

We investigate the customer's perception of service quality of bank teller queue service system. Markovian analysis of queue size data is performed and an optimal strategy is proposed to improve performance of the service system and satisfy the customer.

2) A Queuing Theoretical Approach to Multiproduct Monopoly: Steady State & Transient Behaviour, Isabel Parra-Frutos, Univ. of Murcia, Fac. of Econ., Ronda de Levante, #10, Murcia, 30008, Spain, *ipf@fcu.um.es*, *Joaquin Aranda-Gallego*

The behavior of a service firm is examined in terms of a stochastic model. To consumers, the firm is offering 2 time-based qualities. Given the consumer dynamic choice behavior, we use queuing techniques to derive market shares depending on firm's control variables and, on the other hand, only on time.

3) Robust Design for Traffic Intensity of Nonhomogeneous M/M/1 Queues, So Young Sohn, Yonsei Univ., Dept. of ISE, Seudemungu, Shinchondong, Seoul, Korea, *sohns@bubble.yonsei.ac.kr*

We consider a robust design of controllable factors related to the random traffic intensity parameter of a nonhomogeneous M/M/1 queue. The random traffic intensity parameter is defined as the ratio of the arrival rate to the service rate where both rates are assumed to be functions of associated characteristics of individual queues and random errors...

WA18 Technology Management

Contributed Session

Chair: David Wilemon, Syracuse University, Sch. of Mgmt., Syracuse, NY 13244-2130, *dwilemon@som.syr.edu*

1) The Structure of Technology Development Scheme: A Case Study, Bae Moonsik, ETRI, 161 Kajong-Dong Yusong-Gu, Taejon, 305-350, Korea, *msbae@etri.re.kr*, *Sim Jaeyong, Jun Oksun*

Most companies formulate an organizational vision and try to link it with its technology development and business strategy. In the case of a research institute, such a strategy affects the selection of core technologies. We introduce the structure of technology development scheme that contains an organizational vision, technology forecasting, selection of core technologies and technology processes in ETRI.

2) Development of a Technology Management Curriculum, Michel Benaroch, Syracuse Univ., Sch. of Mgmt., Syracuse, NY 13244, *mbenaroc@syr.edu*, *David Wilemon*

We examine a new graduate curriculum in the MOT at Syracuse University. Issues discussed include how the program was researched, the curriculum's design, student benefits and the content of the 12 credit hour MOT track. Several initial learnings from the MOT program will be discussed.

3) Technology Strategies Based on Technological Competitiveness Analysis: A Case Study, Sim Jaeyong, ETRI, 161 Kajong-Dong, Yusong-Gu, Taejon, 305-350, Korea, *sims@etri.re.kr*

Bae Moonsik

This research suggests a selection procedure of specific technology that has high technological competitiveness. To explore a framework of selection procedure, we introduce a matrix analysis method, that is, a set of relationships between technology gap and technology importance. We also consider 85 core technologies which are major development areas in ETRI.

WA19 Quality & Reliability**Invited Session**

Chair: Haim Shore, Ben Gurion Univ. of the Negev, Dept. of IE, PO Box 654, Beer-Sheva, 84105, Israel, shore@bgumail.bgu.ac.il

1) Rational Function Approximations to Range Control Chart Constants, Don G. Wardell, Univ. of UT, Eccles Sch. of Bus., Salt Lake City, UT 84112

We show exact values for the range and associated \bar{x} -bar control chart constants for sample sizes 2 and 3, and derive accurate rational function approximations for sample sizes from 2 to 1000. These exact values and approximations allow the control chart constants to be computed accurately and quickly without the need for table lookups.

2) Adapted Economic Control of Normal Processes, Elart von Collani, Univ. of Wurzburg, Sanderring 2, Wurzburg, D97070, Germany, collani@mathematik.uni-wuerzburg.de

Controlling a manufacturing process means to control the distribution of quality characteristics. Frequently, it is assumed that the distribution can be approximated by a normal one. The control procedure itself is generally selected without regard that deviations from the target may have different implications on process quality. Control methods are derived which are adapted to a given situation, thus, are more efficient than conventional ones.

3) A Comparative Simulation Study of Reliability Function, Sudha Jain, Univ. of Toronto, Dept. of Stats., 100 St. George St., Toronto, Ontario, M5S 1A1, Canada, jainsu@ustat.utoronto.ca

We study the potential use of the inverse Gaussian distribution for estimating the reliability function. The estimate of the reliability function is also obtained based on the Weibull distribution. A Monte Carlo simulation study shows that the estimate of the reliability based on the inverse Gaussian is quite comparable with those obtained by using the Weibull distribution.

4) General Control Charts for Attributes, Haim Shore, Ben Gurion Univ. of the Negev, Dept. of IE, PO Box 654, Beer-Sheva, 84105, Israel, shore@bgumail.bgu.ac.il

Shewhart control charts for attributes ignore the skewness of the underlying distribution and result in rounded control limits that are not necessarily optimal. We develop general formulae for integer-valued control limits that take account of skewness, and also minimize deviation from the nominal ARL in a state of control.

Chair: To be announced

Wednesday 10:15-11:45**WB01 Energy Derivatives & Management of Energy Risk****Cluster: Energy Applications****Invited Session**

Chair: Yves Smeers, Univ. Catholique de Louvain, 34 voie du Roman Pays, Louvain La Neuve, B-1348, Belgium, smeers@core.ucl.ac.be

1) Value at Risk in Electricity Transmission Contracts, Yves Smeers, Univ. Catholique de Louvain, 34 voie du Roman Pays, Louvain La Neuve, B-1348, Belgium, smeers@core.ucl.ac.be, **Jacqueline Boucker, Emmanuel Canon, Frederick Jonard**

Value at risk is now a major instrument in risk management. We consider its application in the context of electricity transmission contracts. The contract provides revenue. It also requires the purchase of services and hence, costs. Both may be random and hence, induce risks. We consider some of the transmission pricing methods commonly discussed, i.e., postage stamp, MW miles, nodal prices, etc., and discuss how the value at risk can be computed. The approach relies on a DC approximation of the transmission system and uses Monte Carlo simulation. Numerical examples are presented.

2) Irreversible Investment & the Role of Contracts in Imperfectly Competitive Electricity Markets, Juan Mauricio Benavides, Universidad de Los Andes, Dept. of IE, CII 1A No. 18A-70, Bogota, Colombia, jbenavid@uniandes.edu.co

Real options and game theory are used to model entry into an oligopolistic electricity market. We examine 3 issues: the relationship between prices and the level of contracting, the impact of contracting on the option to wait for

favorable entry conditions and the effect of contract length on welfare. These are relevant for assessing the potential of competition in the newly emerging electricity pools.

3) Electricity Transmission Access Pricing via Option Value Insurance, Shmuel S. Oren, Univ. of CA, IEOR Dept., Berkeley, CA 94720-1777, oren@ieor.berkeley.edu, **Shijie Deng**

We consider a competitive electricity network with a reference spot market for spot trading or settlements. We propose a scheme that prices transmission access as the option value corresponding to a strike price selected by the user and guarantees either access to the network or compensation in the amount of the option value corresponding to the selected strike price. Congestion management protocol minimizes compensation payment.

WB02 EC Models**Cluster: Internet & Electronic Commerce****Invited Session**

Chair: Ramayya Krishnan, Carnegie Mellon Univ., Heinz Sch. of Public Policy, Pittsburgh, PA 15213-3875, rk2x@cmu.edu

1) Design Patterns for Object Frameworks in Electronic Commerce, Arie Segev, Univ. of CA, 350 Barrows Hall #1900, Haas School of Bus., Berkeley, CA 947201900, segev@haas.berkeley.edu, **Martin Bichler**

An object framework provides collections of components designed to collaboratively solve a specified task. Frameworks unlike class libraries reuse the source code as well as the architectural design for a new application. We will discuss object frameworks in the context of electronic commerce and demonstrate how such an approach is used to design Web-based business-to-business procurement.

2) Issues in Payment System Design, Marvin A. Sirbu, Carnegie Mellon Univ., Engineering & Public Policy, Rm. BH129, Pittsburgh, PA 15213-3890, sirbu@cmu.edu

A wide variety of cryptographically sophisticated payment system technologies have been introduced in an effort to secure Internet transactions. Yet, the vast bulk of Internet transactions today use no more security than an SSL encrypted channel for uploading the consumer's credit card number, if that. We will examine a range of payment protocols from several perspectives.

3) withdrawn - author request of 6/1, Peter Buxman, Frankfurt Univ., Institute of Info System, Mertonstr. 17, Frankfurt, D-60054, Germany, koenig@wiwi.uni-frankfurt.de, **Wolfgang Koenig, Frank Rose**

WB03 Health Care I**Contributed Session**

Chair: Marion S. Rauner, Univ. of Vienna, Dept. Innovation & Tech. Mgmt., Bruenner Str. 72, Vienna, A-1210, Austria, marion.rauner@univie.ac.at

1) Quantifiable Insights in Health Care Environments: The Application of MS/OR to Ambulatory Care Services in Hong Kong, Limor Aharonson-Daniel, Univ. of Hong Kong, G/F 16 Crown Terrace, Pokfulam, Hong Kong, SAR China, ldaniel@chevalier.net, **Ray J. Paul**

An extensive OR inquiry into Hong Kong ambulatory health care services was triggered by the growing demand for health services and the public's expectation for more service oriented medical care. The understanding achieved in the preliminary modeling stages was sufficient to satisfy the study objectives, thus making the subsequent stages of more complicated modeling unnecessary.

2) Allocating Health Care Resources, Steffen Flessa, Univ. Erlangen-Nurnberg, PO Box 3931, Nuernberg, 90020, Germany, wsora0@wsr2.wiso.uni-erlangen.de

An LP is presented which analyzes the impact of changes of the health care budget, the age structure and health care priorities in an emerging region on the optimal ratio between preventative and curative medicine as well as primary and secondary health care.

3) The Application of Decision Analysis to Evaluate Information in Health Care, Kevin J. Leonard, Univ. of Toronto, 1001 Bay St., Ste. 602, Toronto, Ontario, M5S 3A6, Canada, l.leonard@utoronto.ca, **Gerald Keller**

IT can be used to improve the efficiency and effectiveness of the delivery of health care. We propose applying DA to the evaluation of the value of the information components of a centralized electronic patient record. The results will be used to develop a business process model for IT cost effectiveness throughout health care.

4) Impact of International In-Patient Payment Strategies on Health Technology Management: The New Austrian Reimbursement System, Marion S. Rauner, Univ. of Vienna, Dept. Innovation & Tech. Mgmt., Bruenner Str. 72, Vienna, A-1210, Austria, marion.rauner@univie.ac.at, Michaela-Maria Linzatti

We present the effects of the new Austrian reimbursement system on performance measures from the technology management angle. We first discuss fundamental differences of international payment strategies and their implications for policy makers; then structural problems of the Austrian payment system are analyzed by means of system dynamics.

WB04 Communications Networks

Cluster: Teletraffic for Future Networks

Invited Session

Chair: Hanoeh Levy, Tel-Aviv Univ. & Tadiran Telecommunications Ltd., Dept. of Comp. Science, Tel-Aviv, Israel, hanoeh@math.tau.ac.il

1) On Dispersed Arrival Models in Communication Networks, Moshe Sidi, Technion, Elect. Eng. Dept., Haifa, 32000, Israel, Israel Cidon, Omer Gurevitch

Messages in communication networks consist typically of blocks of consecutive packets. The message generation process can be either "batched," i.e., all packets of a message arrive at the network at the same time, or "dispersed," i.e., the packets of a message arrive one by one dispersed over time according to some distribution. The main difficulty in the analysis of dispersed arrival queueing models is due to the correlation between the system states observed by different packets of the same message. We use recursive methods to compute loss probabilities in priority models and in tandem models with dispersed arrivals.

2) A Markov-Renewal-Modulated TES Model for JPEG-Like Compressed "Star Wars" Video, Benjamin Melamed, Rutgers Univ., RUTCOR, Fac. of Mgmt., Dept. of MSIS, New Brunswick, NJ 08903, melamed@rutcor.rutgers.edu

The bulk of previous work in video source modeling has been confined to short sequences of empirical records, which attempt to capture the autocorrelations of empirical bit rate records. We present a novel approach to video modeling with 2 main contributions: a model of a full-length movie (a JPEG-like version of "Star Wars") and the ability to capture the distribution and autocorrelation functions of the empirical record.

3) Sizing Exit Buffers in ATM Networks: Unstable Systems with Small Cell Loss Rates, Hanoeh Levy, Tel-Aviv Univ. & Tadiran Telecommunications Ltd., Dept. of Comp. Science, Tel-Aviv, Israel, hanoeh@math.tau.ac.il, Tzippi Mendelson, Moshe Sidi, Joseph Keren-Zvi

We deal with the sizing of end buffers in ATM networks for sessions subject to constant bit rate traffic where the objective is the minimization of cell loss. We reveal that under the infinite buffer assumption, the system possesses rather intriguing properties: on one hand, it is unstable, while on the other, the likelihood of the buffer exceeding even small values is very small. We analyze this system under finite buffer assumption and derive bounds on the cell loss rates. Numerical examination of ATM-like examples show that the bounds are very good.

4) Quality Management of a Large-Scale Video Conference, Israel Cidon, Technion, Elect. Eng. Dept., Haifa, 32000, Israel, Youval Nachum

Our goal is to explore meaningful management strategy and algorithms that will enable video conference management over a communication network. An efficient and human friendly video conference management must properly utilize the limited resources and consider its conference participants' quality of service demands and expectations. The conference is composed of participants along with their presentation tools who wish to communicate with each other utilizing the network's services. Each participant operates their multimedia workstation connected to the physical network. A participant may transmit to other participants a variety of information types such as real-time video stream, video clips, slides, real-time shared white-board, etc. Participants are expected to act as they would in a real conference room. Sometimes they wish to talk, sometimes they wish to listen and watch a remote speaker or a multimedia producer. They may even want to burst into someone else's speech. The conference management should support these applications and their QoS demands by allocating capacity and time to multiple multicast transmissions. Participant demands may be in conflict, i.e., too many participants may wish to transmit to the same destination at the same time. The conference management should respond to participant requests by selecting a feasible and humanly reasonable allocation. Designing a multi-party video conference management system faces a conflict between 2 main system resources, time and capacity. Video conference time duration is a limited resource. The conference might have a planned termination time and each participant may have his own time

limits. Participants are not able to follow too many other participants presentation materials in parallel on their screen. Therefore, time allocation policy among all the active participants should be determined. The conference management should determine the time and order of allocating speakers. The conference capacity is also a limited resource, since network capacity is limited. Capacity allocation affects the amount of parallel sources that can be allocated as well as the video picture and voice quality. This limitation also leads to additional management trade-offs.

5) Public Policy & Private Initiative in the Incubation of Israel's High Technology Entrepreneurial Firms, Susanna Khavul, Boston University, Dept. of Mgmt. Policy, 595 Commonwealth Av Fl.6, Boston, MA 02215, skhavul@bu.edu, Candida G. Brush, Shlomo Kalish, Miri Lerner

Research compares the relative impact of publicly and privately funded initiatives on the incubation of high technology within Israeli start-ups distributed along the entrepreneurial lifecycle. Structured interviews explore the impact of the internal and external environments, composition of teams, network clustering, location, strategic alliances and commercialization processes on early growth.

WB05 Panel: Information Knowledge & Strategic Renewal Contributed Session

Chair: Edna Pasher, Edna Pasher, Ph.D & Assoc. Management Consultants, 31 Zohar Tal St., Herzliya, 46741, Israel, pasher@trendline.co.il

1) Panel: Information, Knowledge & Strategic Renewal, Edna Pasher, Edna Pasher, Ph.D & Assoc. Management Consultants, 31 Zohar Tal St., Herzliya, 46741, Israel, pasher@trendline.co.il, Eli Segev, Amiaz Sagis, Sasson Oz

This will be a panel of four: Prof. Segev will focus on the use of IS to support strategy making, Dr. Edna Pasher will focus on knowledge management in strategic planning and a CEO and an internal consultant from the same organization will present a specific process of strategic management.

WB06 Organizational Structures Contributed Session

Chair: A. D. Amar, Seton Hall Univ., Sch. of Business, South Orange, NJ 07079

1) Management Controls in Symbiotic Organizations, A. D. Amar, Seton Hall Univ., Sch. of Business, South Orange, NJ 07079

We present management control models suitable for contemporary organizations that thrive on innovation. The work explains why and under what conditions currently available control techniques are not suitable for unleashing human mind. We provide guidelines for designing new controls to turn controlled employees into "in-control" symbionts.

2) No Title Supplied, Yitzhak Fried, Wayne State Univ., Dept. of Mgmt., 5201 Cass Ave., Detroit, MI 48202, i.fried@wayne.edu

This longitudinal study examined the main and interactive effects of job insecurity, role ambiguity and type A/B on job performance, burnout and self-confidence in a large sample of Israeli industrial employees. Results provided partial support for the expected main and interactive effects of the 3 independent variables.

3) Using Partitioning & Tearing Method in Modeling Public Problems Along the US - Mexico Border, Kazimierz Sliwa, Sul Ross State University, Rio Grande College, 205 Wildcat Dr, Del Rio, TX 78840, cksliwa@delrio.com

Our presentation is based on author's experience working with Mexican public managers on problems modeling and simulation. Complexity of those problems and linear approach traditionally used for solving them used to be a major cause for public mismanagement. We present a practical application of the partitioning and tearing method for ordering complex problems with feedback based structure.

WB07 Value at Risk Corporate Control, Tax Expenditures, Privatization

Cluster: Finance

Invited Session

Chair: S. Abraham Ravid, Rutgers Univ., Grad. Sch. of Mgmt., 180 University Ave., Newark, NJ 07102, ravid@andromeda.rutgers.edu

1) Value at Risk as a Risk Measuring Tool, Zvi Wiener, Hebrew Univ., Grad. Sch. of Bus., Mount Scopus, Jerusalem, 91905, Israel, msweiner@pluto.huji.ac.il

We discuss how VaR can be used for supervision and internal control.

Parametric and non-parametric methods are discussed. The non-parametric approach is represented by historical simulations and Monte Carlo methods. Variance covariance and analytical models are used in the parametric approach. Finally, we discuss back testing.

2) The Democratization Puzzle in US Corporate Law, *Eli Bukspan*, Interdisciplinary Ctr. Herzeliya, PO Box 167, Herzeliya, 46150, Israel, bukspan@idc.ac.il

The relative nonexistence of locked control of US publicly-held corporations is a puzzle. Why do entrepreneurs not establish dual class voting shares and pyramid structures to capture control premiums and prevent hostile takeovers? The fragmented structure of US capital market and its historic role in corporate financing might be the answer.

3) Tax Expenditures in the Israeli Tax System: Legal & Economic Aspects & a Blueprint for Reform, *Ayal Shenhav*, Interdisciplinary Ctr. Herzeliya, PO Box 167, Herzeliya, 46150, Israel, shenhav@idc.ac.il

The tax system aims to advance certain economic or social goals through providing tax incentives to various activities. The tax incentives are known as "tax expenditures." We discuss the economic impact and the pros and cons of tax expenditures. A suggested reform of the Israeli tax system with respect to tax expenditures is also presented.

4) withdrawn - author request of 5/29, *S. Abraham Ravid*, Rutgers Univ., Grad. Sch. of Mgmt., 180 University Ave., Newark, NJ 07102, ravid@andromeda.rutgers.edu, *Kose John, Zsuzsanna Fluck*

WB08 Flexible Manufacturing Systems

Contributed Session

Chair: Aharon Gonik, Ben-Gurion Univ., Shikma St. 22, Omer, 84965, Israel, luxarad@main.aquanet.co.il

1) Production Capacity of Flexible Manufacturing Systems with Dedicated Pallets & Fixed Production Ratios, *Yves P. Dallery*, Univ. Pierre et Marie Curie, Lab. D'Info. de Paris 6, 4 Place Jussieu, Paris, 75252, France, yves.dallery@lip6.fr, *Bruno Baynat, Ronald Buitenhek*

We propose an approach for determining the production capacity of a multi-part type FMS with dedicated pallets & fixed production ratios. We show that the problem reduces to the determination of a single parameter, for which we propose an iterative procedure. Simulation or approximate analytical techniques can be used as building block performance evaluation techniques in the iterative procedure.

2) Developing Deterministic Schedules for FMS with Random Time Operations, *Aharon Gonik*, Ben-Gurion Univ., Shikma St. 22, Omer, 84965, Israel, luxarad@main.aquanet.co.il, *Dimitri Golenko-Ginzburg*

A flexible manufacturing system comprising random time operations in a definite sequence, is considered. Each operation utilizes resources to be fed-in at predetermined moments. Cost penalties both for not meeting the target on time and for idling resources are given. The problem to determine feeding-in moments to minimize the system's costs.

3) A Modular Design of an FMS with Hard & "Soft" Products, *Lilian L. Barros*, GSI-UTT, IE Dept., BP 8, St Julien les Villas, 10800, France, barros2@univ-troyes.fr

There is an international interdisciplinary project linking researchers from Eastern and Western Europe with practical experience in the design of FMS for industrial and academic settings, the latter being largely responsible for the "soft" product demand. These researchers come from a variety of disciplines so the project adopted a modular structure with a supervisor which takes locally optimum solutions and searches for feasibility and then optimality, or at least some asymptotic convergence towards a "good" solution. There are 4 modules in the model: automation and robotics (manned by Eastern Europeans), command and control (manned by French researchers), layout and production planning (manned by English researchers) and logistics and industrial maintenance (manned by the UTT, which also coordinates the project). The supervisor, also called a "simulator" in the broadest sense of the term, is manned by Eastern Europeans and the UTT. This idea generated enough new material for 2 (completed) MSc thesis and 2 PhD dissertations (under development). The base case is a real project for design and installation of a completely automated plastic injection FMS for the UTT.

WB09 Supply Chain Management I

Cluster: Supply Chains
Invited Session

Chair: Laura Rock Kopczak, Stanford University, IE/EM Dept., Terman 351, Stanford, CA 94305-4024, kopczak@leland.stanford.edu

1) Supply Chain Contracting with Forecasting & Moral Hazard, *Martin Lariviere*, Duke Univ., Fuqua Sch. of Bus., Box 90120, Durham, NC 27708, larivier@mail.duke.edu

In 1994, IBM offered its largest resellers a special allocation of laptop computers if they accepted extremely limited returns policies. What was Big Blue thinking?

2) Impact of Differences in Labor & Working Capital Costs on a Supply Chain's Ability to Match Supply with Demand, *Ananth Raman*, Harvard University, Grad. Sch. of Bus. Admin., Soldiers Field, Boston, MA 02136, araman@hbs.edu

Supply-demand mismatch costs, i.e., the sum of stockout costs, inventory holding costs and obsolescence costs, etc., are growing in many industries. Traditionally, these costs have been traced to poor production/inventory planning, bad forecasting and operational constraints. We show that high, and mismatched, labor and working capital costs also exacerbate these costs.

3) Modeling the Supply Chain from a Company Viewpoint: A Different Perspective, *Jan C. Fransoo*, Eindhoven Univ. of Tech., Dept. Op. Planning & Control, PO Box 513, Pav. F12, Eindhoven, 5632DD, The Netherlands, j.c.fransoo@tm.tue.nl, tue.nl/tm/vakgr/lbs/lbst.htm, *J. F. Wouters*

In most modeling literature, be it OR, decision sciences or ISs, supply chains have been modeled from a more or less central, overall perspective. The chain is seen as a series of companies with some demand for central control, without recognizing the authority and interests of individual companies within the chain. We argue that for the design of ISs and decision support procedures, it may be useful to take a different perspective, where the company, as a single supply chain unit, is put central within a web of relations with partner companies in various supply chains. The consequences for modeling supply chain planning decisions are addressed. Finally, we discuss the application of more traditional, central models in this decentralized supply chain planning context.

4) Using Advance Demand Information in a Project-Based Supply Chain, *Laura Rock Kopczak*, Stanford University, IE/EM Dept., Terman 351, Stanford, CA 94305-4024, kopczak@leland.stanford.edu

Demand information about materials required for a project emerges through a sequence of design decisions. Meanwhile, a manufacturer makes a sequence of decisions which allocate resources. We present a framework for characterizing demand and supply milestones and evaluating opportunities to share demand information. An example from a year long study of the construction industry is used.

WB10 Intelligent Scheduling II

Invited Session

Chair: Eugene Levner, The Hebrew Univ., Jerusalem, 01030, Israel

1) A Metaheuristic-Based General Solver for Combinatorial Optimization Problems, *David Abramson*, Monash Univ., Dept. of Digital Systems, Wellington Rd., Clayton, VIC, 3168, Australia, david@dgs.monash.edu.au sgs/monash.edu.au/~davida

We discuss a general purpose combinatorial optimization solver based on metaheuristics such as SA and TS. The general nature of the solver allows a model developer to rapidly prototype different problems quickly. The system uses a modeling environment in which the integer variables are stored in dynamic list structures.

2) Organizing Local Behavior in Complex System Control Tasks, *Victor Varshavsky*, Univ. of Aizu, Comp. Logic Design Dept., Aizu-Wakamatsu City, Tsuruga, Fukushima-ken, 965-80, Japan, victor@u-aizu.ac.jp, *Vladimir Savshenko, Stanislav Sedukhin*

When a system has general goals and criteria, it is necessary that a certain central body intervenes in the behavior of the system components. Social and economic laws give us examples of control organization when introducing laws and rules create an environment providing the tolerance of local and global goals. The increasing complexity of modern informational and computing systems makes them similar to social and economic systems...

3) On Approximation of the Single-Source Unsplittable Flow, *Yefim Dinitz*, Technion, Dept. of Comp. Sci., Haifa, 3200, Israel, dinitz@mpi-sb.mpg.de dinitz@cs.technion.ac.il, *N. Garg, M. Goemans*

Let $G = (V, E)$ be a network with edge capacities, a source s , k sinks and demands $d(i)$. Note that a vertex can contain several sinks. Given that all demands can be routed fractionally, i.e., by a regular flow, we want to route

ki) units of flow from s to sink i concurrently and unsplitably. We will compute an unsplitable flow such that the total flow through an edge exceeds its capacity by at most the maximum demand...

4) Optimal Cyclic Replacement Scheduling for Multistate Technical Systems, Gregory Levitin, The Israel Electric Corp. Ltd., R&D Div., Reliability Dept., PO Box 10, Haifa, 31000, Israel, A. Lisnianski

The multistate series-parallel system where redundant elements are included in order to provide a desired level of reliability is considered. The elements of the system are characterized by their capacity (productivity) as well as by an average time and cost of their repair and replacement. A function representing failure rate dependence on time between replacements is also known for each element...

5) Fuzzy Scheduling & Applications, Yaron Klein, Tel-Aviv Univ., Dept. of Elect. Eng., 40 Moshe Dayan St., Tel-Aviv, 67653, Israel, klein@eng.tau.ac.il

We introduce a fuzzy-based approach for solving scheduling problems. We assume that a human planner is unable to determine criteria weights for a multi-objective system but rather compares only pairs of objectives according to a limited vocabulary. We convert the vocabulary to fuzzy terminology and apply a fuzzy-based optimum search for a solution of the scheduling problem. Real life applications are demonstrated.

WB11 Inventory Modeling II

Invited Session

Chair: Richard A. Ehrhardt, Univ. of NC, Sch. of Bus. & Econ., Greensboro, NC 27412-5001

1) A Standing-Order Inventory Problem with Stochastic Demand, Richard A. Ehrhardt, Univ. of NC, Sch. of Bus. & Econ., Greensboro, NC 27412-5001, J. R. Dennett

We consider a periodic-review inventory model in which the replenishment quantity must remain fixed for a given interval of periods. We formulate a DP model of the multi-interval problem, summarize the results of 132 different infinite-horizon optimal policy calculations for 132 different parameter settings and compare them with heuristic policies.

2) Emergency Replenishment Ordering in Periodic Review Inventory Systems, D. Vlachos, Aristoteles Univ. of Thessaloniki, IM Division, Dept. of Mech. Eng., Thessaloniki, 540 06, Greece, G. Tagaras

We investigate the operational characteristics of a distribution system consisting of a central warehouse and 3 stocking locations. The stocking locations are periodically resupplied by the warehouse. In case of an imminent shortage, a stocking location may also place emergency orders for lateral transshipment from the other locations.

3) A Dynamic Two-Segment Partial Backorder Control of (r, Q) Inventory Systems, C. W. Chu, Kent State Univ., Grad. Sch. of Mgmt., Kent, OH 44242-0001, B. Eddy Patuwo, Abraham Mehrez, Gad Rabinowitz

A new form of particle backorder policy, PB2, using 2 explicit backorder control limits when dealing with shortage is introduced. Parametric analyses of various cost parameters of this policy, the lost sales policy and a partial backorder policy using a single backorder control limit, PB1, (analyzed earlier by the authors) are special cases of PB2; hence, PB2 provides a unified framework for studying different policies dealing with shortage.

4) Production Inventory & Distribution System of a Leading Detergent Industry, Omprakash K. Gupta, IN Univ. Northwest, Division of Bus., 3400 Broadway, Gary, IN 46408-1197, om@iunbus1.iun.indiana.edu

Nimra Ltd. is a leading detergent company in India with a mass customer base. It has over 1 million retail outlets and a massive distribution infrastructure. We will discuss the distribution system of Nimra, including its production, inventory and logistics. The unique features of the distribution system and strengths of the organization will also be highlighted.

WB12 Graph Theory

Contributed Session

Chair: Donald M. Topkis, Univ. of CA, Grad. Sch. of Mgmt., Davis, CA 95616, dmtopkis@ucdavis.edu

1) On the Diameter & Rank of Graphs, Cyriel van Nuffelen, Univ. of Antwerpen, Prinsstraat 13, Antwerpen, 2000, Belgium, ft.vannuffelen.c@ufsia.ac.be

We consider the diameter of a (directed) graph. On the other side we take the adjacency matrix and calculate the rank and eigenvalues of it. The main result:

the rank is an upper bound for the diameter.

2) Path & Tree Decompositions for the Partial Constraint Satisfaction Problem, Arie M.C.A. Koster, Maastricht Univ., PO Box 616, Maastricht, 6200 MD, The Netherlands, a.koster@ke.unimaas.nl, Stan P.M. Van Hoesel

We present dynamic programming algorithms for the PCSP on graphs with small treewidth (pathwidth). Although the running time of these algorithms is exponential in the treewidth (pathwidth) of the graph, we will present some computational results on solving PCSPs using a path- or tree-decomposition.

3) Matching with Complementarities, Donald M. Topkis, Univ. of CA, Grad. Sch. of Mgmt., Davis, CA 95616, dmtopkis@ucdavis.edu

We examine the role of supermodularity and complementarity in matching problems, where workers of different types are assigned among multiple firms. Conditions are given for optimal matchings to be increasing or ordered. An expanded version of the model includes operational decisions within the firm.

4) Pascal Programs for LP Test Network Generation, Gary R. Waissi, Univ. of MI, Sch. of Mgmt., SM 2200, Dearborn, MI 48128-1491, gwaissi@umich.edu

We discuss 13 complete programs intended for the generation of test networks for special LP algorithms. A total of 21 different structured networks can be generated for the maximum flow- and minimum cost flow problems. The network types include acyclic-, bipartite-, random-, grid- and assignment networks. The programs and an efficient max-flow solver will be demonstrated and discussed.

WB13 Network Flows

Cluster: Network Optimization

Invited Session

Chair: James B. Orlin, MIT, E53-357, Cambridge, MA 02142-1347, jorlin@mit.edu web.mit.edu/jorlin/www/

1) withdrawn - B. Lev email of 5/26, Stefano Pallottino, Univ. of Pisa, Comp. Dept., 40 Corso Italia, Pisa, 56125, Italy, pallo@di.unipi.it, Daniele Pretolani, Maria Grazia Scutella

2) On Multicommodity Network Optimization with Step-Increasing Link Cost Functions, Michel Minoux, University of Paris IX, MASI Inst. Blaise Pascal, 4 place Jussieu, Paris, F-75252, France

Minimum cost multicommodity flow problems with step-increasing cost functions on links arise as a natural model in the context of optimum telecommunication network design. We present LP-based heuristic procedures for generating feasible solutions and lower bounds. Computational results are provided on a series of randomly generated test problems.

3) withdrawn - author request of 2/11, James B. Orlin, MIT, E53-357, Cambridge, MA 02142-1347, jorlin@mit.edu web.mit.edu/jorlin/www/, Ravindra K. Ahuja

WB14 Exact Methods for the Vehicle Routing Problem with Time Windows & Precedence Constraints

Invited Session

Chair: Shoshana Anily, Tel Aviv Univ., Fac. of Mgmt., Tel Aviv, 69978, Israel, anily@post.tau.ac.il

1) Exact Methods for the Vehicle Routing Problem with Time Windows & Precedence Constraints, A. Mingozzi, Univ. of Bologna, Dept. of Math., Bologna, Italy, mingozzi@csr.unibo.it, R. Baldacci, D. Palumbo

The VRPTWPC is a generalization of the VRP which involves the design of a set of minimum cost routes to satisfy the transportation demands of a set of clients. Each demand requires the collection of goods at the client origin and the delivery at the client destination under capacity, time windows and precedence constraints. We present an exact algorithm based on the set partitioning formulation of the VRPTWPC...

2) A 5/3 Approximation Algorithm for the Clustered Traveling Salesman Tour & Path Problems, Julien D. Branel, Columbia Univ., 406 Tour Hall, Grad. Sch. of Bus., New York, NY 10027, jdb8@columbia.edu, Shoshana Anily, Alain Hertz

We consider the ordered cluster traveling salesman problem, OCTSP. In this problem, a vehicle starting and ending at a given depot must visit a set of n points. The points are partitioned into K clusters. The vehicle must first visit the points in cluster 1, then the points in cluster 2, ..., and finally the points in cluster K so that the distance traveled is minimized. We present a 5/3-approximation algorithm for this problem which runs in $O(n^3)$ time.

3) Approximation Algorithms for the Capacitated Traveling Salesman Problem with Pickups & Deliveries, Julien D. Bramel, Columbia Univ., 406 Uris Hall, Grad. Sch. of Bus., New York, NY 10027, jdb8@columbia.edu, Shoshana Anily

We consider the CTSPDP. This problem is characterized by a set of n pickup points and a set of n delivery points. A single product is available at the pickup points, which must be brought to the delivery points. A vehicle of limited capacity is available to perform this task. The problem is to determine the tour the vehicle should follow so that the total distance traveled is minimized. We present a heuristic with a guaranteed worst-case bound.

WB15 Markov Decision Processes

Contributed Session

Chair: Irwin E. Schochetman, Oakland Univ., Rochester, MI 48309, schochet@oakland.edu

1) Asymptotic Properties of Two Time Scale Markov Decision Processes, Matthew W. Jacobson, Technion, PO Box 1328, Technion-IIT, Haifa, 32000, Israel, mwj@tx.technion.ac.il, Nahum Shimkin, Adam Shwartz

We consider a class of Markov decision processes whose decisions consist of 2 kinds of actions, 1 of which has a delayed effect. We formulate an optimization problem with discounted rewards and examine the behavior of the optimal value and policies as the time-delay becomes large.

2) Comparison of Certain Optimality Criteria in Deterministic Infinite Horizon Optimization, Irwin E. Schochetman, Oakland Univ., Rochester, MI 48309, schochet@oakland.edu, Robert L. Smith

We consider the problem of making an infinite sequence of decisions, each chosen from a finite action set, subject to time-varying costs and constraints. In this context, we study optimal solution existence for several optimality criteria, introduce notions of present/future bias and apply them to our criteria.

WB17 Queuing Models II

Contributed Session

Chair: Hongtao Zhang, Hong Kong Univ. of Sci. & Tech., Dept. of Info. Sys. Mgmt., Clear Water Bay, Kowloon, Hong Kong, imhzhang@ust.hk

1) Multi-Class Cyclic Arrival Queue With A Single Server, Hongtao Zhang, Hong Kong Univ. of Sci. & Tech., Dept. of Info. Sys. Mgmt., Clear Water Bay, Kowloon, Hong Kong, imhzhang@ust.hk

A single server serves customers from n classes who arrive in a cyclic manner: after the arrival of a customer from class i (or n), the next arriving customer is from class $(i+1)$. We find the waiting time distribution for each customer class.

2) A System of Fluid Queues with Feedback, W. R. W. Scheinhardt, Univ. of Twente, Fac. of Applied Math., PO Box 217, Enschede, 7500, The Netherlands, w.r.w.scheinhardt@math.utwente.nl, D. P. Kroese

We analyze a system of 2 interacting fluid reservoirs, driven by a 2-state Markov process. We determine the stationary joint distribution of the on-off process and the contents of both reservoirs. The system may be used to model both an ATM-traffic-regulation mechanism and a tandem fluid queue.

WB19 Extensions of DEA

Invited Session

Chair: H. David Sherman, Northeastern Univ., Coll. of Bus. Admin., 404 Hayden Hall, Boston, MA 02115, hsherman@lynx.neu.edu

1) Sensitivity in DEA for Arbitrary Perturbations of Data in the Charnes-Cooper-Rhodes Model, Luka Neralic, Univ. of Zagreb, Fac. of Economics, Kennedyjev Trg 6, Zagreb, 10000, Croatia, neralic@oliver.efzg.hr

Sensitivity analysis in DEA is studied for arbitrary perturbations of all data in the CCR model for which efficiency of an efficient DMU is preserved. Sufficient conditions for an efficient DMU to preserve its efficiency under these perturbations are found.

2) DEARA, Performance Evaluation Covering Ordinary DEA, L1-Metric Canonical Correlation Analysis & Inverted DEA, Masaaki Shinohara, NTT Multimedia Networks Lab., Japan, shinohara@hashi.tnl.ntt.co.jp

A new performance evaluation method is presented which performs a broad-view evaluation continuously from ordinary DEA to inverted DEA from the standpoint of L1-metric CCA. A generalization of DEA efficiency,

generalized efficiency, is proposed as a performance measure. The L1-metric CCA can handle additional linear constraints and can be solved with an LP package.

3) Comparisons Among Scale Ranks via DEA: A Case Study of Industrial Branches, Zilla Sinuany-Stern, Ben-Gurion Univ., Dept. of IE&M, PO Box 653, Beer-Sheva, Israel, zilla@bgumail.hgu.ac.il, Lea Friedman, Arieh Avishur

We apply DEA to estimate the Pareto-efficient frontier of a joint production process in which multiple inputs yield multiple outputs. Four ranking methods are used to rank industrial branches in Israel in the DEA context: cross efficiency, canonical correlation and discriminant analysis (linear and of ratios). Goodness-of-fit is valued through utilization of nonparametric tests.

4) The Use of DEA in Selecting the Brand, Size & Other Strategic Choices for a Hotel, Richard C. Morey, Griffith Univ., Sch. of Tourism & Hotel Mgmt., PMB50 Gold Coast Mail Ctr., Queensland, 4217, Australia, r.morey@bhm.gu.edu.au

The "go/no go" decision for a candidate property requires the explicit consideration of the interconnectedness of the many elements affecting the property's potential profits. We integrate a best practices benchmarking methodology with regression analyses to explore the interface between marketing and operations. The model is applied to different sites.

5) Productivity Impact of Bank Mergers: Potential vs. Actual Productivity Gains in Branch Networks, H. David Sherman, Northeastern Univ., Coll. of Bus. Admin., 404 Hayden Hall, Boston, MA 02115, hsherman@lynx.neu.edu, Timothy J. Rupert

Mega-bank mergers may achieve some but not all of their potential scale economies. One bank resulting from the merger of 5 banks achieved some productivity gains from the merger. It did not realize other attainable substantial productivity gains, suggesting merger potential benefits exceed achieved benefits. Operating differences in the 5 branch networks yield operating inefficiencies identified using DEA.

WB20 Organizational Structures Theory & Practice

Contributed Session

Chair: Dov Dori, Israel Inst. of Tech., Technion City, Fac. of IE&M, Haifa, 32000, Israel, dori@ie.technion.ac.il

1) Integrated Systems Engineering Environment through the Object-Process CAST Tool, Dov Dori, Israel Inst. of Tech., Technion City, Fac. of IE&M, Haifa, 32000, Israel, dori@ie.technion.ac.il, Dagan Gilat, Arnon Sturm, Iris Berger, Victor Gindin, Yaniv Even-Hayim

We present a novel approach to systems engineering by applying the object-process methodology through the use of OPCAT - Object-Process CASE Tool. The approach handles the entire system life cycle. To this end, we are in the process of developing a second generation of OPCAT. The systems development process involves multiple distributed teams through computer-supported collaborative work.

2) Quality & Structure of Organizational Decision-Making, Ruth Ben-Yashar, Bar-Ilan University, Ramat-Gan, 52900, Israel, benyasr@mail.biu.ac.il, Shmuel Nitzan

Organizational quality is defined in terms of the decision criterion that the organization applies. This quality endogenously determines the decisional skills of the individual decision makers and, in turn, the optimal structure of decision making. Our analysis focuses on the relationship between quality and structure of decision making in organizations. Our results imply that the performance of organizations is determined by their quality as well as by their structure and size.

Wednesday 11:45-13:15

WC01 Managerial Applications of DEA

Cluster: DEA

Invited Session

Chair: Joseph C. Paradi, Univ. of Toronto, CMTE - IE, 4 Taddle Creek Rd., Toronto, Ontario, M5S 1A4, Canada, paradi@ie.utoronto.ca

1) Forecasting & Tradeoff Analysis Using DEA, Joseph C. Paradi, Univ. of Toronto, CMTE - IE, 4 Taddle Creek Rd., Toronto, Ontario, M5S 1A4, Canada, paradi@ie.utoronto.ca, David N. Reese

While methods for trade-off analysis presented in this paper play an important part in the overall project management lifecycle, additional tools are needed to provide initial forecasts. Simple DEA models can be used to provide these initial project forecasts. In many cases, forecasting and trade-off analysis methods are applied iteratively within the project management cycle as

problems or other issues necessitate constant revision to the project plan. Better forecasts reduce project risk, a particularly interesting issue in software development. The various software production models used to validate these ideas indicated that the analytical techniques compare well with observed results.

2) **DEA of the Performance Characteristics in the Canadian Insurance Industry**, *Claire Schaffnit*, Univ. of Toronto, CMTE - IE, 4 Taddle Creek Rd., Toronto, Ontario, M5S 3G9, Canada, *Allison J. Hewlitt, Joseph C. Paradi*

We examine the efficiency of about 150 property and casualty and 90 life and health insurance companies in Canada using DEA. Variables considered are staff, general expenses, commissions as inputs and net incurred claims and returns on investment as outputs. Economies of scale are investigated. We also explore the impact of reinsurance and the ownership type on efficiency.

3) **How to Apply Data Envelopment Analysis**, *Lawrence M. Seiford*, Ntl. Science Foundation, 4201 Wilson Blvd., DMII Rm. 550, Arlington, VA 22230, *lseiford@nsf.gov, H. David Sherman, Joseph C. Paradi*

The rapid growth and widespread acceptance of the methodology of DEA is testimony to its strengths and applicability. A group of international DEA researchers describe their experiences in applying DEA models and selecting variables for specific problem areas, describing obstacles overcome and insights gained from actual DEA studies. Guidelines for performing an analysis will be proposed. DEA practitioners and researchers are invited to attend and contribute their personal observations.

WC02 Value of Information Contributed Session

Chair: Arik Ragowsky, Wayne State Univ., Sch. of Bus. Admin., 5229 Cass Avenue, Rm 200, Detroit, MI 48202, *aragowsky@aol.com*

1) **Decisions with Incomplete Information**, *Handanhal V. Ravinder*, Univ. of NM, Anderson Sch. of Mgmt., Albuquerque, NM 87131, *ravinder@anderson.unm.edu*

Often, there is not enough time for a full-blown DA or the effort is deemed to be excessive. What is the price paid for this? We examine the effect of partial information regarding the different aspects of a multiattribute problem on the quality of the resulting decisions.

2) **Information System for Strategic Evaluation Based on Success Probability Applying Reliability Theory**, *Eliana S. Lima*, Companhia Hidro Eletrica do Sao Francisco, Cx. Postal 7462, Recife, PE 50 722-970, *pos_producao@npd.ufpe.br, Adiel Teixeira de Almeida*

We present a model for strategic performance evaluation. Critical factors of success represent elements of a system, which is analyzed through fault tree analysis method. Success probability of each is obtained based on prior knowledge of managers. The model has been applied to an electric power company.

3) **Decision Making with Incomplete Information: Models & Applications**, *Vladimir Donskoy*, Simferopol State Univ., 4 Yalinskay St., Simferopol, 333036, Ukraine, *donskoy@cssu.crimea.ua, Alexandr Glubochansky, Serge Goldayev*

Intelligent decision making must be accompanied by important abilities, i.e. generalization of empirical data, deductive inference using knowledge base and an optimal choice from a set of alternatives. The canonical optimization model with a disjunctive constraint that we consider allows the connection of the optimization-based approach with knowledge-based and case-based approaches for IDSS development.

4) **Estimating the Benefit Manufacturing Organizations Can Gain By Using Information Systems**, *Arik Ragowsky*, Wayne State Univ., Sch. of Bus. Admin., 5229 Cass Av, Rm 200, Detroit, MI 48202, *aragowsky@aol.com*

Based on a sample of 310 Israeli manufacturing organizations, a recent study found that the benefit a manufacturing organization may gain by using information systems depends on the organizational characteristics. We generalize these results by using a similar sample of 200 US manufacturing organizations that was recently collected.

WC03 Information Technology Contributed Session

Chair: Vesper Owei, UIC-Chicago, IDS Dept., 601 South Morgan St., Chicago, IL 60607, *vesper@uic.edu*

1) **Putting Information Technology into Practice: A Case Study**

of Implementation-Cooperation, *Yoram Yordan*, Sharit Tech. Ltd.

We describe the implementation-cooperation between 2 companies, the US and Israel. Cross-functional teams solve enterprise-wide problems using concepts and methods of technology management.

2) **An Empirical Investigation of Information Use in Problem Solving: A Decision Process Approach**, *Effy Oz*, PA State Univ., 30 E. Swedesford Rd., Malvern, PA 19355, *effyoz@psu.edu, Richard Glass*

We use verbal protocol analysis to identify and compare the information cues used by experts and novices during the process of performing software diagnosis tasks. Experts agreed more often in their use of information cues and were more likely to use a set of information cues that are considered key for the solution.

3) **The Knowledge Production Process**, *Francis D. Tuggle*, American Univ., 4400 Massachusetts Ave. NW, Washington, DC 20016, *ftuggle@american.edu, Wendy Goldfinger*

We examine a knowledge organization and model a process by which information gets converted into knowledge. This process is driven by the decisional needs of a client organization; the process is executed by knowledge experts possessing factual, procedural, metaprocedural and interpersonal knowledge. Implications for knowledge management are discussed.

4) **Semantic Organization of Database Entities to Support Conceptual Updates in a Concept-Based Query Language**, *Vesper Owei*, UIC-Chicago, IDS Dept., 601 South Morgan St., Chicago, IL 60607, *vesper@uic.edu*

The semantic integrity of organizational databases is assured only if every instance of such databases conforms with and reflects organizational business policies. One way of attaining this goal is to unify application database design with business policy constraint modeling, so that the latter is performed as part of the database design task.

WC04 Queueing Models in Telecommunications

Cluster: Teletraffic for Future Networks
Invited Session

Chair: Yonatan Levy, AT&T Labs., 101 Crawfords Corner Rd., Rm. IL-224, Holmdel, NJ 07733, *ylevy@att.com*

1) **Delay in Multi-Queue Single Server Systems Under Heavy Load**, *Rob Van der Mei*, AT&T Labs, POB 3030, Holmdel, NJ 07733

Multi-queue single server models are applicable in situations in which a common resource (processing power, bandwidth) has to be shared by different types of users (connections, jobs). Main system performance measures are the moments of the delay incurred by each of the user types, while the proper operation of the system is particularly critical when the system is heavily loaded. For a general class of multi-queue single-server models, we derive closed-form expressions for the moments of the delay incurred at each of the queues under heavy-traffic assumptions.

2) **Last Come First Served M/M/c with Reneging**, *David Jagerman*, Rutgers Univ., Piscataway, NJ 08854

The LCFS queueing model with Poisson input and exponentially distributed server times is investigated for the case that customers can renege from the queue. The exact Laplace transforms of waiting time distributions, i.e., time in queue, time to reach service, time to renege, etc., are found for an arriving customer who finds the servers busy. An approximation is found for the transform which permits its practical inversion. A numerical illustration is provided. Consideration of this model was motivated by its application to the study of overload control for the No. 1 ESS. A typical example was used for the numerical example.

3) **withdrawn - chair note of 5/18**, *William A. Massey*, Lucent Technologies/Bell Labs., Math. Sci. Research Ctr., 700 Mountain Ave., Murray Hill, NJ 07974-0636, *will@research.bell-labs.com*

4) **Quality of Service Delivery via Selective Blocking**, *Yonatan Levy*, AT&T Labs., 101 Crawfords Corner Rd., Rm. IL-224, Holmdel, NJ 07733, *ylevy@att.com, Xiaowen Mang*

Traditional queueing models require steady-state analysis to relate performance measures to traffic and queue parameters. We present a method that guarantees fair blocking to individual traffic streams based on a virtual queueing structure coupled with simple tracking of selective discarding. Several efficiency and fairness properties are proven and performance is demonstrated by simulation. The method is highly relevant to the provisioning of QoS to traffic classes in the emerging IP/ATM technology.

WC05 Health Care II Contributed Session

Chair: Jim E. Everett, Univ. of Western Australia, Dept. of Info. Mgmt. & Mktg., Nedlands, WA 6009, Australia, jeverett@ecel.uwa.edu.au

1) Simulating the Scheduling of Surgical Operations, Jim E. Everett, Univ. of Western Australia, Dept. of Info. Mgmt. & Mktg., Nedlands, WA 6009, Australia, jeverett@ecel.uwa.edu.au

Our Health Department faces lengthening queues of public patients waiting for elective surgery. Management is confused by game playing between hospitals and doctors. A simulation model, using historic data, provides a yardstick of attainable performance and locates critical bottlenecks. Exploring the system's intrinsic operational capacity helps identify the political confusions.

2) Data & Simulation Modeling for Hospital Lift Systems, Sydney C. K. Chu, Univ. of Hong Kong, Dept. of Math., Pokfulam Rd., Hong Kong, Hong Kong, schu@hkucc.hku.hk, **Lisa Chu, Mary P. P. Ho**

Recent high-rise designs have caused congestion and long waiting time problems for hospital lift systems in Hong Kong. We integrate a new data modeling approach for accurate inter-floor passenger traffic estimation in a detailed hospital lift simulation seeking operational improvement from zoning strategies.

WC07 Market Microstructure

Cluster: Finance
Invited Session

Chair: Tavy Ronen, Rutgers Univ., Dept. of Finance & Econ., Grad. Sch. of Mgmt. Rm. 128, Newark, NJ 07102, tronen@andromeda.rutgers.edu

1) Tick Size & Liquidity, Eugene Kandel, Hebrew Univ., Grad. Sch. of Bus., Dept. of Economics, Mt. Scopus Jerusalem, 91905, Israel, mskandel@pluto.mscc.huji.ac.il, **George Benston, Paul Irvine**

We postulate a measure of liquidity which combines the spreads and the depth. We calculate our liquidity measure using 2 TSE data sets. We find that decimalization improved liquidity for the majority of actively traded stocks, while there is little evidence of a significant reduction in liquidity in other stocks.

2) Market Making & Trading in NASDAQ Stocks, Michael A. Goldstein, New York Stock Exchange, 11 Wall St., 17th Fl., New York, NY 10005, michael.goldstein@colorado.edu, **Edward F. Nelling**

We examine relations between the number of market makers, trading activity and price improvement in NASDAQ stocks, using a model motivated by Grossman & Miller. Results indicate a positive relation between the number of market makers and trading frequency, with competition among market makers reducing effective bid-ask spreads.

3) Tick Price Changes & The American Stock Exchange, Tavy Ronen, Rutgers Univ., Dept. of Finance & Econ., Grad. Sch. of Mgmt. Rm. 128, Newark, NJ 07102, tronen@andromeda.rutgers.edu, **Daniel Weaver**

We examine the effects of the American Stock Exchange's May 1997 minimum tick size change reduction to 1/16. We study the effects on liquidity, volume, market participant profits and the degree of internalization. A direct is developed for the change in the degree of professional traders' activity in "stepping ahead of the book."

WC09 Supply Chain Management II

Contributed Session

Chair: Roby Rajan, Univ. of Wisconsin - Parkside, 900 Wood Rd., Box 2000, Kenosha, WI 53141-2000, rajan@uwp.edu

1) withdrawn - author request of 5/7, Yasemin Aksoy, Tulane Univ., Cnsrtn. for Supply Chain Mgmt., Freeman Sch. of Bus., New Orleans, LA 70118, yaksoy@freeman.tulane.edu

2) Modeling Complex Business Rules in Supply Chain Optimization Implementations, David Einav, PeopleSoft, Inc., 1820 Gateway Dr., Ste. 250, San Mateo, CA 94404, david.einav@peoplesoft.com, **Andrew L. Hill, Jonathan N. Silverman**

SCO, a product of PeopleSoft, Inc., enables an enterprise to allocate orders using a variety of criteria such as customer priority, resource load, transportation time and material availability. Combined, they can represent complex enterprise-specific business rules. We will discuss a typical implementation done for one of our major clients.

3) Aggregate Value Management Along the Supply Chain, Roby

Rajan, Univ. of Wisconsin - Parkside, 900 Wood Rd., Box 2000, Kenosha, WI 53141-2000, rajan@uwp.edu

We develop a methodology for aggregate value management through the length of an organization's supply chain by integrating both performance (functionality, productivity, lead time, quality, flexibility) and cost dimensions to provide a comprehensive view of the entire supply chain from vendor to customer.

WC10 Production Control

Invited Session

Chair: Konstantin Kogan, Holon Ctr. for Technological Education, Dept. of Computerized Systems, PO Box 305, Holon, 58102, Israel

1) Decomposition Methods for Complex Production System Analysis & Control, Stanley B. Gershwin, MIT, Lab. for Mfg. & Productivity, Dept. of ME, Cambridge, MA 02139-4307

We extend existing decomposition methods for tandem production line analysis to account for multiple part types. To decide which part to operate on, the control policy, an extension of hedging point or base stock methods, uses kanban-like tokens. This representation allows a wide variety of realistic policies to be represented and allows the performance of the system to be predicted very accurately. The method is fast enough so that optimization of the system and of the control policy is practical.

2) Using Machine Learning Capabilities for Production Control of a Multi-Cell FMS Operating in a Random Environment, Avi Herbon, Tel-Aviv Univ., Dept. of IE, Tel Aviv, 69978, Israel, **Yohanan Arzi**

An adaptive production control approach is used for controlling a multi-cell FMS with machines subject to failures, operating in a highly changing produce-to-order environment. A probabilistic machine learning procedure is integrated within a 2-level distribution production control system, DPCS. This enables the DPCS to adapt itself to large fluctuations in demand as well as to other stochastic factors. An extensive simulation study shows that the proposed adaptive control approach significantly improves the production system performance in terms of a combined measure of throughput and orders' tardiness. The proposed DPCS can be easily implemented as a real-time DPCS due to its simplicity, modularity and the limited information it requires. The proposed adaptive scheme can be integrated in any parametric production control system.

3) One-Part-Type Serial Manufacturing System Control with Periodic Maintenance: An Analytic Solution, Sheldon Lou, CA State Univ., Coll. of Bus. Admin., San Marcos, CA 92096-0001, **Konstantin Kogan**

This research concerns a manufacturing system with tandem machines producing 1-part-type. The system is periodically stopped for maintenance. The objective is to determine machine production rates and the production duration so that the inventory, backlog and maintenance related expenses can be minimized. We show that only a few so-called restricting machines need to be considered. The optimal control for a system with 2-restricting machines is derived under 2 different cost structures.

4) Iterative Methods for Flow Control Scheduling: Performance & Comparison, Oded Maimon, Tel-Aviv Univ., Dept. of IE, Tel-Aviv, 69978, Israel, **Evgeni Sheinin**

The flow control approach to production scheduling in manufacturing systems provides an extensive framework for construction of heuristic numerical procedures for finding near optimal scheduling solutions. We develop such procedures and study their performance on the basis of a number of practical industrial cases. The performance of the procedures is compared with the aid of a measure introduced to relate averaged computational characteristics of iterative numerical methods. The developed measures take into account a trade-off between computational effort and convergence to optimum.

5) Optimal Timing of Project Control Points, Tzvi Raz, Tel Aviv Univ., Fac. of Mgmt., Ramat Aviv, Tel Aviv, 69978, Israel, tzviraz@post.tau.ac.il, **Erdal Erel**

The project control cycle consists of status measurement, comparison to the plan, analysis of the deviations and, if they exist, corrective action. We present a DP model for determining the optimal timing or project control points throughout the life cycle of the project. Our approach is based on considering the amount of the information generated by the control point, discounted by the reporting delay. We report the results of numerical experimentation with the model, which included different types of activity intensity profiles: the classic and inverted bell-shaped curves, front-loaded and back-loaded curves and the uniform shape, at several levels of steepness and of the information loss fraction. We compared the optimal amount of information to the amount of information obtained with 2 simpler policies: control at equal time intervals and control at equal activity contents intervals.

6) **A Genetic Algorithm for Production Flow Control in a JIT Environment**, *Jack Leu*, Univ. of CA, Coll. of Bus. Admin., San Marcos, CA 92096-0001

One of the critical problems in a JIT environment is the control of production flow in the final assembly line. A GA is developed to determine the final assembly line's production sequence. Results are compared to several heuristic approaches with respect to the impact on the downstream production units.

WC11 Inventory Management

Contributed Session

Chair: Steven J. Erlebacher, Washington Univ., John M. Olin Sch. of Bus., 1 Brookings Dr., St. Louis, MO 63130-4899, erlebacher@wuolin.wustl.edu

1) **A Continuous Review Inventory System in a Random Environment**, *Asli Bayar*, Bilkent Univ., Fac. of Bus., Ankara, 06533, Turkey, bayar@bilkent.edu.tr, *Emre Berk*

We consider a continuous review inventory system in a random environment where demand rate and cost parameters vary in Markovian fashion. We develop expressions for the operating characteristics of the system and present sensitivity results.

2) **Challenges of Implementation of Computer Integrated Management Systems (MRP II) in Eastern Europe**, *Zbigniew J. Czajkiewicz*, CA State Univ., 2320 E. San Ramon Ave., Fresno, CA 93740, zbigniew@csufresno.edu

To remain competitive and survive in the global market environment, Eastern European companies have to improve their technology and management systems. One of the highly demanding areas is computerization of the operations by implementation of the integrated management systems MRP II. During the last 5 years, I worked in Poland helping companies to move their computer systems to modern levels of technology.

3) **An Inventory Model with Multiple Vendors & Random Yield**, *Suleyman Ozekici*, Bogazici Univ., Dept. of IE, Bebek - Istanbul, 80815, Turkey, ozekici@boun.edu.tr ieiris.cc.boun.edu.tr/faculty/ozekici.html, *Asli Erdem*

We consider an inventory model where the decision maker can purchase the product from a number of vendors. The yield of each vendor is random and the order is received in full if the yield exceeds the order quantity. In case the yield is insufficient, then the quality received is equal to the yield. Characterizations on the optimal ordering policy are provided.

4) **The Interaction of Location & Inventory in Distribution Systems**, *Steven J. Erlebacher*, Washington Univ., John M. Olin Sch. of Bus., 1 Brookings Dr., St. Louis, MO 63130-4899, erlebacher@wuolin.wustl.edu, *Russell D. Meller*

We consider the problem of designing a distribution system with multiple distribution centers, DCs, serving multiple customers. Our model accounts for fixed, transportation, inventory and ordering costs and examines the relationship between DC location and inventory levels. We present alternative solution procedures and examine factors that effect the solution quality.

WC12 Multiple Lot-Sizing Production to Order

Cluster: Lot-Sizing

Invited Session

Chair: Abraham Grosfeld-Nir, Tel Aviv Univ., Recanati Grad. Sch. of BA, Tel Aviv, 69978, Israel

1) **Multiple Lot-Sizing Production to Order: A Review**, *Abraham Grosfeld-Nir*, Tel Aviv Univ., Recanati Grad. Sch. of BA, Tel Aviv, 69978, Israel, *Yigal Gerchak*

The basic MLPO model fits situations where products are custom made and demand needs to be satisfied in full. Then, multiple production runs may be required due to quality problems. The tradeoff is between using small lots, possibly necessitating many setups, and large lots, which may result in costly overproduction. Early studies of this problem, often titled "reject allowance," date back to the mid-50s...

2) **Optimal Lot-Size for the General Interrupted Geometric Yield**, *Shoshana Anily*, Tel Aviv Univ., Fac. of Mgmt., Tel Aviv, 69978, Israel, anily@post.tau.ac.il, *Avraham Beja*, *Ami Mendel*

When production yields are random and demand is rigid, several lots may be required to fulfill a given demand. Assume the yield's pdf is interrupted (generalized) geometric. We minimize the expected total production cost of the lots that consist of a setup and variable costs. We characterize the sets of optimal lot-sizes for any demand level and prove their convergence to a specific set of at most 2 consecutive integers.

WC13 Polynomially Searchable Sets in Combinatorial Optimization

Invited Session

Chair: Gregory Gutin, Brunel Univ., Dept. of Math. & Stats., Uxbridge, Middx, UB8 3PH, UK, z.g.gutin@brunel.ac.uk

1) **Exponential Neighborhoods for the TSP & Related Problems**, *Abraham Punnen*, Univ. of New Brunswick, Dept. of Math. Stats. & CS, PO Box 5050, Saint John, NB, E2L 4L5, Canada

We provide new exponential neighborhoods for the TSP and some related combinatorial optimization problems. Computational results and domination analysis are also presented.

2) **Exponential Neighborhoods For a One-Machine Batching Problem**, *Johann Hurink*, Univ. Osnabrueck, Fac. of Math., Albrechtstr. 28, Osnabrueck, 49069, Germany, johann.hurink@mathematik.uni-osnabrueck.de

We focus on the development of neighborhoods for a 1-machine matching problem which is a combination of a sequencing and a partitioning problem. We will introduce an exponential neighborhood which can be evaluated in quadratic time and report on computational results.

3) **On the One-Way Street Theorem & Its Extensions**, *K. M. Koh*, Ntl. Univ. of Singapore, Kent Ridge, Singapore, 0511, Singapore

Robbins' celebrated one-way theorem states that a connected graph has a strong orientation if it contains no bridges. The problem we are interested in is: How to orient a bridgeless connected graph so that the resulting digraph has the minimum diameter? We give a survey on results pertaining to this problem.

4) **Gigantic Polynomially Searchable Sets of Tours for the TSP**, *Gregory Gutin*, Brunel Univ., Dept. of Math. & Stats., Uxbridge, Middx, UB8 3PH, UK, z.g.gutin@brunel.ac.uk

A set S of tours for the TSP with n cities is gigantic if for every positive $\epsilon < 1$, the set S has more tours than $(n!)^\epsilon$ for n large enough. We will describe some gigantic polynomially searchable sets of tours (the best tour in S can be found in polynomial time).

WC14 Airlines: Planning & Scheduling

Sponsor: Section on Aviation Applications

Sponsored Session

Chair: Eric Gelman, United Airlines, Inc., WHQKB, PO Box 66100, Chicago, IL 60666-0100, eric.gelman@ual.com

1) **Crew Scheduling at El Al**, *Hana Granot*, El Al Israel Airlines, Ltd., Head Office, Ben Gurion Airport, 70100, Israel, *Avi Harpaz*

Pairing System was developed for ELAL by IBM, Israel Science & Technology. The system is a full operational software package that runs on an IBM RS/6000 and includes GUI, Solver and a DB2/6000 database. The system's main function is to take the monthly flight schedule and construct pairings (also called trips, which are sequences of flights and rest periods that start and end in a crew base) in the most efficient and optimal way.

2) **Managing Complexity in the Development of Yield Management Systems**, *Claude Cohen*, United Airlines, Inc., WHQKB, PO Box 66100, Chicago, IL 60666-0100

The design and development of a new YM system is a complex undertaking on 2 fronts: technical implementation and process management. We will describe client-server and parallel processing techniques currently used in developing ORION, United Airline's new generation YM system. We also describe how the client organization had to rethink its business functions to take advantage of new system functionality.

3) **Topic: Crew Scheduling for Cabin Crew - Is It Different?**, *Eric Gelman*, United Airlines, Inc., WHQKB, PO Box 66100, Chicago, IL 60666-0100, eric.gelman@ual.com, *Srini Ramaswamy*

The scheduling of cockpit crews has been a hot topic for discussions in the OR community for years because of the impact it has on airlines' bottom line. While the scheduling of cabin crews is very important operationally, it has less impact on airlines' operational budget. Can we schedule cabin crews efficiently while meeting United Airline's high quality customer service objectives?

WC16 Panel: Publication Opportunities in the International Journal of Operations & Quantitative Management

Invited Session

Chair: Omprakash K. Gupta, IN Univ. Northwest, Division of Bus., 3400 Broadway, Gary, IN 46408-1197, om@iunbus1.iun.indiana.edu

1) **Panel: Publication Opportunities in the International Journal of Operations & Quantitative Management**, *Kathryn E. Stecke*, Univ. of MI, Sch. of Business, 701 Tappan, Rm. 5206, Ann Arbor, MI 48109-1234, *kstecke@umich.edu*, *Sven B. Axsater*, *Asher Tishler*, *Haim Shore*, *Omprakash K. Gupta*

The International Journal of Operations and Quantitative Management was launched in 1995 and is currently in its 4th year of publication. The editors will discuss the policies of the journal and the publication opportunities that it offers to academia and industry. The audience will be invited to propose suggestions and comments for improvement of the quality of the journal.

WC19 DEA as a Decision Making Tool

Invited Session

Chair: *Pekka J. Korhonen*, IIASA, DAS, Laxenburg, A-2361, Austria, *korhonen@iiasa.ac.at* *iiasa.ac.at/~korhonen*

1) **Using DEA in Organizations: Some Theoretical Perspectives**, *Peter Bogetoft*, Royal Agricultural Univ., Dept. of Economics, Rolighedsvej 26, Copenhagen, Denmark, *pb@kvl.dk*

DEA's contribution to organizational decision making and control is shown. In particular, DEA-based incentive contracts may encourage shrinking, excess imitation, as well as excess specialization. Modified DEA measures can be used to cope with these difficulties. Traditional DEA can be an adequate methodology when downsizing a "single agent" multiple task organization.

2) **An Extension of the DEA-MCDM Liaison for the Free Disposable Hull Model**, *Per J. Agrell*, Univ. of Copenhagen, Dept. of OR, Copenhagen DK, 2100, Denmark, *per.agrell@ipe.liu.se*, *Jorgen Tind*

This presentation solidifies the bounds between the DEA models and linear and non-linear MOP models. By drawing on the dual properties, a correspondence is shown between the CCR, BCC and FDH models in DEA and the MOP model. The weighted scalarizing function is shown to be sufficient even for the non-convex case FDH.

3) **A Framework for Performance Evaluation with Reference to DEA**, *Jaap Spronk*, Erasmus Univ., PO Box 1738, Rotterdam, 3000, The Netherlands, *spronk@few.eur.nl*, *Thierry Post*

A framework describing and connecting the different steps in the performance evaluation process is presented. A number of issues should be addressed in any performance evaluation process, including the definition of the activity, the performance question, choice and measurement of performance attributes and the derivation of conclusions from the collected attribute scores.

4) **Value Efficiency in Practice**, *Aapo Siljamaki*, Helsinki Sch. of Econ., Pienlänne 10, Nummela, 03100, Finland, *Pekka J. Korhonen*

Practical aspects for measuring value efficiency in DEA is considered. Value efficiency is an efficiency measure taking into account the decision maker's preferences. The most preferred solution by the decision maker is the information needed in value efficiency analysis. Alternative ways to locate the most preferred solutions are discussed.

Monday 08:30-10:00

- MA01 Behavioral Issues in MCDM
- MA02 Adaptive Enterprise Technology: Models, Processes & Issues
- MA03 Survival of the Fittest? Multilevel, Multidisciplinary Perspectives
- MA04 Optimization Techniques in Network Design
- MA05 Resource Allocation & Pricing in Broadband Networks
- MA06 Alternative Organizational Forms: Structures & Processes
- MA07 Derivative Securities I
- MA08 Banking
- MA09 Drawing Lessons From Experience
- MA10 Technology Management I
- MA11 Production
- MA12 Optimization I
- MA13 Generalized Convexity & Monotonicity I
- MA14 Development & Analysis of Algorithms for Combinatorial Problems
- MA15 Fluid Methods in Control of Queueing Networks & Scheduling
- MA16 Statistical Analysis of Operational Robotic Phenomena
- MA17 Asymptotic Behavior of Queues
- MA18 Preference Modeling & Applications
- MA19 Transshipments & Substitutions
- MA20 New Product Development & Commercialization

Monday 10:30-11:45

- MO21 Opening Session

Monday 13:00-14:00

- MS02 Invited Tutorial: What Can the World Wide Web do for You?!
- MS04 Keynote: Teletraffic Theory for CDMA Cellular Systems
- MS09 Keynote: A Survey of Control Mechanics for Multi-Echelon Supply Chains - Implications for Product Design
- MS13 Keynote: The Use of Relaxations Stronger than Linear Programming for Approximation Algorithms
- MS15 Keynote: Optimal Solutions - Dream & Reality
- MS16 Keynote: Implicit Valuation of a Blood Exclusion Decision
- MS18 Invited Tutorial: Statistical Inference About Risk
- MS19 Logistics: A New Teaching Approach

Monday 14:00-15:30

- MC01 MCDM & the Environment
- MC02 Marketing Technology Practice
- MC03 From Networks to Networking: Dynamic Views of Interorganizational Relationships
- MC04 Telecommunication Network Routing & Design Modeling
- MC05 Network Traffic Issues
- MC06 Managerial Attention
- MC07 Derivative Securities II
- MC08 Real Estate I
- MC09 Optimal Maintenance & Production Planning
- MC10 Technology Management II
- MC11 Semiconductor Manufacturing
- MC12 Optimization II
- MC13 Generalized Convexity & Monotonicity II
- MC14 Algorithmic Problems in Molecular Biology
- MC15 Queueing, Reliability & Inventory
- MC16 Cellular Manufacturing
- MC17 Tandem Queues & Applications I
- MC18 Measuring Decision Situations
- MC19 Military Logistics
- MC20 The Role of Technology Transfer in Developed & Less Developed Countries

Monday 15:45-17:15

- MD01 MCDM - Theory
- MD02 Health Care Information Systems
- MD03 Levels of Learning: Individual, Organizational & Interorganizational
- MD04 Analytic Methods for Matrix Geometric Systems
- MD05 Design of Telecommunication Networks
- MD06 Organizational & Group Decision Making
- MD07 Equilibrium Asset Pricing
- MD08 Real Estate II
- MD09 Operations, Replacement & Maintenance Aspects of Improving the Use of Machines
- MD10 Panel: Publishing in IEEE Transactions on Engineering Management
- MD11 Algorithms for the Earliness-Tardiness Problem
- MD12 Logistics
- MD13 Ant Colony Optimization
- MD14 Nonlinear Optimization
- MD15 Stochastic Networks
- MD16 Flexible Manufacturing
- MD17 Tandem Queues & Applications II
- MD20 The West Bank Economy

Tuesday 08:30-10:00

- TA01 MCDM Tools & Applications
- TA02 Electronic Commerce & Interorganizational Systems
- TA03 Service Sector Performance
- TA04 Computational Methods for Queueing Systems
- TA05 Service Operations
- TA06 Operations Management & Quality
- TA07 Debt Valuation & Dividend Policy, the Term Structure of Interest Rates, Market Micro Structure
- TA09 Supply Chain Logistics
- TA10 Performance Evaluation & Optimization of Production Systems I
- TA11 Scheduling & Routing
- TA12 Manufacturing
- TA13 Heuristic Search Methods for Mobile Radio Applications
- TA14 Dynamic Programming & Control
- TA15 Scheduling
- TA16 Panel: Management Education
- TA17 Fluid Models & Large Deviations in Queueing I
- TA18 Technology Roadmapping: Strategic & Operational Considerations & Experiences
- TA19 Continuous Location Problems
- TA20 Developing Economies

Tuesday 10:15-11:45

- TB01 MCDM in Managing Telecommunications Networks
- TB02 Impact of Information & Telecommunication Technology in the Global Marketplace
- TB03 Attitude Modeling: Issues & Measurement
- TB04 Performance Models & Solution Techniques in Communication Systems I
- TB05 Marketing Strategy & Signaling
- TB06 Marketing Research I
- TB07 Market Entropy & Efficiency
- TB08 Portfolio Management
- TB09 Supply Contracts in Supply Chains
- TB10 Performance Evaluation & Optimization of Production Systems II
- TB11 Metaheuristics & Scheduling
- TB12 Project Management
- TB13 Algorithms for Cutting & Packing
- TB14 Optimization in German Industrial Research Groups
- TB15 Stochastic Modeling of Communication Systems
- TB16 Knowledge Management
- TB18 Managing Learning & Experimentation in R&D

TB19 Current Topics in Location Analysis

TB20 Models of the Firm I

Tuesday 13:00-14:00

TS02 Keynote: Data Mining

TS03 Keynote: The Management of Higher Education - Models, Perspectives & Illustrations

TS07 Keynote: Correlated Equilibria & Weather Forecasting - It is All a Matter of Approach

TS09 Invited Tutorial: Set-Partitioning, Linear Programming & Combinatorial Problems in Supply Chain Management

TS13 Invited Tutorial: Post-Solution Analysis in Linear Programming from an Interior Solution

TS14 Invited Tutorial: Some Future Directions in Vehicle Routing Research

TS18 Industry Roadmapping Workshop

TS19 Invited Tutorial: On Equitable Resource Allocation Problems - A Lexicographic Minimax Approach

Tuesday 14:00-15:30

TC01 Negotiating & Making Decisions Over the WWW

TC02 Information Business & Learning on the Internet

TC03 Panel: The OR-MS/WWW Interface

TC04 Performance Models & Solution Techniques in Communication Systems II

TC05 Telecommunications Network Design

TC06 Marketing Research II

TC07 Information & Returns, IPOs, Closed End Funds

TC08 Pricing Models

TC09 The Effects of Prices Capacity & Information on the Performance of the Supply Chain

TC10 Fixed Cycle Time Policies in Stochastic Manufacturing Systems

TC11 Scheduling in Computer Systems

TC13 Applications of Integer & Combinatorial Optimization

TC14 Graph Theory

TC15 Statistical Design of Experiments in Simulation

TC16 Collaborative Technologies

TC17 Approximation Methods for Large-Scale Probability Modeling

TC18 Military R&D

TC19 Location Problems

TC20 Models of the Firm II

Tuesday 15:45-17:15

TD01 DEA

TD02 OR/MS on the Web: Java & Distributed Computing

TD03 Internet-Based Applications

TD04 Rare Event Simulation

TD05 Network Design Issues

TD06 Marketing Research III

TD07 Investment Risk Taking, Equilibrium Under Transaction Costs, CAPM Stability

TD08 Finance

TD09 Inventory Management

TD10 Advances in Polling Systems

TD11 Quality Improvement Models

TD13 Network Optimization

TD14 Transportation Network Analysis

TD15 Efficient Simulation Techniques

TD17 Queues & Applications

TD18 Product Development

TD19 System Reliability

TD20 Public Policy

Wednesday 08:30-10:00

WA01 Planning & Operation in a Competitive Electricity Industry

WA02 Workflow Technology & Management

WA03 Burning OR/MS Issues in Health Care

WA04 Performance in Modern Media

WA05 Modeling End-to-End Network Reliability & Data Mining for Better Customer Care

WA06 Service Quality

WA07 Inequality Aversion, Approximate Stochastic Dominance, Investment Strategies

WA08 Production Planning

WA09 Production & Forecasting Issues in Supply Chains

WA10 Intelligent Scheduling I

WA11 Inventory Modeling I

WA12 Heuristics

WA13 Minimum Cuts

WA14 Transportation

WA15 Variance Reduction & Efficient Rare Event Simulation

WA16 Panel: Design of Inter-Cultural Computer Supported Cooperative Work

WA17 Queueing Models I

WA18 Technology Management

WA19 Quality & Reliability

Wednesday 10:15-11:45

WB01 Energy Derivatives & Management of Energy Risk

WB02 EC Models

WB03 Health Care I

WB04 Communications Networks

WB05 Panel: Information Knowledge & Strategic Renewal

WB06 Organizational Structures

WB07 Value at Risk Corporate Control, Tax Expenditures, Privatization

WB08 Flexible Manufacturing Systems

WB09 Supply Chain Management I

WB10 Intelligent Scheduling II

WB11 Inventory Modeling II

WB12 Graph Theory

WB13 Network Flows

WB14 Exact Methods for the Vehicle Routing Problem with Time Windows & Precedence Constraints

WB15 Markov Decision Processes

WB17 Queueing Models II

WB19 Extensions of DEA

WB20 Organizational Structures Theory & Practice

Wednesday 11:45-13:15

WC01 Managerial Applications of DEA

WC02 Value of Information

WC03 Information Technology

WC04 Queueing Models in Telecommunications

WC05 Health Care II

WC07 Market Microstructure

WC09 Supply Chain Management II

WC10 Production Control

WC11 Inventory Management

WC12 Multiple Lot-Sizing Production to Order

WC13 Polynomially Searchable Sets in Combinatorial Optimization

WC14 Airlines: Planning & Scheduling

WC16 Panel: Publication Opportunities in the International Journal of Operations & Quantitative Management

WC19 DEA as a Decision Making Tool

- Aardal, Karen TC13
 Abolnikov, Lev MD04
 Abramson, David WB10
 Abuznaid, Samir MD20
 Abzug, Rikki MA03
 Achary, K. K. WA11
 Achatz, Hans TD13
 Adan, Ivo J. B. F. TD17
 Addie, Ronald G. TD05
 Adelson-Velsky, George WA10
 Agarwal, James TB03
 Agnihotri, Sal R. TA05
 Agrawal, Naren TB09
 Agrell, Per J. WC19
 Aharoni, Yair MO21
 Aharonson-Daniel, Limor WB03
 Ahuja, Ravindra K. WB13
 Ainspan, Nathan D. MA10, TB16
 Akkan, Can WA08
 Aksin, Zeynep Oya TA09
 Aksoy, Yasemin WC09
 Albright, Richard E. TA18
 Alfa, Attahiru S. TD10
 Altiok, Tayfur MC17, MD17, TA10
 Altman, Eitan MA15
 Amar, A. D. WB06
 Amir, Amihod MC14
 Ananth, Iyer V. TC09
 Andras, Frank TC05
 Anily, Shoshana WB14, WC12
 Antosik, Roman WA05
 Aranda-Gallego, Joaquin WA17
 Arbel, Ami MD01
 Armony, Mor TD17
 Arzi, Yohanan MA11, MC16, WC10
 Asea, Patrick K. MD07
 Avi-Itzhak, Benjamin MC17, MD17
 Avineri, Erel WA14
 Avishur, Arieh WB19
 Aviv, Yossi TB09
 Axsater, Sven B. TD09, WC16
 Azulay, Israel MC10
 Baccelli, Francois TB15
 Bae, Moonik TD03
 Baeuerle, Nicole MA15
 Bagozzi, Richard P. TB03
 Bai, Yu-Hua MA02
 Balachandra, R. MD10
 Balas, Egon TD13
 Balazs, Katalin MC20
 Baldacci, R. WB14
 Bambos, Nicholas TD17
 Bang-Jenson, J. TC05
 Baptista, Leo L. TD18
 Barczak, Gloria TD18
 Bard, Jonathan F. TA11
 Barnea, Amir TA16
 Barros, Lilian L. TD18, WB08
 Barsadem, Sigal MA03
 Barzilai, Jonathan MA18
 Bassok, Yehuda MA19, TC09
 Basu, Amit MC16, TC16
 Baum, Joel MD03
 Bayar, Asli WC11
 Baynat, Bruno WB08
 Behar, Reuven TA16
 Beja, Avraham WC12
 Bekhor, S. WA14
 Ben-Akiva, Moshe E. TD14, WA14
 Benaroch, Michel WA18
 Benarroch, David TD08
 Benavides, Juan Mauricio WB01
 Ben-Gal, Irad MA11
 Ben-Israel, Adi TA14
 Benjamin, Julian M. MA12
 Ben-Shahar, Danny MC08
 Benston, George WC07
 Ben-Tal, Aharon MS15
 Ben-Yashar, Ruth WB20
 Berger, Iris WB20
 Bergman, Yaacov MC07
 Berk, Emre WC11
 Berman, Oded TA19
 Bertsimas, Dimitris MA14
 Betz, Frederick MD10
 Bhargava, Hemant K. TC03, TD02
 Bichler, Martin WB02
 Bick, Avi MC07
 Bierlaire, Michel TD14
 Bihan, Herve Le MD17
 Bini, Dario TA04
 Bisgaard, Soren TD19
 Blazewicz, Jacek TA11
 Bloch, Francis TB05
 Blum, Yosef WA03
 Bodily, Samuel E. TC20
 Boffey, T. Brian MA12
 Bogdahn, Ruediger WA02
 Bogetoft, Peter WC19
 Bolotin, Vladimir TD05
 Bonaventure, O. TD05
 Bondarenko, Oleg TA07
 Bononi, Luciano TB04
 Bordetsky, Alex TC16
 Boucker, Jacqueline WB01
 Bradley, Gordon H. TD02
 Braha, Dan MA11
 Bramel, Julien D. WB14
 Brandt, Andreas TB15
 Brandt, Manfred TB15
 Braunstein, Jerome G. MC12
 Brenner, Rafi MC11
 Bretz, Sarah WA01
 Brill, Percy H. TC17
 Brimberg, Jack TC19
 Brittain, David TB01
 Brixius, Nathan MC12
 Broadie, Mark MA07
 Brosh, Ayelet MD08
 Brush, Candida G. WB04
 Bucatinsky, Julio TD02
 Buchanan, John T. MA01
 Budescu, David V. MA18, MD06
 Buitenhek, Ronald WB08
 Bukchin, Joseph MC16
 Bukspan, Eli WB07
 Bullnheimer, Bernd MD13
 Buxman, Peter WB02
 Bykadorov, Igor A. MA13
 Byrnes, Patricia TA03
 Calinescu, Gruia WA13
 Calvin, James WA15
 Canon, Emmanuel WB01
 Caramanis, Michael MA11
 Carmel, Erran TA02
 Carmo, Rosa M.L.R. TB04
 Carnieri, Celso TD08
 Carroll, John S. MA09
 Catanas, Fernando J. TB08
 Ceder, Avishai WA14
 Chapel, Stephen W. WA01
 Chau, Patrick Y. K. TB02
 Chauvet, Fabrice WA10
 Chiu, Hung-Chang WA06
 Chor, Benny MC14
 Chou, Yu-Li TC08
 Chu, C. W. WB11
 Chu, Lisa WC05
 Chu, Sydney C. K. WA12, WC05
 Church, Kenneth W. WA05
 Churilov, Leonid MA13, TB08
 Cidon, Israel WB04
 Clark, Theodore TA02
 Cohen, Allon TD07, WA07
 Cohen, Claude WC14
 Cohen, Morris A. TA09, TA16
 Cohn, Harry TB11
 Collison, Gary MA11
 Colorni, Alberto MD01
 Conti, Marco TB04
 Cook, Wade D. TD01
 Coopersmith, Lewis William TA06
 Corner, James MA01
 Corsten, Daniel WA09
 Costa, Carlos Antonio Bana e TA01
 Costa, J. Paulo O. TC16
 Coullard, Collette R. MA14
 Courcoubetis, Costas MA05, MC05
 Coval, Joshua D. TC07
 Covaliu, Zvi TB12
 Crisan, Christine TA13
 Czajkiewicz, Zbigniew J. WC11
 Dai, Jim MD15
 Dalcol, Paulo R. T. MD16
 Dallery, Yves P. MA11, MD17, TA10, WB08
 Darr, Asaf MA06
 Daskin, Mark S. TB19
 David, Israel WA11
 David, Sinriech MC16
 Davidovitz, Liama WA07
 de Almeida, Adiel Teixeira WC02
 de Lucena, Sidney C. TB04
 de Souza e Silva, Edmundo TA04, TB04, TC04
 Dean, Burton V. MC10, MD10
 Deckro, Richard F. MA01
 Dekel, Kineret MC16
 Delcoigne, Franck MD04
 Dell'Olmo, B. Paolo TC11
 Dempster, M. A. H. MA19
 Denardo, Eric V. TA14
 Deng, Shijie WB01
 Dennett, J. R. WB11
 Detemple, Jerome MA07, MD07
 Dietz, Christiane B. MD06
 Dillon, Stuart MA01
 Dincer, Cemal TB10
 Dinitz, Yefim WA13, WB10
 Dladla, Johannes MA08
 Dominique, Peeters TB19
 Domschke, Wolfgang TC19
 Donatiello, Lorenzo TB04
 Donskoy, Vladimir WC02
 Doole, Isobel MD20
 Dorf, Richard C. MD10
 Dori, Dov MC11, WB20
 Dorigo, Marco MD13
 Dathan, Michael TB07
 Drezner, Tammy TA19
 Drezner, Zvi TA19
 Dror, Moshe TA11, TB11
 Drozdowski, Maciej TC11
 Duan, Jin-Chuan MA07
 Dubi, Arie TD19
 Duenyas, Izak TD09
 Dukhovny, Alexander MD04
 Dumlu, Deniz R. TC18
 Duncan, George T. MD02
 Durrant, P. J. TA13
 Dvir, Dov MA10, TD18
 Eaves, B. Curtis TA14, TD17
 Ecker, Klaus H. TC11
 Edan, Yael MA16
 Ehrhardt, Richard A. WB11
 Ehrman, Chaim TD06
 Eichhorn, Benjamin H. TA06
 Einav, David WC09
 Eisenberg, Martin TD10
 Eisenblaetter, Andreas TC13
 Eisner, Alan B. MC06
 Eliashberg, Jehoshua TA06, TA16, TB05
 Ellis, Shmuel MA09
 Elron, Efrat TD07
 Ensslin, Leonardo MC01, TA01
 Erdem, Asli WC11
 Erel, Erdal WC10
 Erev, Ido MD03, MD06
 Erkip, Nesim K. TC10
 Erlebacher, Steven J. WC11
 Ernst, Ricardo TC09
 Espinouse, Marie-Laure TA11
 Etkar, R. TB12
 Etzkowitz, Henry MC20
 Even-Hayim, Yaniv WB20
 Everett, Jim E. WC05
 Fackler, James C. MD02
 Fadiloglu, Murat MC17
 Fan, Hua TA07
 Farkas, Andras MD16
 Farris, George F. MD10
 Fatti, Paul MA08
 Fayolle, Guy MD04
 Feder, Meir WA04
 Federgruen, Awi MS09, TC10
 Feigin, Gerry WA09
 Feinstein, Charles D. WA01
 Feldman, David MD07, TA16
 Fernandes, Luis M. MC12
 Fernandez-Santos, Erik TD04
 Feurstein, Markus C. TB06
 Filho, Virgilio J.M.F. MA12
 Fine, Charles H. TA09
 Finke, Gerd TA11
 Fischer, Martin J. TC17
 Fleming, Philip J. MS04, TD15

- Flessa, Steffen WB03
 Flipo, Clarisse TA11
 Fluck, Zsuzsanna WB07
 Forsund, Finn R. TA03
 Fortin, Dominique TA11
 Foster, Bryce MC11
 Foster, F. Douglas MC07
 Fourer, Robert MA14, TC03
 Fox, Dale R. TA06
 Francis, Richard L. TC19
 Francis, S. TB12
 Fransoo, Jan C. TC10, WB09
 Freeman, Mark A. TA03
 Freeman, Steve MC06
 Fried, Yitzhak WB06
 Friedman, Lea MA16, WB19
 Friedman, Victor MA06
 Frigyesi, Veronika MC20
 Frostig, Esther MC15, TA15
 Fruchter, Gila E. TB06
 Fuchs, Dieter R. TA20
 Fuentes, Hugo TA03
 Fuks, Saul TD06
 Fulkerson, William MA02
 Fuxman, Leonora TA12
 Gaba, Anil MC18
 Gabow, H. N. TC05
 Gagliardi, Marco TD02
 Gail, H. R. TA04
 Gaimon, Cheryl MD10
 Gall, Francoise Le TA04
 Galvao, Roberto D. MA12
 Gambardella, Luca-Maria MD13
 Garcia-Palomares, Ubaldo M. MA12
 Garg, Amit TC08
 Garg, N. WB10
 Gartner, Nathan H. TD14
 Gat, Daniel MC08, MD08
 Gaver, Donald P. MC15
 Gavius, Arieh TC08
 Gelman, Eric WC14
 Geman, Helyette MA07
 Gemuenden, Hans Georg MC10
 Gerchak, Yigal MA19, WC12
 Gershwin, Stanley B. MA11, MD17, TA10, WC10
 Gerstner, Eitan TB06
 Gertsbakh, Ilya TD19
 Ghashghai, Elham TD13
 Ghose, Sanjoy TB06
 Gilat, Dagan WB20
 Gilat, Sharon MD06
 Gindin, Victor WB20
 Giordani, Stefano TC11
 Glass, Richard WC03
 Glasserman, Paul MA07, WA15
 Glubochansky, Alexandr WC02
 Goemans, M. WB10
 Goerg, Carmelita TD04
 Golan, Amos TB07
 Goldayev, Serge WC02
 Golden, Bruce L. TS14
 Goldenberd, Jacob TC06
 Goldengorin, Boris WA10
 Goldfarb, Donald MD14
 Goldfinger, Wendy WC03
 Goldstein, Michael A. WC07
 Golenko-Ginzburg, Dimitri WB08
 Golubchik, Leana TC04
 Gonik, Aharon WB08
 Goodman, Gerald R. MC06
 Goren, Shai MD09
 Gouvea, Silvio Roberto TD08
 Granat, J. TB01
 Granot, Hana WC14
 Greenberg, Harvey J. TC03, TS13
 Greenleaf, Eric TC06
 Griem, Walter TB14
 Grifell-Tatje, Emili TA03
 Grosfeld-Nir, Abraham WC12
 Grosskopf, Shawna TA03
 Gullu, Refik TC10
 Gunalay, Yavuz TD10
 Gunn, Eldon Archibald MA18
 Gunther, Oliver TB18
 Guo, R. WA17
 Gupta, Diwakar TD10
 Gupta, Omprakash K. WB11, WC16
 Gurevitch, Omer WB04
 Gursoy, Melike MD17
 Gutin, Gregory WC13
 Hababou, Moez TD01
 Hadjiconstantinou, Eleni TB13
 Hadjinicola, George TD06
 Hamalainen, Raimo P. TC01
 Hantler, Sidney L. TA04
 Harpaz, Avi WC14
 Harris, Carl M. TC17
 Hart, Sergiu TS07
 Hartl, Richard F. MD13
 Hartman, Alan TC05
 Hartman, Bruce C. TB11
 Haviv, Moshe TD17
 Hayes, Kathy TA03
 Hayya, Jack C. TA05
 Hazony, Yehonathan TA12
 He, Xin Xin TA05
 Heegaard, Poul E. WA15
 Hefner, Andreas TB14
 Heidelberger, Philip WA15
 Helber, Stefan TB10
 Herbon, Avi WC10
 Herer, Yale T. MA19, MD12
 Herman, Al MC10
 Hertz, Alain WB14
 Hesse, Susan M. TB19
 Heuts, Ruud WA11
 Hewlitt, Allison J. WC01
 Higa, Kunihiko TB02
 Hikaru, Inooka TD20
 Hill, Andrew L. WC09
 Hirshleifer, David TC07
 Hlynka, Myron TC17
 Ho, Mary P. P. WC05
 Hochbaum, Dorit S. MS13, WA13
 Hofmann, Jens TB15
 Hokkanen, Joonas MC01
 Holz, Elio MC01
 Honig, Benson L. MD20
 Hooghiemstra, Gerard G. MC15
 Hu, Paul Jen-Hwa TB02
 Huang, Lucy TA11
 Humes, Jr., Carlos TC04
 Hurink, Johann WC13
 Hurkens, C.A.J. TC13
 Hurley, Steve TA13
 Huxley, Stephen J. TD20
 Hwang, Juhwen TC09
 Hyer, Nancy Lea MC16
 Iansiti, Marco TB18
 Iaroslavitz, Lior MA11
 Ikkai, Yoshitomo TB16
 Ilhan, Or MA11
 Ingalls, K. WA09
 Ingram, Paul MD03
 Ioffe, Ioulia TA07
 Irvani, Seyed M. R. TD09
 Irvine, Paul WC07
 Itman, Tamy TA15
 Jackson, Jack A. MA01
 Jacobs, Kris MA07
 Jacobs, Patricia A. MC15
 Jacobson, Matthew W. WB15
 Jaeyong, Sim WA18
 Jagerman, David MD17, WC04
 Jaillet, Patrick TA11
 Jain, Sudha WA19
 Jang, Yunhee MC04
 Janssen, Ron MC01
 Jarvenpaa, Sirka TB02
 Jemric, Igor TB20
 Jennings, Otis B. MD15
 Ji, Xiaoyan WA05
 Jimenez, Tania MA15
 John, Kose WB07
 Johnson, Eric J. TC06
 Johnson, Timothy MD06
 Jonard, Frederick WB01
 Jones, C. Kenneth TA20
 Jones, Candace MC03
 Jordan, Tibor TC05
 Judice, Joaquim J. MC12
 Juell, Henrik TC19
 Kalish, Shlomo WB04
 Kalyanam, Kirithi TD08
 Kaminsky, Philip MA14
 Kandel, Eugene WC07
 Kandel, Shmuel TC07
 Kantor, Paul B. TD11
 Kaplan, Edward H. MS16
 Kappel, G. WA02
 Kappel, Thomas A. TA18
 Kapur, Sandeep TA09
 Karacaer, Sule TD01
 Karaesmen, Fikri TA10
 Karayannis, F. TA10
 Karloff, Howard WA13
 Katalan, Ziv TC10
 Katircioglu, Kaan WA09
 Kats, Vladimir WA10
 Kayaligil, Sinan TC18
 Kaye, John MD12, TA14
 Kedad-Sidhoum, Safia TB11
 Kella, Offer MD15
 Keller, Gerald WB03
 Kellerer, Hans WA12
 Kelsey, Sheryl F. TD03
 Keren-Zvi, Joseph WB04
 Khan, Sarosh I. TD14
 Khavul, Susanna WB04
 Kim, Young Ki MA04
 Kivetz, Ran TC06
 Kleijnen, Jack P. C. TC15
 Klein, Yaron WB10
 Kleindorfer, Paul R. TA06
 Kleinschmidt, Peter TD13
 Kloeber, Jack M. MA01
 Knotts, Gary TB11
 Kocaoglu, Dundar F. MA10, MC10, MD10
 Kocemba, Kai V. TB15
 Kodialam, Muralidharan S. MC04
 Koechel, Peter WA11
 Koenig, Wolfgang WB02
 Kogan, Konstantin WC10
 Koh, K. M. WC13
 Koh, Seok Ha MA04
 Kohane, Isaac S. MD02
 Koksai, Atik MA11
 Koltai, Tamas MD16
 Komoda, Norihisa TB16
 Koole, Ger M. MA15
 Kopczak, Laura Rock WB09
 Korhonen, Pekka J. WC19
 Korn, Helaine J. MA03
 Koslowsky, Samuel MC02
 Koster, Arie M.C.A. WB12
 Kouvelis, Panos TB09
 Kovalyov, Mikhail Y. MD11
 Krass, Dmitri TA19
 Kreimer, Joseph MD09
 Kress, Moshe MC19
 Krishnan, Ramayya MD02, TC03, TD02, WB02
 Krispin, Gabriela TC19
 Kroese, D. P. TD04, WB17
 Kroll, Yoram WA07
 Kubiak, Wieslaw MD11
 Kuchta, Dorota TD08
 Kumaran, M. WA11
 Kummerle, Walter TB18
 Kushner, Harold J. MD16
 Lahdelma, Risto MC01
 Lampel, Joseph MC03, MD06
 Lang, Karl R. TC02, WA02
 Laniado, Eliot MD01
 Lapid, Koty MA20, MC20, MD16
 Lariviere, Martin WB09
 Lauther, Ulrich TB14
 Lavaud, Nicolas TC05, TD05
 Law, E. TC02
 Lechner, Jan-Peter MC18
 Lee, Ho Geun TA02, TC02
 Lee, Po Wing WA12
 Lee, Young MC04
 Leelahakriengkrai, Rangsan TD15
 Lenstra, A.K. TC13
 Lent, Arnold WA05
 Leonard, Kevin J. WB03
 Lerner, Miri MC10, WB04
 Leshno, Moshe WA07
 Leu, Jack WC10
 Levi, Moti TA06
 Levi, Offer WA11
 Levikson, Benny Z. MC15
 Levin, Daniel Z. TA18
 Levitin, Gregory WB10
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 Levy, Haim TD07, WA07
 Levy, Hanoch WB04
 Levy, Yonatan WC04
 Li, Chung-Lun TB09

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 Loewenstein, George TD08
 Lopes, Secundino TC16
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 Lou, Sheldon WC10
 Love, C. E. MC09
 Lowe, Timothy J. TC19
 Lowengart, Oded TB06
 Lui, John C.S. TB04
 Luss, Hanan TS19
 Lutfi, Munir WA16
 Lynn, Leonard MA20
 Ma, Chenghu MD07
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 Phillips, Steven MD05
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 Pinker, Edieal J. TC18
 Piore, Michal TB01
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 Ponte, Amiram MC11
 Portougal, Victor WA06
 Post, Thierry WC19
 Potra, Florian MC12
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 Pratt, C. WA09
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 Prisman, Eliezer Z. TA07
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 Puskun, Alexander WA10
 Punnen, Abraham WC13
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 Ragowsky, Arik WC02
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 Retschitzegger, W. WA02
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 Reuveni, Haim WA03
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 Ridder, Ad WA15
 Rieder, Ulrich MA15
 Riehme, Jan TB13
 Robertson, Thomas TB05
 Rogers, Edward W. TB16
 Ronen, Tavy WC07
 Rosato, Paolo TD20
 Rosberg, Zvi WA04
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 Rothblum, Uriel TA14, TD17
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 Rubino, Gerardo TC04
 Rubinovitch, Yaacov MC16
 Rubinstein, Reuven Y. TD15
 Rudi, Nils TA09
 Rudolph, Jenny W. MA09
 Rupert, Timothy J. WB19
 Rushton, Gerard TC19
 Rymon, Talia TB05
 Sadeh, Arik TD18
 Sadka, Ronnie MD01
 Sagis, Amiaz WB05
 Sakano, Ryoichi MA12
 Salk, Jane MC03
 Salminen, Pekka MC01
 Saltelli, Andrea TC15
 Sanchez, Susan M. TC15
 Santos-Ramon, Alfonso TD04
 Saporta, Ishak MA03
 Sarig, Oded TC07
 Sassen, Simone TD17
 Savshenko, Vladimir WB10
 Schaffnit, Claire WC01
 Schaible, Siegfried MA13, MC13
 Schechtman, Jack TD06
 Scheinberg, Katya MD14
 Scheinhardt, W. R. W. WB17
 Scheithauer, Guntram TB13
 Schkade, Lawrence L. TD03
 Schlegel, Sabine TB15
 Schmidt, Volker TB15
 Schneckeburger, Thomas WA09
 Schneller, Meir I. TD07
 Schochetman, Irwin E. WB15

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 Schoner, Bertram MA18
 Schrimpf, Gerhard TB14
 Schwartz, David WA16
 Schwartz, Leon MC02
 Schweitzer, Eithan WA03
 Scott, J. E. TD05
 Scutella, Maria Grazia WB13
 Sedukhin, Stanislav WB10
 Segev, Arie WB02
 Segev, Eli WB05
 Seidel, Marc-David MA03
 Seidel, Wilfried MS18, TB15
 Seiford, Lawrence M. WC01
 Sengupta, Kishore WA16
 Serra, Daniel TB19
 Serrat, Angel MD07
 Sezgen, Osman WA01
 Shadmon, Michal MD11
 Shahabuddin, Perwez WA15
 Shahwan, Usamah Salim MD20
 Shalmon, Michael TA17
 Shamir, Ron MC14, TC14
 Shapira, Zur MA06, MC06, MD06
 Shapiro, Edwin S. TB08
 Sharan, Roded TC14
 Sharda, Ramesh TC03
 Shaw, Dong X. TB08
 Shaw, Michael J. MA02
 Sheinin, Evgeni WC10
 Shemesh, Eli MD09
 Sheng, Olivia R. Liu TB02, TC02
 Sheng, Rongqin MC12
 Shenhar, Aaron MA10
 Shenhan, Ayal WB07
 Sherman, H. David WB19, WC01
 Sheth, Jagdish TB03
 Shifan, Yoram WA14
 Shih, Sam J.S. TA19
 Shimkin, Nahum WB15
 Shin, Bongsik TB02
 Shinohara, Masaaki WB19
 Shor, Naum MD14
 Shore, Haim TD19, WA19, WC16
 Shtub, Avraham MC16, MS19, TB12
 Shumsky, Robert TA05
 Shwartz, Adam WB15
 Sidhoum, Safia Kedad TB11
 Sidi, Moshe WB04
 Sierksma, Gerard WA10
 Sigman, Karl MD15
 Silberman, Gabriel M. WA04
 Siljamaki, Aapo WC19
 Silverman, Brian S. MD03
 Silverman, Jonathan N. WC09
 Simchi-Levi, David MA14, TS09
 Simon, Burton TD15
 Simons, Tal MA06
 Simonson, Itamar TC06
 Singh, Medini R. TC09
 Sinuany-Stern, Zilla WB19
 Sirbu, Marvin A. WB02
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 Sliwa, Kazimierz WB06
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 Smeers, Yves WB01
 Smirnov, M. MC05
 Smith, D. H. TA13
 Smith, J. MacGregor MC17
 Smith, Robert L. WB15
 Smith, Robert P. MA10
 Sniedovich, Moshe MA13, MS02, TB08, TC03
 Sobel, Matthew J. MC09
 Sohn, So Young WA17
 Sokol, Dina MC14
 Sommerweiss, Uta TB13
 Soteriou, Andreas C. TD06
 Soyer, Refik TB12
 Spera, Cosimo TD02
 Speranza, Grazia M. TC11, WA12
 Spiegel, Matthew TC07
 Spring, James TA05
 Spronk, Jaap WC19
 Srinivasan, Ramesh WA09
 Stadje, Wolfgang MC15
 Stamatiadis, Chronis TD14
 Stashevsky, Shmuel TD11
 Stecke, Kathryn E. MD16, WC16
 Steiner, Maria Teresinha TD08
 Stewart, David TB05
 Stewart, M. TC05
 Stokell, Nicola MD20
 Stolyar, Alexander L. TA17
 Strahilevitz, Michal TD08
 Strahle, William TA06
 Strauss, Christine MD13
 Stuetzle, Thomas MD13
 Sturm, Arnon WB20
 Stutzer, Michael TB07
 Subrahmanian, V.S. TC04
 Sundaresan, Suresh TA07
 Sung, Jaeyoung TA07
 Sung, Kiseok WA12
 Sural, Haldun MA19
 Syam, Niladri TB06
 Szigeti, Zoltan TC05
 Tagaras, G. WB11
 Takeda, Sachi MA09
 Talmore, Irit MC19
 Talmud, Ilan MA03
 Tam, Kar Yan TB02
 Tamas, Pal MC20
 Tamuz, Michal MA09, MC06
 Tan, Baris TA10, TB10
 Tarasenko, Valery MA10
 Tarasiuk, Ariel WA03
 Tarim, S. Armagan TD01, WA11
 Tartakovsky, Evgeny TD19
 Tauman, Yair TC08
 Taylor, B. A. TA04, TC05
 Taylor, Lori TA03
 Te'eni, Dov WA16
 Teich, Jeffrey E. TC01
 Tekinalp, Melike TC10
 Temkin, Sanford TA06
 Terno, Johannes TB13
 Tetzlaff, Ulrich A. MD16
 Thisse, Jacques-Francois TB19
 Thomke, Stefan TB18
- Timmor, Yaron TC20
 Tind, Jorgen WC19
 Tishler, Asher MA10, MC10, WC16
 Toledo, Tomer WA14
 Toomey, Fergal W. MA17
 Topkis, Donald M. WB12
 Tov, Nurit Bar MD08
 Tractinsky, Noam TB02
 Trietsch, Dan WA06
 Tripathy, Ashish MA19
 Tsay, Andy TB09
 Tsechansky, Maytal Saar TD11
 Tsien, Christine L. MD02
 Tsitsiklis, John MA05
 Tuggle, Francis D. WC03
 Tzourakis, Melissa MD02
 Tzur, Michal MA19
 Ulrich, Gary WA05
 Urbanski, Ryszard MC13
 Valdmanis, Vivian TA03
 van Breda, Elmarie MA08
 Van de Leedel, Robert L.M.J. TC13
 Van der Duyn Schouten, Frank WA11
 Van der Mei, Rob WC04
 van der Wal, Jan TD17
 Van Eijs, Marc WA11
 Van Groenendaal, Willem J. H. TC15
 Van Herwijnen, Marjan MC01
 Van Hoesel, Stan P.M. TC13, WB12
 van Lier, Hubert N. MC01
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 Vaninsky, Alexander TD01
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 Venezia, Itzhak TD07
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 Ventura, Y. TB12
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 Vlach, Milan WA10
 Vlachos, D. WB11
 Vladimoriv, Andrey V. MC13
 Vohra, Rakesh TD13
 von Collani, Elart WA19
 Vorst, Ton MA07
 Vujcic, Boris TB20
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 Wallenius, Hannele TC01
 Wallenius, Jyrki TC01
 Wallsten, Thomas S. MD06
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 Wardi, Yoram Y. TA15
 Wargitsch, Christoph WA02
 Warhurst, Chris MA06
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 Weber, Bill TA03
 Weber, Richard R. MA05
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 Weiss, Gideon MA15, TA15
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 Westbrook, J. MD05
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 Whitt, Ward MD15
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 Wielicki, Tom R. TD11
 Wiener, Zvi WB07
 Wierzbicki, A. P. TB01
 Wilemon, David TB20, TD18, WA18
 Winter, Thomas TC13
 Wisniewski, Stephen TD03
 Wohl, Avi TC07
 Wolfson, Haim MC14
 Wouters, J. F. WB09
 Wright, Russell W. MA02
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 Yaiche, H. MA05
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 Yang, Meng-Chyn MA02
 Yang, Qi TD14
 Ye, Jianming TC09
 Yeh, Min-Sung WA08
 Yeralan, Sencer MC17, TB10
 Yoo, Jinho TD03
 Yordan, Yoram MA20, WC03
 Young, Neal MD05
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 Zajic, Tim WA15
 Zakay, Dan MA09, MD06
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Organization Science

Public Programs and Processes
Railroad Applications
Simulation
Social Science Applications
Technology Management
Telecommunications
Transportation Science

Societies:

Decision Analysis
Military Applications

Fora:

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Departments (ACORD)
Forum on Education (INFORMED)
Pre-Collegiate Teachers' Forum
Women in OR/MS Forum

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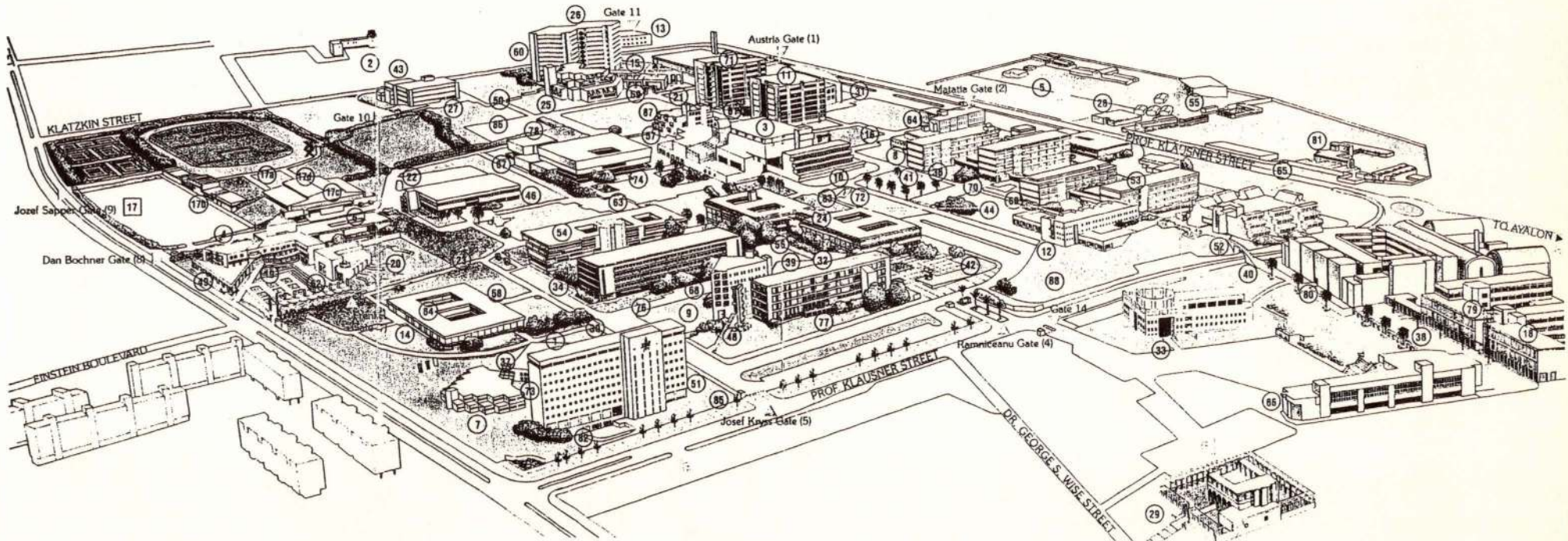
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LEGEND:

- Bar-Shira Auditorium - Building 1
- Dan David Building - Building 12

MASTER TRACK SCHEDULE

SESSIONS HELD IN THE DAN DAVID BUILDING & THE OPENING SESSION IN THE BAR-SHIRA AUDITORIUM

		MA	MO	MC	MD	TA	TB	TC	TD	WA	WB	WC
ROOM	TRACK	8:30-10:00	10:30-11:45	2:00-3:30	3:45-5:15	8:30-10:00	10:15-11:45	2:00-3:30	3:45-5:15	8:30-10:00	10:15-11:45	11:45-1:15
101	1	MCDM		MCDM				MCDM	DEA	Plan. & Op.	Energy	
201	2	AET		Mktg.	Global IT & Mgmt.			GIT&M	Info/Netwk.	IT & EC		Information
204	3	Org. Sci.		Organization Sci.		Service	Att. Modeling	Panel*	Internet	Health Care		Info. Tech.
209	4	Telecomm.		Telecomm.	Computer/Comm. Systems			Computer/Comm. Systems			Telecommunications	
211	5	Telecomm.		OR in Telecomm.		Service Op.	SQ & P	Telecommunications		Modeling	Panel*	Health Care
203	6	Org. Sci.		Organization Sci.		Op. Mgmt.	Mktg.	Marketing Research		Service	Org.	
205	7	Finance		Finance				Finance				
207	8	Finance		Finance			Portfolio	Pricing	Finance	Prod.	FMS	
102	9	Experience		Maintenance		Supply Chains		Supply Chains			Supply Chain Mgmt.	
110	10	Tech. Mgmt.		Tech. Mgmt.	Panel*	Queueing Models		Queueing Models		Intelligent Scheduling		Prod. Control
103	11	Production		Semi Mfg.	Combinatorial Models			Comb.	Quality	Inventory Modeling		Inv. Mgmt.
107	12	Opt. I		Opt. II	Logistics	Mfg.	Project Mgmt.				Heuristics	Graph Theory
108	13	Gen. Con.		Gen. Con.	Heuristics		Comb. Opt.	Comb. Opt.	Network Optimization			Comb. Opt.
109	14	D & A		Algorithms	NL Opt.	Dyn. Progr.	German IR	Graph Theory	Traffic	Transport.	VRPs	Airlines
111	15	AP		Applied Probability				Statistical Methodology			MDP	
104	16	Stat. Analysis		Cell. Mfg.	FMS	Panel*	Know.Mgmt.	Coll. Tech.	Queue/Apps.	Panel*	Lot-Sizing	Panel*
112	17	Queues		Queues				Queues				
105	18	Choice Eng.		Choice Eng.		Tech. & Prod.	R&D	Mil. R&D	Prod. Devl.	Tech. Mgt.		
106	19	Logistics		Logistics		Location Analysis		Location	Reliability		DEA	
202	20	New Prod.		Tech.Trans.	West Bank	Economies	Models	Models	Public Pol.		Org. Struc.	
	21		Opening									

PLEASE NOTE:

Room Assignments for
Keynote, Tutorial &
Panel Sessions

MONDAY			1:00-2:00	TUESDAY		1:00-2:00
Rm. 004	MS02	Tutorial	Rm. 003	TS02	Keynote	
Rm. 002	MS04	Keynote	Rm. 004	TS03	Keynote	
Rm. 003	MS09	Keynote	Rm. 002	TS07	Keynote	
Rm. 111	MS13	Keynote	Rm. 201	TS09	Tutorial	
Rm. 112	MS15	Keynote	Rm. 112	TS13	Keynote	
Rm. 001	MS16	Keynote	Rm. 111	TS14	Tutorial	
Rm. 205	MS18	Tutorial	Rm. 205	TS18	Tutorial	
Rm. 110	MS19	Tutorial	Rm. 203	TS19	Tutorial	

* PANELS		
Rm. 001	MD10	3:45 - 5:15
Rm. 001	TA16	8:30 - 10:00
Rm. 001	TC03	2:00 - 3:30
Rm. 001	WA16	8:30 - 10:00
Rm. 001	WB05	10:15 - 11:45
Rm. 001	WC16	11:45 - 1:15