Monday, 9:00-10:30am

■ MA-01

Monday, 9:00-10:30am

Honolulu I

Renewable and Natural Resources

Cluster: Renewable and Natural Resources

Contributed session

Chair: *Martin Treitz*, Institute for Industrial Production, University of Karlsruhe, Hertzstr. 16, 76187, Karlsruhe, Germany, martin.treitz@wiwi.uni-karlsruhe.de

1 - Using the Technical Scope for Optimizing Resource Efficiency

Martin Treitz, Institute for Industrial Production, University of Karlsruhe, Hertzstr. 16, 76187, Karlsruhe, Germany, martin.treitz@wiwi.uni-karlsruhe.de, *Hannes Schollenberger*, *Jutta Geldermann*, *Otto Rentz*

Integrated process design aims at a holistic approach to operations planning, since changes in materials and operating states influence the whole supply chain. The combination of methods of process integration and Operations Research (OR) in Multi Objective Pinch Analysis (MOPA) allows the consideration of a variety of economic and environmental attributes.

2 - Determining the foot of the South African continental slope

Jan van Vuuren, Applied Mathematics, University of Stellenbosch, Private Bag X1, Matieland, 7602, Stellenbosch, Western Cape, South Africa, vuuren@sun.ac.za, *Nicky Pantland*

Surfaces of extremal curvature of the Atlantic and Indian Ocean seafloors are used to locate the foot of the Southern African continental slope from bathymetric data as part the preparation process for claiming extended maritime estate for South Africa, under the United Nations Convention on the Law of the Sea.

3 - Plant Layout Planning based on Multi Objective Pinch Analysis

Martin Treitz, Institute for Industrial Production, University of Karlsruhe, Hertzstr. 16, 76187, Karlsruhe, Germany, martin.treitz@wiwi.uni-karlsruhe.de, *Hannes Schollenberger*, *Jutta Geldermann*, *Otto Rentz*

Multi Objective Pinch Analysis (MOPA) is a systematic analysis for the assessment of production systems in a combination of engineering and Operations Research. Case studies from Chile and China are employed to demonstrate the application of this integrated approach requiring a tight coupling of mass, energy, economic and environmental assessment methods.

■ MA-02

Monday, 9:00-10:30am

Honolulu II

Project Scheduling

Cluster: Scheduling and Timetabling

Contributed session

Chair: *Yan Chen*, Industiral Engineering, Arizona State University, 32 West loma Vista Dr., #102, 85282, Tempe, AZ, jennychen@asu.edu

1 - Scheduling of Multiple Projects with Inter-site Resource Transfers: A Mathematical Programming Approach

M L Mittal, Mechanical Engineering Department, Indian Institute of Technology Delhi, Hauz Khas, New Delhi, 110016, India, mlmittal.nitj@gmail.com, *Arun Kanda*

The focus of the present paper is on consideration of positive inter-project resource transfer times in resource constrained multiproject scheduling. A generalized model is presented and an ILP is proposed that consider three objectives; delay penalties, cost of idle resources and cost of resource transfers.

2 - Hierarchical Control Model for Several Stochastic Network Projects

Aharon Gonik, Head of Logistics Studies Department, Sapir Academic College, Sapir academic college. D.N. Hof, Ashkelon, 79165, Sderot, Israel, aharong@sapir.ac.il

Companies are handling simultaneously several projects, but supervising each project independently, neglecting optimisation of limited resources and supporting projects that are "Legging-behind".The suggested model determines specified control point for :Optimal budget allocation and resource delivery schedules "on-Line" to meet the projects completion due dates.

3 - New algorithm for Project Scheduling Problem

Majid Salari, Ferdowsi University Iran, 9821, Mashhad, Iran, Islamic Republic Of, salarimajid@yahoo.com

Scheduling of a project with constrained resources is a NP-Complete problem.In this paper we obtain effective and efficient criteria in serial and parallel methods and also compare these procedures in necessary time that they will take to complete projects.Finally we introduce the best method of applying these procedures

4 - Methodologies for Parameterization of Composite Dispatching Rules

Yan Chen, Industiral Engineering, Arizona State University, 32 West loma Vista Dr., #102, 85282, Tempe, AZ, jennychen@asu.edu, *John Fowler*, *Douglas Montgomery*, *Michele Pfund*

A design of experiments based regression methodology is proposed for setting appropriate scaling parameter values for composite dispatching rules to improve their scheduling performance. In addition, a scheme to find robust scaling parameter values is developed for situations that require rapid decisions. They are compared with methods in the literature.

■ MA-03

Monday, 9:00-10:30am

Honolulu III

Innovation / Entrepreneurship

Cluster: Innovation / Entrepreneurship

Contributed session

Chair: *Susana Barbeito*, Economics Analysis And Bussiness Administration, University Of La Coruna, Escuela Politecnica Superior, c/ MENDIZABAL S/N, 15403, Ferrol- La Coruna, SBAR@CDF.UDC.ES

1 - Administrative Leadership and Operations Research

Ellen Jordan, Academic Affairs (VP), Mount Olive College, 634 Henerson St, 28365, Mount Olive, NC, United States, ejordan@moc.edu

Training in Operations Research provides us with the critical thinking needed in administrative positions. How does that "big picture" view of operations help one improve in leadership roles?

2 - New Product Development Models Applied In Different Industries In North West Spain.

Manuel Martinez, Economic Analysis And Business Administration, University Of La Coruna, E U Diseno Industrial, Dtr Vazquez Cabrera Sn, 15403, Ferrol-la Coruna, mmc@udc.es, *Eduardo Guillén*, *Susana Barbeito*

We present new product innovation models arising from a cross section analysis in different industries in Spain, outlying the similarities and differences found among them. We also present a comparison between these models and the European Design Innovation Tool (EDIT), a standard methodology developed for managing innovation in European Industries.

3 - Developing Product Design Audit Procedures.

Susana Barbeito, Economics Analysis And Bussiness Administration, University Of La Coruna, Escuela Politecnica Superior, c/ MENDIZABAL S/N, 15403, Ferrol- La Coruna, SBAR@CDF.UDC.ES, *Eduardo Guillén*, *Manuel Martinez*

Previously to the implementation of product innovation models, it is necessary to evaluate the product design area. It is advisable to support this activity on a written document where all areas to be studied are perfectly defined. We present a proposal for design and innovation activities audit in order to achieve better results in business process re-engineering.

■ MA-04

Monday, 9:00-10:30am

Iolani I

Nonlinear Programming

Cluster: Nonlinear Programming

Contributed session

Chair: *Hidefumi Kawasaki*, Faculty of Mathematics, Kyushu University, Hakozaki 6-10-1, Higashi-ku, Fukuoka, JAPAN, 812-8581, Fukuoka, kawasaki@math.kyushu-u.ac.jp

1 - Global Solution of Factorable Nonseparable MINLP's Using A Nonconvex Piecewise Linear Relaxation

Edward Gatzke, Chemical Engineering, University of South Carolina, 301 Main St., 29229, Columbia, SC, United States, gatzke@sc.edu

Using McCormick's reformulation method, new variables, linear constraints, and simple nonlinear constraints can be added to the original MINLP. Introducing additional binary variables and using propositional logic, a piecewise linear lower bounding relaxation MILP problem is generated by use of multiple outer approximations of the original nonlinear function relaxations.

2 - Mixed-integer Bi-level Programming: Application To A Gas Cash-out Problem

Vyacheslav Kalashnikov, Systems and Engineering, ITESM (Monterrey Technological Institute), ITESM, Ave. Eugenio Garza Sada 2501 Sur, 64849, Monterrey, Nuevo Leon, kalash@itesm.mx, *Stephan Dempe*

We model an applied problem as a mixed-integer bilevel program. To simplify it we move Boolean variables from the lower to the upper level, investigate the implications of this change, formulate conditions guaranteeing the existence of an optimal solution, and find bounds on the optimal value of the original problem.

3 - Optimization Of Thermal Plasma Systems For Hazardous Waste Remediation

Joao Lauro Faco', Dept. of Computer Science, Universidade Federal do Rio de Janeiro, Rua Lasar Segall, 100 / 109- A, 22611-100, Rio de Janeiro, RJ, Brazil, jldfaco@acd.ufrj.br

Thermal plasma reactors for the destruction of hazardous wastes are considered the best solution if efficient waste inventory policies related to transportation logistics and a well planned system operation induce the synergy for a scale gain. Linked models using Optimal Control techniques for complex dynamic systems are presented.

4 - The Shapley value for a conjugate-set game induced from the shortest path problem

Takeaki Fuchikami, Faculty of Mathematics, Kyushu University, Hakozaki 6-10-1, Higashi-ku, Fukuoka, 812-8581, Fukuoka, Japan, ma204047@math.kyushu-u.ac.jp

The essence of the conjugae point is cooperation of variables. We define a cooperative game from a finite-dimensional analogue of the classical shortest path problem on a surface. We call it a conjugate-set game. In this talk, we explicitly calculate the Shapley value for it.

5 - Conjugate sets and duality for a three-phase partition problem

Hidefumi Kawasaki, Faculty of Mathematics, Kyushu University, Hakozaki 6-10-1, Higashi-ku, Fukuoka, JAPAN, 812-8581, Fukuoka, kawasaki@math.kyushu-u.ac.jp

The conjugate point is a global concept in the calculus of variations. We defined it for nonlinear programming problems and introduced a conjugate-set game. In this talk, we deal with a three-phase partition problem as an application of the above-mentioned research and show duality for the problem.

■ MA-06

Monday, 9:00-10:30am
Iolani III

Simulation

Cluster: Simulation
Contributed session

Chair: *Nuno Moreira*, Cesur, Instituto Superior Tecnico, Av.
Rovisco Pais, 1049-001, Lisboa, Portugal,
nmoreira@mail.ist.utl.pt

1 - Uncertainty and Sensitivity Methods in System Dynamics

Christian Haxholdt, Statistics, Copenhagen Business School,
Solbjerg Plads 3, 2000, Frederiksberg, Denmark,
ch.mes@cbs.dk, *Malene Haxholdt*

Uncertainty and sensitivity are defined in the context of SD. As SD
models are both nonlinear, complex and must cope with intrinsic vari-
ability the use of rigorous probabilistic and statistical measures are nec-
essary. Various types of uncertainty and sensitivity analysis techniques
are presented and demonstrated on the Beer Game model.

2 - A Re-Examination of the USGA Golf Handicapping System

Steven Nahmias, OMIS Department, Santa Clara University,
95053, Santa Clara, california, United States,
snahmias@scu.edu, *Eugene Yano*

The US Golf Association's handicapping system is based on the best
10 of the most recent 20 rounds posted. We investigate whether this ap-
proach provides for fair matches among players of different abilities by
simulating 5 hypothetical golfers. Our results indicate that the system
favors better and steadier players.

3 - An integrated queue management support system: the application to the Portuguese post-offices

Nuno Moreira, Cesur, Instituto Superior Tecnico, Av. Rovisco
Pais, 1049-001, Lisboa, Portugal, nmoreira@mail.ist.utl.pt,
Pedro Maia Graça, Luis Tavares

Managing queues is a dilemma for managers in particular when it
comes to the application of theoretic models to real life situations. The
authors developed an integrated approach to support queue manage-
ment in post-offices including stochastic modeling, simulation and in-
teger linear programming. The methodology is applied to several real
cases.

■ MA-08

Monday, 9:00-10:30am
Iolani VI

Supply Chain Management I

Cluster: Supply Chain Management
Contributed session

Chair: *Andreas Nilsson*, Division of Industrial Logistics, Ies, Lulea
University of Technology, S-97187, Lulea, Sweden,
andreas.n.nilsson@ltu.se

1 - Synchronization in Supply Chains by Overlapping Production Between Stages: An Implication for Efficient Management

Md Abdul Hoque, Department of Mathematics, University
Brunei Darussala, Faculty of Science, Brunei Darussalam,
Be1410, Bandar Seri Begawan, Brunei - Muara, Brunei
Darussalam, hoque@fos.ubd.edu.bn

Though simple serial supply chains models with synchronization by
overlapping production between stages have received attentions, sim-
ple solution procedures of such models are unavailable. This paper de-
velops simple optimal solution procedures of such models and solves
two numerical examples to show significant costs reductions.

2 - Inventory Policies in a Two-Echelon Supply Chain Facing Various Demand Patterns

Su-Hwa Wu, Graduate Institute of Business Administration,
National Dong Hwa University, 1 Sec 2, University Road, 970,
Hualien, Taiwan, marina@mail.ndhu.edu.tw, *Juhwen Hwang*

We consider a two-echelon supply chain facing various demand pat-
terns. Under different demand structures, a sequence of inventory poli-
cies is obtained to maintain appropriate inventory levels and minimize
the total cost. The impact of costs parameters related to inventory hold-
ing and ordering setup is also considered.

3 - A New Reorder Policy Utilizing the Centralized Stock Information for Two-Echelon Distribution Systems

Yongwon Seo, Dept. of Business Administration, Dankook
University, Anseo Cheonan, 330-714, Chungnam, Korea,
Republic Of, yongwon@chol.com, *Young-Soo Myung*

It has been known that neither the echelon stock policy nor the installa-
tion stock policy minimizes the inventory cost in distribution systems
where the stock information of all facilities are available. In this talk,
we clarify the reason and address an optimal policy. Simulation results
of comparing the three policies will be provided.

4 - Prioritizing retailers in a two-echelon inventory system

Andreas Nilsson, Division of Industrial Logistics, Ies, Lulea
University of Technology, S-97187, Lulea, Sweden,
andreas.n.nilsson@ltu.se

In this paper we deal with the problem of prioritizing retailers in a
two-echelon inventory system when there is a shortage of supply at the
warehouse. We evaluate the performance of both the warehouse and
retailers, which face Poisson demand and use a one-for-one replenish-
ment policy.

■ MA-10

Monday, 9:00-10:30am
Tapa Ballroom I

Rough Set and Decision Rule Approach to Multiple-Criteria Decision Analysis

Cluster: Tutorials
Invited session

Chair: *Matthias Ehrgott*, Engineering Science, University of
Auckland, Private Bag 92019, 1001, Auckland, New Zealand,
m.ehrgott@auckland.ac.nz

Chair: *Theo Stewart*, Statistical Sciences, University of Cape
Town, 7701, Rondebosch, South Africa, tjstew@iafrica.com

1 - Rough Set and Decision Rule Approach to Multiple-Criteria Decision Analysis

Roman Slowinski, Institute of Computing Science, Poznan University of Technology, Laboratory of Intelligent Decision Support Systems, Street Piotrowo 3a, 60-965, Poznan, Poland, slowinsk@sol.put.poznan.pl

We present the methodology of Multiple-Criteria Decision Analysis (MCDA) based on preference modeling in terms of "if..., then..." decision rules. The basic assumption of the decision rule approach is that the decision maker (DM) accepts to give preferential information in terms of examples of decisions and looks for simple rules justifying his/her decisions. An important feature of this approach is the possibility of handling inconsistencies in the preferential information. The methodology is based on elementary, natural and rational principle of dominance. From an algorithmic point of view, the set of decision rules constituting the preference model is induced from the preferential information using a knowledge discovery technique properly adapted, so as to handle the dominance principle. The mathematical basis of the decision rule approach to MCDA is the Dominance-based Rough Set Approach (DRSA). We present some basic applications of DRSA, starting by multiple-criteria classification problems, and then going through decision under uncertainty, hierarchical decision making, classification problems with partially missing information, until multiple-criteria choice and ranking problems. All these applications are illustrated by didactic examples.

■ MA-11

Monday, 9:00-10:30am

Tapa Ballroom II

Combinatorial Optimization I

Cluster: Combinatorial Optimization

Contributed session

Chair: *Genrikh Levin*, Operations Research Laboratory, United Institute of Informatics Problems, Surganov str., 6, 220012, Minsk, Belarus, levin@newman.bas-net.by

1 - Finding Pareto-Optimal Set by Merging Attractors for Multi-Objective TSP

Weiqi Li, School of Management, University of Michigan-Flint, 303 East Kearsley Street, 48502, Flint, Michigan, United States, weli@umflint.edu

This paper presents a new search procedure to tackle multi-objective TSP. This procedure constructs the solution attractor for each of objectives individually. Each attractor contains the best solutions found for the corresponding objective. Then these attractors are merged to find the Pareto-optimal solutions. The goal of the procedure is not only to generate a set of Pareto-optimal solutions, but also to provide the information about these solutions that will allow a decision-maker to choose a good compromise solution. The procedure is applied to a triple-objective TSP instance in this paper.

2 - An Empirical Study of Hybrid Genetic Algorithms for the Set Covering Problem

Francis Vasko, Mathematics & Computer Science, Kutztown University, 170 Lytle Hall, 19530, Kutztown, PA, United States, vasko@kutztown.edu

This paper explores the performance of hybrid algorithms that are extensions of a genetic algorithm (GA) for solving the set covering problem. Hybrid solution approaches are introduced that combine the GA with local neighborhood search, with greedy randomized adaptive search procedure (GRASP), and with an estimation of distribution algorithms.

3 - A Local Search Approach for the Error Localization Problem in Data Cleaning

Juan José Salazar González, Estadística e Investigación Operativa, Universidad de La Laguna (Tenerife), Av. Astrofísico Francisco Sánchez, s/n, 38271, La Laguna, Tenerife, Spain, jjsalaza@ull.es, *Jorge Riera-Ledesma*

The Error Localization Problem has been shown to be NP-hard. We present a new heuristic algorithm, based on a local search approach, to obtain a near-optimal solution for this problem. Some of the procedures of this approach make use of a Benders' decomposition of a linear programming model.

4 - Balancing Paced Production Lines with Blocks of Parallel Operations at Stations

Genrikh Levin, Operations Research Laboratory, United Institute of Informatics Problems, Surganov str., 6, 220012, Minsk, Belarus, levin@newman.bas-net.by, *Alexandre Dolgui*, *Nikolai Guschinsky*

The problem of grouping operations into blocks and assigning them to workstations is investigated under the assumption of simultaneous executing operations in the block. The goal is to minimize the line cost under technological constraints. Proposed algorithms are based on MIP and graph approaches. INTAS and ISTC support the work.

■ MA-12

Monday, 9:00-10:30am

Tapa Ballroom III

Transportation Logistics

Cluster: Transportation

Invited session

Chair: *Bernard Gendron*, Diro, Université de Montréal, C.P. 6128, succ. Centre-ville, H3c 3j7, Montréal, Québec, Canada, gendron@iro.umontreal.ca

1 - Planning Intermodal Rail Transportation Services

Teodor Gabriel Crainic, Management and Technology, Univ. du Québec à Montréal, C.P. 8888, succ. Centre-Ville, H3c 3p8, Montréal, Québec, Canada, theo@crt.umontreal.ca, *Michael Berliner Pedersen*

We discuss issues and challenges associated to planning and managing the operations of rail intermodal transportation systems. We also present modelling approaches for the service network design of such systems.

2 - A Barge Routing Problem With Pickup And Delivery

Frédéric Semet, Lamih, University of Valenciennes, Le Mont Houy, Istv 2, 59313, Valenciennes, Cedex 9, France, frederic.semet@univ-valenciennes.fr, *Said Hanafi*

We propose an integer linear programming model for the barge routing problem with pickup and delivery. We derive valid inequalities to strengthen the model and we propose a two-phase heuristic. Models and methods are compared on data provided by the Port of Lille.

3 - A Combined Dual Ascent/Variable Neighbourhood Heuristic for a Multi-Echelon Location-Distribution Problem

Bernard Gendron, Diro, Université de Montréal, C.P. 6128, succ. Centre-ville, H3c 3j7, Montréal, Québec, Canada, gendron@iro.umontreal.ca, *Frédéric Semet, Imen Temimi*

We consider a multi-echelon location-distribution problem arising from an actual application in fast delivery service. We propose a heuristic that exploits a simple plant location relaxation of a MIP formulation of the problem to solve a large-scale actual application. The heuristic combines DUALOC with a variable neighborhood descent.

■ MA-13

Monday, 9:00-10:30am
Sea Pearl I

Complex Process Monitoring

Cluster: Quality, Statistics and Reliability
Invited session

Chair: *Lianjie Shu*, University of Macau, Macau, LJShu@umac.mo

Chair: *Wei Jiang*, Systems Engineering and Engineering Management, Stevens Institute of Technology, Castle Point of Hudson, 07030, Hoboken, NJ, wjiang@stevens.edu

1 - Enterprise quality measurement level

Slavica Jovetic, Management and Business Economy, Faculty of Economics, Djure Pucara Starog 3, 34 000, Kragujevac, Serbia and Montenegro, sjovetic@kg.ac.yu

This paper is result of long term of practical and theoretical work of the author on improvement of quality system and management of processes by statistical, engineering, management methods...

It is consisted of following parts: measuring methodology, indicators of quality level, process, balanced scorecard, questionnaire results (in Serbia), conclusion.

2 - Run Length Performance of An Adaptive CUSUM Chart

Lianjie Shu, University of Macau, Macau, LJShu@umac.mo, *Wei Jiang*

Compared to conventional cumulative sum (CUSUM) charts, the adaptive CUSUM (ACUSUM) chart can detect a broader range of mean shifts. This paper develops a two-dimensional Markov chain model to analyze the performance of ACUSUM charts. Moreover, a more general operating model is suggested to the current ACUSUM chart to simplify its implementation.

3 - Multivariate Quality Control Charts for Monitoring Univariate Autocorrelated Processes

Wei Jiang, Stevens Tech, Nj, United States, wjiang@stevens.edu

Recently T2 chart has been studied for detecting mean shifts of a univariate autocorrelated process. This paper proposes a control chart based GLRT to take into consideration special shift patterns. The proposed control chart is shown to outperform other charts when monitoring the mean of a univariate autocorrelated process.

■ MA-15

Monday, 9:00-10:30am
Sea Pearl III

Routing

Cluster: Routing
Contributed session

Chair: *Burcin Bozkaya*, Graduate School of Management, Sabanci University, Orhanli, Tuzla, 34956, Istanbul, Turkey, bbozkaya@sabanciuniv.edu

1 - Routing and Scheduling a Fleet of Hazmat Vehicles Avoiding Risk Accumulation in a Time Dependent Transportation Network

Masoud Hamedi, Civil & Environmental Engineering Department, University of Maryland, 1173 Glenn L. Martin Hall, 20742, College Park, MD, United States, masoud@umd.edu, *Ali Haghani, Saini Yang*

When having multiple hazmat shipments over a network, there might be situations that several vehicles share the same road segment at the same time. This raises the level of risk as a result of accumulated potential chain effects. This paper provides a method to minimize the overall risk

2 - Team Orienteering Problem

Bryan Lawson, Computer Science, Slippery Rock University, 706 Cameron Drive, 16057, Slippery Rock, Pa, United States, bryanlawson@mail.com, *Sam Thangiah*

Team Orienteering Problem using vehicles involves a set of trucks that have to select a subset of customers or shipments that will maximize the revenue. We detail new heuristic operators that have been implemented to obtain solutions for problems from the literature and compare it with known solutions.

3 - Optimizing Service Technician Operations for a Gas Utility Company

Burcin Bozkaya, Graduate School of Management, Sabanci University, Orhanli, Tuzla, 34956, Istanbul, Turkey, bbozkaya@sabanciuniv.edu, *Buyang Cao, Julie Wunderlich*

A common task for gas utility companies is to respond to customer requests for various services. In this paper, we present a VRP-based model and a heuristic methodology for routing service technicians to fulfill such requests. We also describe a GIS-based implementation in Southern California area, serving 30,000 customers daily.

■ MA-16

Monday, 9:00-10:30am
Sea Pearl IV

Research and Development

Cluster: Research and Development
Contributed session

Chair: *Masatake Saito*, Faculty of Commerce, Chuo University, 742-1, Higashi-nakano, 194-0393, Hachioji, Tokyo, Japan, msaito@tamacc.chuo-u.ac.jp

1 - Justice OR

Stanley Erickson, Office of Science and Technology, National Institute for Justice, 810 7th St. NW, 20351, Washington, DC, United States, serickson@inbox.ru

There has been little OR devoted to criminal justice. The National Institute of Justice is starting a program to increase the interest of the OR community in applying known techniques to justice problems. This paper describes the steps to be followed, the goals to be targeted, and the support expected.

2 - The Research and Development Portfolio Problem

Roger Burk, Systems Engineering, US Military Academy, 309 Mahan Hall, Bldg 752, 10996, West Point, NY, United States, roger.burk@usma.edu

We consider how to select the best portfolio of R&D projects from a given set under a budget limit. The problem is complicated by multiple criteria and nonadditive interactions among the projects. We review the literature on various approaches and our experience, and recommend value modeling and good graphics.

3 - Research Mapping System for Research Strategy

Masatake Saito, Faculty of Commerce, Chuo University, 742-1, Higashi-nakano, 194-0393, Hachioji, Tokyo, Japan, msaito@tamacc.chuo-u.ac.jp

When researchers carry their theme forward, it has become important for them to decide next theme along the research strategy. The purpose is to apply the system being useful for Research Strategies. The developed system shows research papers mapping by system rules. This version of system is corresponded with English.

■ MA-17

Monday, 9:00-10:30am
Sea Pearl V

Interactive Methods and Web Tools I

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *Kaisa Miettinen*, Helsinki School of Economics, P.O. Box 1210, Fi-00101, Helsinki, Finland, miettine@hkkk.fi

1 - Generalized Differential Evolution Compared to NIM-BUS

Saku Kukkonen, Department of Information Technology, Lappeenranta University of Technology, P.O. Box 20, 53851, Lappeenranta, saku.kukkonen@lut.fi, *Jouni Lampinen*

In this paper previously introduced Generalized Differential Evolution (GDE) is compared to Nondifferentiable Interactive Multiobjective BUndle-based optimization System (NIMBUS) with a set of multiobjective problems. Working principles and usability of GDE and NIMBUS are compared. New interactive web version of GDE is proposed and designed.

2 - Interactive Analyzing, Optimizing, and Controlling of Multi Criteria Processes

Hans L. Trinkaus, Optimierung, Fraunhofer ITWM, Gottlieb-Daimler-Str. 49, D 67663, Kaiserslautern, Germany, trinkaus@itwm.fhg.de

knowCube®, a novel multi criteria decision support system, already has proven high performance in real-life projects (e.g. in industrial

engineering, life sciences, manufacturing, and marketing). Now, the further developed toolbox is applied on new application domains: the management of production processes, and even the communication of medical or psychological information.

3 - Interactive Approach Utilizing Approximations of the Nondominated Set

Kaisa Miettinen, Helsinki School of Economics, P.O. Box 1210, Fi-00101, Helsinki, Finland, miettine@hkkk.fi, *Kathrin Klamroth*

We present a new interactive approach for solving multiobjective optimization problems. After producing a rough approximation of the nondominated set, we let the decision maker to indicate where to refine the approximation. In this way, (s)he iteratively directs the search towards the best nondominated solution.

■ MA-18

Monday, 9:00-10:30am
Sea Pearl VI

Manufacturing

Cluster: Manufacturing
Contributed session

Chair: *Wilco van den Heuvel*, Econometrics & Operations Research, Erasmus University Rotterdam, Burg. Oudlaan 50, P.O. Box 1738, 3000dr, Rotterdam, Netherlands, wvandenheuvel@few.eur.nl

1 - Managing the Life of a Remanufactured Product

Geraldo Ferrer, Graduate School of Business and Public Policy, Naval Postgraduate School, IN-234, 555 Dyer Rd., 93943, Monterey, CA, United States, gferrer@nps.edu, *Jayashankar Swaminathan*

We study a firm that uses returned cores to make remanufactured products along with new products. We focus our attention on the duopoly environment where an independent operator may intercept cores of products made by the original equipment manufacturer to sell remanufactured products in future periods.

2 - A practical method to mine knowledges from data in consumer behavior

Hiroshi Noguchi, Faculity of Commerce, University of Marketing and Distribution Sciences, 3-1, Gakuen-Nishimachi, Nishiku, Kobe 651-2188 Japan, 651-2188, Kobe city, Hyogo Prefecture, Japan, Hiroshi_Noguchi@red.umds.ac.jp

It is generally applied Basket Analysis to get the connection between goods,and Tree Analysis to specify the similarity among attributes of consumers who purchased some good. We introduce a practical method to search the relation between good's connections and consumer's attributes simultaneously.

3 - The economic lot-sizing problem with remanufacturing options

Wilco van den Heuvel, Econometrics & Operations Research, Erasmus University Rotterdam, Burg. Oudlaan 50, P.O. Box 1738, 3000dr, Rotterdam, Netherlands, wvandenheuvel@few.eur.nl

We consider an extension of the economic lot-sizing problem. Besides producing new items there is an option of remanufacturing returned

items to satisfy demand. We show that the problem is polynomially solvable in the case of a single production line and NP-hard in the case of dedicated production lines.

4 - A comparison between manual and automated visual inspection in Industrial Work Environment

Alberto Silva, Infineon Technologies Portugal, Vila do Conde, Portugal, alberto.silva@infineon.com, *Maria Madalena Araújo*, *José Alberto Tavares de Oliveira*

Visual Inspection is a critical process to ensure the expected delivery quality level of computer memories. In this work accuracy and repeatability study is performed to compare automated against manual inspection. The results are analysed and an inspection strategy proposed for this particular product type.

■ MA-19

Monday, 9:00-10:30am
Nautilus I

AHP01: Multi-problem, multi-actor, multi-decision

Cluster: Analytic Hierarchy / Network Process
Invited session
Chair: *Luis Vargas*, University of Pittsburgh, Pittsburgh, United States, vargas@katz.pitt.edu

1 - Multi-Decisions Decision-Making (MDDM):Choosing from and Ordering Many Decisions

Thomas Saaty, Katz Graduate School of Business, University of Pittsburgh, Pittsburgh, PA. 15260 USA, 15260, Pittsburgh, Pennsylvania, United States, saaty@katz.pitt.edu

Corporations and governments must often order and prioritize numerous decisions according to urgency and importance to optimize implementation and allocate scarce resources. What values and criteria do we need to prioritize decisions as the alternatives of a more general decision process? The best alternatives of these decisions may be unknown.

2 - Activities of the AHP research group in the Operations Research Society of Japan

Takao Ohya, System Engineering Research Laboratory, Central Research Institute of Electric Power Industry, 2-11-1 Iwado Kita, 201-8511, Komae-shi, Tokyo, Japan, ohya@criepi.denken.or.jp, *Eizo Kinoshita*

In the AHP research group in the Operations Research Society of Japan, researches on AHP theory and the development of methodologies for the practical use of AHP applicable to specific problems occurring in the world of business, government offices, etc. are studied from May, 2004.

3 - Approaches for Studying Group Decision Process

Amilcar Serrao, Universidade de Évora, Largo dos Colegiais, 7000-554, Evora, Alentejo, Portugal, TTT30@clix.pt

This study presents procedures for generating a group decision-making. The method for reaching an agreement consists of harmonizing the individual preferences. The preference 'harmonization' leads to inefficient solutions, when there are multiple alternatives. This work presents an approach of preference 'aggregation' that ensures an efficient solution with multiple alternatives.

4 - Dispersion of Group Judgments

Luis Vargas, Katz Graduate School of Business, University of Pittsburgh, 314 Mervis Hall, 15260, Pittsburgh, PA, United States, lgvargas@pitt.edu, *Thomas Saaty*

Achieving group satisfaction with a decision the group members must accept the judgments, and the priorities. This requires judgment homogeneity. There are three homogeneity levels: for a paired comparison (monogeneity), for a matrix (multigeneity), and for a hierarchy/network (omnigeneity). Here we study monogeneity and its impact on group priorities.

■ MA-20

Monday, 9:00-10:30am
Nautilus II

Advances in Decision Analysis Theory and Practice

Cluster: Decision Analysis
Invited session
Chair: *John Butler*, Ohio State University, 2100 Neil Ave, 43215, Columbus, Ohio, United States, butler.267@osu.edu

1 - Does more money buy more happiness?

Manel Baucells, IESE Business School, Spain, mbaucells@iese.edu, *Rakesh Sarin*

People seek higher incomes to buy comforts of life and for security for themselves and their families. Beyond a certain point, however, higher income does not always lead to greater life satisfaction or happiness. A model of consumption is described that incorporates satiation with consumption. In this model, utility of additional consumption depends on past consumption. Under some assumptions, this model indeed predicts that additional income does not lead to higher experienced utility. A brief summary of results from economics and psychology is given to provide some insight into the determinants of happiness.

2 - Metaphorical Representation for MCDM

James Felli, Eli Lilly and Company, Lilly Corporate Center, 46285, Indianapolis, Indiana, United States, jcfelli@lilly.com

We discuss the use of a contextual metaphor as a foundation for the visual display of alternatives in a multiattribute decision-making setting. This type of representation enables decision-makers to consider trade-offs in an environmental context while limiting the effects of biases consequent to knowledge of specific alternatives.

3 - Modeling the Effects of Reference Point Dependence on Supplier Selection

Tianjun Feng, The Paul Merage School of Business, University of California, Irvine, 335 Gsm, 92697, Irvine, CA, United States, tfeng02@gsm.uci.edu, *L. Robin Keller*

The primary goal of this paper is to develop an analytical framework for a buyer to understand the impact of reference level and loss aversion on supplier selection and make smart choices among her suppliers. A mathematical reference-dependent model is proposed to explore the effects on supplier selection by evaluating the suppliers relative to multi-attribute reference points characterized by price, delivery time guarantee.

4 - Pharmaceutical Portfolio Management - what's new?

Kazuo Ezawa, Strategic Planning & Decision Analysis, Bristol-Myers Squibb Company, Route 206 & Provinceline Road, 08540, Princeton, NJ, kazuo.ezawa@bms.com

Pharmaceutical portfolio management has many challenges and issues which are unique to pharmaceutical industry. We will discuss new insights gained based on the current practice/experience at a major pharmaceutical company, e.g., an impact of a "stage-gate pharmaceutical development / decision process" and a corporate strategy to the pharmaceutical pipeline portfolio.

■ MA-21

Monday, 9:00-10:30am
Lehua Suite

History of OR

Cluster: History of OR
Invited session

Chair: *Maurice Kirby*, Department of Economics, Lancaster University, The Management School, Bailrigg, Lancaster LA1 4YX, United Kingdom, m.kirby@lancaster.ac.uk

1 - Professionalism in OR: Anglo-American contrasts and comparisons

Maurice Kirby, Department of Economics, Lancaster University, The Management School, Bailrigg, Lancaster LA1 4YX, United Kingdom, m.kirby@lancaster.ac.uk

This paper provides contrasts and comparisons between the UK and USA in relation to the issue of professioanl status in the history of the two national OR societies. The paper will relate national experiences to the established literature on professional elites.

2 - FIG in the Fifties: the Early Years of the National Coal Board's Field Investigation Group

John Ranyard, Management Science, Lancaster University, Management School, La1 4yx, Lancaster, jranyard@cix.co.uk

The NCB established, in 1948, the first industrial OR group in the UK, initially called the Field Investigation Group, FIG. Whilst much of the work was pragmatic, many activities mirrored those of subsequent academic OR Departments, including training, study groups, peer review, colloquia and encouragement to publish.

■ MA-23

Monday, 9:00-10:30am
Kahili II

Health Care

Cluster: Health Care
Contributed session

Chair: *Chun-Ling Chuang*, Department of Information Management, Kainan University, Taoyuan, Taiwan, clchuang@mail.knu.edu.tw

1 - Modelling Intermediate Care services for Older People

Kathy Kotiadis, Kent Business School, University of Kent, Canterbury, Kent, Ct2 7pe, Canterbury, Kent, United Kingdom, K.Kotiadis@kent.ac.uk

In less than a decade health and social services established Intermediate Care (IC) services for Older People across the UK. This paper is about building a simulation model for a complex IC system that integrates several services using real patient data.

2 - The Effect of Size on Hospitals' Efficiency: The Case of Israel

Zilla Sinuany Stern, College of Judea and Samaria, Israel, zilla@bgumail.bgu.ac.il, *Lea Friedman*, *Dov Chernichovsky*, *Yossi Hadad*

In this paper we study the effect of the hospitals' size on their efficiency. The size of hospitals is measured by the number of beds. The efficiency is measured by using the Data Envelopment Analysis (DEA) performance measure. Input and output data for 24 hospitals in Israel were included during 1998-2002.

3 - Siren - Simulation and Optimisation for Emergency Services

Andrew Mason, Dept Engineering Science, University of Auckland, Private Bag 92019, Auckland, New Zealand, a.mason@auckland.ac.nz

Ambulance services face complex problems that include determining base locations, deciding where/when to allocate new resources, and developing move-up strategies that anticipate incoming calls. We discuss the development of the Siren software system being used by the Metropolitan Ambulance Service in Melbourne, Australia to help address some of these questions.

4 - Development of the Electronic Medical Record System in Taiwan

Chun-Ling Chuang, Department of Information Management, Kainan University, Taoyuan, Taiwan, clchuang@mail.knu.edu.tw, *Rong-Ho Lin*

With the advent of Internet, healthcare institutions in Taiwan have simultaneously implemented electronic medical record system (EMRS) and paper-based medical record system for three years. This research applied an AHP to investigate the feasibility for the paperless of EMRS, KSF for paperless and the suggestions of EMRS development in Taiwan.

■ MA-24

Monday, 9:00-10:30am
Hibiscus I

Complex Societal Problems

Cluster: Complex Societal Problems
Contributed session

Chair: *Chun Kwong Han*, President, ManagementSciences@Malaysia, Malaysia, hanck@pc.jaring.my

1 - Reinventing Operational Research

Arabinda Tripathy, Indian Institute of Management, Ahmedabad, Indian Institute of Management, Ahmedabad, 380015, Ahmedabad, Gujarat, India, tripathy@iimahd.ernet.in

Reinventing Operational Research arises out of concerns about implementation of OR studies and applicability of OR to various societal and messy problems. "Soft OR" addresses these issues to some extent. The Complementary nature of SOFT and HARD OR is discussed through a model and its validity through cases.

2 - Social Investment Model to Improve the Human Development Index - HDI

Nélio Pizzolato, Departamento de Engenharia Industrial, Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil, ndp@ind.puc-rio.br, *Flavio Sohler*

The HDI is a composite index that evaluates every country's average economic and social well-being. The present research evaluates decisions of an electrical generating company to make basic education investments in its area of activity. The proposal is to select projects according to the regional impact on the HDI.

3 - Making the Knowledge-based Economy: A Complexity-Structurational Perspective of a Developing Country

Chun Kwong Han, President, ManagementSciences@Malaysia, Malaysia, hanck@pc.jaring.my, *Amirudin Abdul Wahab*

"National Contribution of Malaysia" from Management Science/Operations Research Society of Malaysia, a member of IFORS since 1986.

Malaysia is redefining its developmental strategy for a knowledge-based and innovation economy. Various initiatives are being designed and executed at various levels. A theoretical framework is constructed from complexity and structurational theories, and this provides a sophisticated way of seeing, thinking and interpreting the new world. An in-depth understanding of the issues is assessed using two national case studies. Implications are drawn regarding the theory and practice of success strategies.

2 - With a View to a Kill

Karsten Bergdahl, Division of Defence Analysis, Swedish Defence Research Agency (FOI), Se-164 90, Stockholm, Sweden, karsten.bergdahl@foi.se, *Richard Loe*

The Swedish Defence Research Agency (FOI) has been assessing the new tactical command network developed for the Royal Swedish Navy, as part of a wider task to evaluate and develop naval tactics. This paper sets the problem in context and describes the methods used to assess the command network.

3 - 'Cutting Edge' Warrior Systems Analysis with IWARS (Infantry Warrior Simulation)

Alicia Borgman, Natick Operations, Anteon International Corporation, 209 West Central Street Ste 301, 01760, Natick, MA, United States, aborgman@anteon.com, *Medhat Korna*

IWARS is a constructive force-on-force simulation for assessing warrior systems in research, development, and acquisition analyses. Its focus is dismounted individual combatants. The flexible model can represent current and future systems, including components of Future Force Warrior. We discuss features of IWARS on the forefront of DoD modeling and simulation.

■ MA-25

Monday, 9:00-10:30am
Hibiscus II

Military Applications I

Cluster: Military Applications
Contributed session

Chair: *Alicia Borgman*, Natick Operations, Anteon International Corporation, 209 West Central Street Ste 301, 01760, Natick, MA, United States, aborgman@anteon.com

1 - Deterministic Lanchester Models Taking Account of Anti-Missile Defense and Reconnaissance Capabilities

Toru Komiya, Computer Science, Japan National Defense Academy, Hashirimizu 1-10-20, 2398686, Yokosuka, kanagawa, Japan, komiya@nda.ac.jp, *Koji Iida*

We propose deterministic Lanchester models that regard anti-missile defense and reconnaissance capabilities. Taking these capabilities into account, we derive an N-cubic law. But if one service lacks any one of them, it results in a mixed law. We will show some Lanchester models by investigating the battles between asymmetric forces.

Monday, 1:30-3:00pm

■ MC-01

Monday, 1:30-3:00pm
Honolulu I

Operations Research in Agriculture I

Cluster: Renewable and Natural Resources
Invited session

Chair: *Andrew Higgins*, Level 3, QBP, CSIRO Sustainable
Ecosystems, 306 Carmody Road, St. Lucia, 4067, Brisbane, QLD,
Australia, andrew.higgins@csiro.au

**1 - Static multicriteria model for use in formulating diets
for growing pigs**

François Dubeau, Mathématiques, Université de Sherbrooke,
Faculté des sciences, 2500 Boul. Université, J1k2r1,
Sherbrooke (Qc), Canada, francois.dubeau@usherbrooke.ca,
Pierre-Olivier Julien, Candido Pomar

We use multicriteria linear programming models for the problem of for-
mulating diets for growing pigs which not only minimize the feed cost
but also that taking into account nitrogen and phosphorous excretions.
A combined criterion is minimized within the set of feasible solutions.
Methods of solution and visualization are presented.

2 - A linear programming model to schedule pig facilities

Javier Faulin, Department of Statistics and OR, Public
University of Navarra, Los Magnolios Building, 1st Floor,
Campus Arrosadía., 31006, Pamplona, Navarra, Spain,
javier.faulin@unavarra.es, *LluisM Pla*

Different models are proposed to design pig housing facilities. All of
them takes the life span of a sow as reference. In this work we approach
the problem using a linear programming model in order to exploit out-
comes resulting in a better management of available resources.

**3 - Applying Operations Research to Agricultural Sys-
tems: Some Keys to Success**

Andrew Higgins, Level 3, QBP, CSIRO Sustainable
Ecosystems, 306 Carmody Road, St. Lucia, 4067, Brisbane,
QLD, Australia, andrew.higgins@csiro.au, *Simon Dunstall,
Ainsley Archer, Andreas Ernst, Mohan Krishnamoorthy*

Agriculture is a fundamental industry in a many of the world's
economies. The successful application of OR in agriculture is rare
compared to other industries. We discuss the complexities and perti-
nent issues in the management of harvests and post-harvest processing
and analyse features of OR successes in Australian agricultural indus-
tries.

■ MC-02

Monday, 1:30-3:00pm
Honolulu II

The 7th EURO Working Group on Automated Timetabling Workshop: Multi-Objective Timetabling and Rostering

Cluster: Scheduling and Timetabling
Invited session

Chair: *Dario Landa Silva*, Computer Science, University of
Nottigham, Jubilee Campus, Wollaton Road, Ng9 1hx,
Nottingham, jds@cs.nott.ac.uk

Chair: *Patrick De Causmaecker*, Industrieel Ingenieur, KaHo
St.-Lieven, IT-Group, Gebr.Desmetstraat 1, 9000, Gent, Flanders,
Patrick.DeCausmaecker@kahosl.be

**1 - On the Multi-objective Nature of Timetabling and
Rostering Problems**

Dario Landa Silva, Computer Science, University of
Nottigham, Jubilee Campus, Wollaton Road, Ng9 1hx,
Nottingham, jds@cs.nott.ac.uk

Timetabling and rostering problems are frequently formulated as multi-
criteria decision problems. We propose a procedure to assess the multi-
objective nature of these problems and illustrate it using a number of
test cases. This allows a better guided approach for tackling these prob-
lems in a multi-objective fashion.

2 - A Model for Distributed Employee Scheduling

Patrick De Causmaecker, Industrieel Ingenieur, KaHo
St.-Lieven, IT-Group, Gebr.Desmetstraat 1, 9000, Gent,
Flanders, Patrick.DeCausmaecker@kahosl.be

In distributed employee scheduling autonomous departments manage
detailed schedules for their assigned employees while the company as
a whole will profit from a more globally optimised schedule. Depart-
ments do not normally need to communicate in detail but can profit
from exchanging aggregated information. A model and experimental
results are discussed.

**3 - Comparison of Solutions from a Genetic Heuristic
and Goal Programming for Nurse Rerostering with
Soft Constraints**

Margarida Pato, Dept. Matemática, ISEG (Univ. Técn.
Lisboa), Centro de Investigação Operacional, FC (Univ.
Lisboa), Rua do Quelhas, 6, 1200-781, Lisboa, Portugal,
mpato@iseg.utl.pt, *Margarida Moz*

The nurse rerostering problem was modelled as an integer multicom-
modity flow bi-objective problem. A simple genetic heuristic and a
goal programming approach are presented, along with results of a com-
putational experiment designed to compare these methods within a set
of instances taken from a real situation at a Lisbon hospital.

■ MC-03

Monday, 1:30-3:00pm
Honolulu III

Stochastic Programming I

Cluster: Stochastic Programming
Invited session

Chair: *Hanif Sherali*, Virginia Tech Industrial & Systems Engineering, United States, hanifs@vt.edu

1 - Global Optimization for Nonconvex Stochastic Mixed-Integer Nonlinear Programs

Kevin Furman, Corporate Strategic Research, ExxonMobil Research & Engineering, 1545 Route 22 East, 08801, Annandale, NJ, United States, kevin.c.furman@exxonmobil.com, *Jing Wei*, *Marco Duran*, *Mohit Tawarmalani*, *Nick Sahinidis*

We apply sample average approximation (Shapiro, 2003) for solving nonconvex stochastic MINLPs. Global optimality with a probabilistic measure is assured by solving the MINLP samples via convexification techniques (Tawarmalani and Sahinidis, 2004) within spatial branch-and-bound and/or outer approximation (Duran and Grossmann, 1986). Preliminary theoretical and computational results are presented.

2 - Two-Stage Stochastic Risk Threshold and Hierarchical Multiple Risk Problems

Cole Smith, Systems and Industrial Engineering, University of Arizona, Tucson, AZ, United States, cole@sie.arizona.edu, *Hanif Sherali*

We consider a class of two-stage stochastic risk management problems. The objective minimizes a first-stage cost function plus an expected second-stage hierarchical risk measure. We develop mixed-integer 0-1 programming models and adopt an automatic convexification procedure to recast the problem into a form that is amenable to applying Benders' decomposition.

3 - Disjunctive Decomposition with Branch-and-Cut for Stochastic Mixed-Integer Programming

Lewis Ntaimo, Industrial Engineering, Texas A&m University, 3131 Tamu, 77843, College Station, TX, United States, ntaimo@tamu.edu

In this talk, we present a novel disjunctive decomposition algorithm with branch-and-cut for solving large-scale two-stage stochastic mixed-integer programming (SMIP) problems with relatively complete recourse and having continuous/mixed-binary first-stage variables. This method extends the disjunctive decomposition (D2) algorithm for SMIP, which is a pure cutting-plane algorithm and requires the first-stage solutions to be extreme points of the first-stage feasible set. This requirement is not necessary in the proposed method, whose novelty stems from the fact that branching is done on a continuous domain and is guided by the disjunction variables in the second-stage.

4 - Totally Unimodular Stochastic Programs

Nan Kong, Industrial Engineering, University of Pittsburgh, 1070 Benedum Hall, 15261, Pittsburgh, PA, United States, nkong@ie.pitt.edu, *Andrew Schaefer*, *Shabbir Ahmed*

We consider a class of totally unimodular stochastic programs (TUSPs), that is, stochastic integer programs whose extensive forms have TU constraint matrices. When solving TUSPs using the L-shaped method it is not clear whether the integrality restrictions should be imposed on the master. Our computational results investigate this trade-off.

■ MC-04

Monday, 1:30-3:00pm
Iolani I

Applications of Optimization

Cluster: Nonlinear Programming
Invited session

Chair: *Richard Rosenthal*, Operations Research, Naval Postgraduate School, Monterey, CA, United States, RRosenthal@nps.edu

1 - Scheduling U.S. Coast Guard Helicopter Deployment and Maintenance

Alexandra Newman, Division of Economics and Business, Colorado School of Mines, 1500 Illinois Street, 80401, Golden, CO, United States, newman@mines.edu, *Richard Hahn*

The Coast Guard uses the HH60J helicopter for missions such as search and rescue. Because of the long amounts of time that the helicopters spend hovering over salt water, the Coast Guard uses an aggressive preventative maintenance regimen. We present a highly-constrained integer program for scheduling such maintenance, and results.

2 - Assigning People in Practice

Robert Fourer, Industrial Engineering and Management Sciences, Northwestern University, 2145 Sheridan Road, 60208-3119, Evanston, IL, United States, 4er@iems.northwestern.edu

Chances are you've been stuck at least once with a problem of assigning people to offices, projects, tables, etc. The venerable idea of an "assignment problem" can be useful in these circumstances, if applied with care. I describe several real assignment applications along with rules for success that they suggest.

3 - Air Tasking Orders

Richard Rosenthal, Operations Research, Naval Postgraduate School, Monterey, CA, United States, RRosenthal@nps.edu

Designing air tasking orders (ATO) for strike assets to engage targets is an example of an "assignment problem," as discussed by the previous speaker, albeit with side constraints and additional considerations. We discuss progress in the application and testing of optimization for ATO design and revision.

■ MC-05

Monday, 1:30-3:00pm
Iolani II

Information Technology Management

Cluster: Auctions and e-markets
Invited session

Chair: *Michel Berthiaume*, Groupe Geobusiness - Faculté d'administration, Université de Sherbrooke, boul. Université, J1k2r1, Sherbrooke, Québec, Canada, Michel.Berthiaume@USherbrooke.Ca

1 - Wireless Networks, Ubiquitous Computing and Location-Based Technologies Impacts on Businesses: the Need for New Models and Approaches

Michel Berthiaume, Groupe Geobusiness - Faculté d'administration, Université de Sherbrooke, boul. Université, J1k2r1, Sherbrooke, Québec, Canada, Michel.Berthiaume@USherbrooke.Ca, *Claude Caron*, *Lin Gingras*

Wireless networks, ubiquitous computing and location technologies are fostering the development of information systems that are radically changing businesses. After describing these technologies, this paper illustrates their convergence and its main dimensions, presents impacts on businesses management and proposes research approaches and models to improve on their implementation in organizations.

2 - Workflow Analysis of an IT Organization

Kevin Ng, Department of National Defence, Operational Research Division, 101 Colonel By Drive, National Defence Headquarters, K1a 0k2, Ottawa, Ontario, kevin.ng@drdc-rddc.gc.ca, *Natalie Lam*

This paper studies the operational mode of an Information Technology organization during a time of crisis. A nonlinear optimization model is employed to examine the cost, time trade-off relationship. The effects of changes of input data are obtained via the sensitivity analysis. An example is included to illustrate the methodology.

3 - OR ans IS - Convergence or Conflict?

José Dias Coelho, Faculty of Economics, Tr. Estevão Pinto, Campolide, 1099-032 LISBOA Portugal, 1099, Lisbon, Portugal, jdcoelho@fe.unl.pt

The development of Operations Research and Information Systems has common roots and many links in the last fifty years, since the Second World War.

Having in mind the future prospects of both disciplines, it is relevant to analyse if they converge, follow distinctive paths or one absorbs the other.

4 - IT AND PRODUCTIVITY - Results from a Swedish research programme

Birger Rapp, Eis, Computer and Information Science, Linköping University, Se-58183, Linköping, Sweden, birger@rapp.se, *Åsa Horzella*, *Maria Kollberg*, *Thomas Falk*, *Mathias Coster*

The research program IT and Productivity studies the consequences of IT investments on three Swedish business systems, i.e. graphical production, grocery distribution and the forest industry. The paper will show results from conducted empirical studies based on our specific research approach and generate a general framework

5 - Industry vs. Firm Efects in Taiwan's IT Industry

Feng-Jyh Lin, Business Administration, Feng Chia University, 100, Wenhwa Rd. Seatwen, Taiwan, R.O.C., 40724, Taichung, Afghanistan, fjlin@fcu.edu.tw, *Shu-Ming Lin*, *Yi-Min Chen*

This study investigates the sources of a firm's performance in Taiwan's IT industry. The total variance of performance measure is partitioned into the firm factor, industry factor, and year factor. We use the VAR-COMP procedure to estimate the different variance components. ROA, EVA, and MVA are used as performance measures.

■ MC-06

Monday, 1:30-3:00pm
Iolani III

Internet Routing and Traffic Engineering

Cluster: Telecommunications and Network Design
Invited session

Chair: *Bernard Fortz*, Institut d'Administration et de Gestion, Université Catholique de Louvain, Place des Doyens 1, 1348, Louvain-la-Neuve, Belgium, bfortz@euro-online.org

Chair: *Janny Leung*, Systems Engineering & Engineering Management Dept., The Chinese University of Hong Kong, Shatin, NT, Hong Kong, janny@se.cuhk.edu.hk

1 - TOTEM: A TOolbox for Traffic Engineering Methods

Bernard Fortz, Institut d'Administration et de Gestion, Université Catholique de Louvain, Place des Doyens 1, 1348, Louvain-la-Neuve, Belgium, bfortz@euro-online.org, *Selin Cerav*, *Hakan Ümit*

We present a toolbox of algorithms for traffic engineering purposes. We unify existing algorithms and develop new techniques applicable in a single network or between distinct networks. Our toolbox will be available in open source and will be designed such that its elements can easily be integrated in various platforms.

2 - Traffic Engineering and Congestion Control for Open Shortest Path First Networks

Ue-Pyng Wen, Industrial Engineering and Engineering Management, National Tsing Hua University, 101 Kung Fu Road, Sec. 2, 300, Hsinchu, Taiwan, upwen@ie.nthu.edu.tw

Open Shortest Path First (OSPF) is the most widely used intra-domain Internet routing Protocol. This paper formulates the model of OSPF routing, and further evaluates the performance of different approaches. We propose two heuristic algorithms to solve the routing problems by optimizing OSPF weights and computational results will be presented.

3 - On Improving the Internet routing protocol EIGRP

James Yee, University of Hawaii, Honolulu, HI, United States, jyee@hawaii.edu

Cisco's routing protocol EIGRP has been implemented on millions of routers in the Internet. This protocol is reputed to be optimal. We discuss the routing problem addressed by EIGRP; construct a counterexample to show that EIGRP is not optimal; and discuss simple ways of improving the algorithm.

■ MC-07

Monday, 1:30-3:00pm
Iolani V

Financial Models and Stochasticity

Cluster: Management Information Systems
Invited session

Chair: *Vittorio Moriggia*, Mathematics, Statistics, Computer Science and Applications, University of Bergamo, via dei Caniana, 2, 24127, Bergamo, BG, Italy, vittorio.moriggia@unibg.it

Chair: *Kweku-Muata Osei-Bryson*, Information Systems, Virginia Commonwealth University, 1015 Floyd Avenue, 23284, Richmond, kweku.muata@isy.vcu.edu

1 - Risk Assessment for ERP Outsourcing using the Qualitative Discriminant Process

Kweku-Muata Osei-Bryson, Information Systems, Virginia Commonwealth University, 1015 Floyd Avenue, 23284, Richmond, kweku.muata@isy.vcu.edu

Outsourcing of ERP systems involves various risks, some of which if realized could result insignificant negative impacts on the organization. There is thus the need to identify significant risks, and to design effective resolution actions. This paper presents a risk management approach that is based on the Qualitative Discriminant Process.

2 - Pricing TIPS in the Euro-zone. An analysis from the issuer's and the investor's perspectives

Francesco Paris, Quantitative Methods, University Of Brescia, Contrada S.chiara, 50, 25122, Brescia, paris@eco.unibs.it, *Cristian Pelizzari, Maria Elena De Giuli*

We price TIPS indexed to the Euroland inflation and issued in Italy. We'll compare the stability of the TIPS' yield in real terms with respect to the nominal one. Furthermore,we'll assess the savings realized by the Treasury by issuing TIPS instead of bonds with a fixed nominal coupon rate.

3 - Simple Unified Pricing of Vanilla and Asian Options

Georgios Dalakouras, Quantitative Research, Susquehanna International Group, 401 City Line Ave, Suite 220, 19004, Bala Cynwyd, PA, United States, gbdalako@umich.edu

We propose a simple framework that simplifies the derivation, as well as the final form, of the Black-Scholes-Merton PDE for pricing vanilla and Asian options. We cover all Asian options and provide fast and efficient ways for pricing including high order Monte-Carlo, finite difference and moments methods, and semidefinite programming.

4 - Logical Analysis of Data for Default Prediction Models Validation

Vittorio Moriggia, Mathematics, Statistics, Computer Science and Applications, University of Bergamo, via dei Caniana, 2, 24127, Bergamo, BG, Italy, vittorio.moriggia@unibg.it

One of the main objectives of Basel-II, is a more detailed registration of risk types. Henceforth, there is the necessity to validate the internal rating systems of each banking institution. Based on Logical Analysis of Data, this study is focusing on the interactions between bond spreads, financial ratios and rating.

■ MC-08

Monday, 1:30-3:00pm
Iolani VI

Supply Chain Management II

Cluster: Supply Chain Management
Invited session

Chair: *Chaiho Kim*, OMIS Department, Santa Clara University, 500 El Camino Read, 95070, Santa Clara, CA, Afghanistan, ckim@scu.edu

1 - Supplier Response in Quality-Differentiated Markets

Narendra Agrawal, Omis, Santa Clara University, Santa Clara, CA, United States, nagrawal@scu.edu

This paper examines decisions made by a supplier facing multiple, quality-differentiated market segments. We restrict our attention to production systems where quality is stochastic and the supplier can improve quality by applying resources. Our research allows us to characterize and determine the optimal quality improvement strategy, and the corresponding profits.

2 - Inventory replenishment and allocation in retail chains with non-identical stores

Narendra Agrawal, Omis, Santa Clara University, Santa Clara, CA, United States, nagrawal@scu.edu, *Stephen Smith*

The stores within a retail chain often differ significantly in the mean-and-variance of their sales-rates for a given class of merchandise. We develop a two-stage Bayesian-model that uses learning in the first-stage to optimize the initial order size, allocation of merchandise to the stores, as well as subsequent replenishment decisions.

3 - Computer Models for Internet Supply Chain Collaborations

Chaiho Kim, OMIS Department, Santa Clara University, 500 El Camino Read, 95070, Santa Clara, CA, Afghanistan, ckim@scu.edu

This paper will compare the existing and proposed computer models for Internet supply chain collaborations. Models will include ERP, EDI, XML-EDI, various models based on XML, APS, Trading Hubs, and EAI. We will also examine semantic based models such as REA. Frameworks for comparing such models will also be discussed.

■ MC-09

Monday, 1:30-3:00pm
Iolani VII

Metaheuristics for Constraint Satisfaction Problems

Cluster: Metaheuristics
Invited session

Chair: *Philippe Codognet*, dept for Science and Technology, Embassy of France / University Paris 6, 4-11-44, Minami-Azabu, Minato-ku, 106-8514, Tokyo, Philippe.Codognet@lip6.fr
Chair: *Charlotte Truchet*, Computer Science, University of Nantes, 2 rue de la Houssiniere, 44322, Nantes Cedex 03, charlotte.truchet@univ-nantes.fr

1 - An efficient unit commitment schedule by combining of genetic algorithm and linear relaxation method

Ken-ichi Tokoro, System Engineering Research Laboratory, Central Research Institute of Electric Power Industry, 2-11-1 Iwado Kita,, 2018511, Komae-shi, tokoro@criepi.denken.or.jp, *Yasushi Masuda, Hisakazu Nishino*

We propose a genetic algorithm for solving the unit commitment problem formulated as a nonlinear mixed-integer programming problem. In the algorithm, a genome represents a partial integral solution of the problem, and values of free variables are determined based on a solution of a continuous relaxation problem.

2 - Polymerization Reactions Optimized By Particle Swarm Optimization

João Carlos Furtado, Departamento de Informática, Universidade de Santa Cruz do Sul, Av. Independência, 2293, 96815900, Santa Cruz do Sul, RS, Brazil, jcarlosf@dinf.unisc.br, *Geraldo Lopes Crossetti, Marco Flôres Ferrão, Jaime Fernando Neis, Rafael Ramos dos Santos*

This paper deals with the analysis of the Particle Swarm Optimization (PSO) method used in the polymerization yield optimization and prediction of structural properties in polymerization. We proposed a model, in which an expression was optimized. We showed PSO is an efficient optimization method when applied in polymerization yield maximization.

3 - Memetic Algorithms for the Resource-Constrained Project Scheduling Problem

Chiuh-Cheng Chyu, Department of Industrial Engineering and Management, Yuan-Ze University, 135 Yuan-Tung Rd., Chung-Li, Taoyuan Shihn, 320,Taiwan, 320, Chung-Li, Taoyuan Shihn, Taiwan, Taiwan, iehshsu@saturn.yzu.edu.tw, *Angela H. L. Chen*

The paper proposes two memetic algorithms (MAs), one with multi-local search (MLS) and the other with forward-backward improvement method (FBI), for solving the resource-constrained project scheduling problem (RCPSP). Our computational results show that the two MAs generate rather competitive results in the RCPSP instances of PSPLIB.

4 - A musical overconstrained CSP and its cost-functions' issues

Charlotte Truchet, Computer Science, University of Nantes, 2 rue de la Houssiniere, 44322, Nantes Cedex 03, charlotte.truchet@univ-nantes.fr

Most of the local search algorithms are based on min-conflict-like cost-functions. There might be some cases where this choice can be discussed, in terms of efficiency, or for instance when approximate solutions are needed (overconstrained CSP). We will give an example of such a CSP in computer assisted musical composition.

■ MC-10

Monday, 1:30-3:00pm
Tapa Ballroom I

OR in Natural Resources: Models, Algorithms and Applications

Cluster: Tutorials
Invited session

Chair: *Jeff Arthur*, Statistics, Oregon State University, 44 Kidder, 97331-4606, Corvallis, Oregon, United States, arthur@science.oregonstate.edu

1 - OR in Natural Resources: Models, Algorithms and Applications

Andrés Weintraub, University of Chile, Santiago, Chile, aweintra@dii.uchile.cl

OR has played an important role in various areas of natural resouces in planning and managing decisions, both in terms of methodological developments as well as applications of important impact. We discuss these developments in forestry, mining, agriculture and fishing. Important aspects include how to realistically model problems that are often complex, how to deal with fuzzy and incomplete information, and uncertainties in terms of market demands, supply of the resources, fires, and plagues. We also discuss algorithms developed to handle these problems as well as the use of new technologies in data handling and communications. Finally we discuss the impact of applications in the different areas, and future perspectives in research and applications.

■ MC-11

Monday, 1:30-3:00pm
Tapa Ballroom II

Advanced Topics in Combinatorial Optimization

Cluster: Combinatorial Optimization
Invited session

Chair: *Paolo Toth*, Deis, University of Bologna, Viale Risorgimento 2, 40136, Bologna, Italy, ptoth@deis.unibo.it

1 - The Use of Severely Limited Subsequence in Set Partitioning Optimisation

David Ryan, Engineering Science, The University of Auckland, Auckland, New Zealand, d.ryan@auckland.ac.nz, *James Priestley*

Set Partitioning Problems possessing a 'limited subsequence' property are known to be easier to solve. We consider the use of severely limited subsequence formulations where it is possible to identify or generate additional subsequences which have the potention to improve solution quality.

2 - A Metaheuristic Approach for the Vertex Coloring Problem.

Enrico Malaguti, Deis, University of Bologna, Viale Risorgimento, 2, 40136, Bologna, Italy, emalaguti@deis.unibo.it, *Michele Monaci, Paolo Toth*

We propose a metaheuristic approach for the Vertex Coloring Problem, integrating an Evolutionary Algorithm with a post-optimization phase based on the Set Covering formulation of the problem. Extensive computational experiments on DIMACS instances show that the algorithm is able to produce high quality solutions in a reasonable amount of time.

3 - Preprocessing of Unconstrained Quadratic Binary Optimization

Peter L. Hammer, Rutcor, Rutgers, The State University of New Jersey, 640 Bartholomew Road, 08854, Piscataway, NJ, United States, hammer@rutcor.rutgers.edu, *Gabriel Tavares, Endre Boros*

Efficient roof duality-based methods (implemented by repeatedly finding maximum network flows) are proposed for the sequential identification of "strong" and "weak" reducibilities of quadratic unconstrained binary optimization problems, and are shown to allow substantial simplifications. Significant size reductions, or even complete solutions, are reported for numerous large benchmark problems.

■ MC-12

Monday, 1:30-3:00pm
Tapa Ballroom III

Application of OR/AI to Railway Scheduling Problems

Cluster: Transportation
Invited session

Chair: *Antonio Lova*, Departamento de Estadística e Investigación Operativa, Universidad Politécnica de Valencia, Spain, allova@eio.upv.es

1 - Periodic Single Track Railway Scheduling: A Sequential Approach

Pilar Tormos, Statistics And Operations Research, Universidad Politecnica De Valencia, Camino De Vera S/n, Valencia, 46022, Valencia, SPAIN, ptormos@eio.upv.es, *Antonio Lova, Federico Barber, Laura Ingolotti, Montse Abril, Miguel A. Salido*

The Single track railway scheduling problem can be modeled using mixed integer programming. However the resulting model can not be solved to optimality in a reasonable computational time. We present alternative efficient techniques to reduce the computational effort of the resulting model. These techniques are applied and evaluated on real-cases.

2 - An Efficient Heuristic Technique To Schedule New Trains On A High Loaded Network

Antonio Lova, Departamento de Estadística e Investigación Operativa, Universidad Politécnica de Valencia, Spain, allova@eio.upv.es, *Pilar Tormos, Federico Barber, Laura Ingolotti, Montse Abril, Miguel A. Salido*

Usually, railway scheduling problems require the allocation of time slots to new trains to be scheduled on an already high loaded network. The problem can be modeled using mixed integer programming. In this paper, an efficient heuristic is presented, which is able to obtain near optimal solutions in realistic sized networks.

3 - MOM: A Decision Support System for Railway Scheduling

Federico Barber, Sistemas Informaticos Y Computacion, Universidad Politecnica De Valencia, Camino De Vera S/n, Valencia, 46022, Valencia, SPAIN, Spain, fbarber@dsic.upv.es, *Montse Abril, Laura Ingolotti, Antonio Lova, Miguel A. Salido, Pilar Tormos*

We present a computer-based system to help railway managers in an efficient and reactive management of railway infrastructures. The system can generate optimized railway schedules, both off-line and on-line when disruptions occur. It also provides information on the railway network capacity and on the timetable robustness, allowing make better decisions.

4 - Real-scale Traffic Assignment Model for Commuters in the Public Railway Network in Tokyo

Azuma Taguchi, Information and System Engineering, CHUO University, 1-13-27 Kasuga, Bunkyo-ku, 112-8551, Tokyo, taguchi@ise.chuo-u.ac.jp

We propose a real-time forecasting system of commuters' trip in the public railway network in Tokyo. It treats time dependent traffic demand, employing a time-space network which expresses the timetable of trains. It assigns each passenger to his route by solving equilibrium flow assignment problem. We considered several applications.

■ MC-13

Monday, 1:30-3:00pm
Sea Pearl I

Data Mining and Quality Management

Cluster: Quality, Statistics and Reliability
Invited session

Chair: *Wei Jiang*, Stevens Tech, Nj, United States, wjiang@stevens.edu

1 - Using Neural Network Rule Extraction for Credit-Risk Evaluation

Pedro Steiner neto, Business, Federal University at Paraná, R. Pe. Anchieta, 1231, 80730-000, Curitiba, Pr., Brazil, pedrosteiner@ufpr.br, *Maria Teresinha Arns Steiner, Nei Yoshihiro Soma, Tamio Shimizu, Julio Cesar Nievola, Fabio Mendonca Lopes, Andreia Smiderle*

Credit-Risk evaluation is a very important problem in the financial analysis field. Neural Networks have a high predictive accuracy rate, but it is not easy to understand how they reach a decision. In this paper, we present a actual credit-risk data set and analyzed it through the neurorule extraction technique.

2 - Application of Neural Networks in the Analysis of Business Losses Due to Unexpected Market Disturbances

Zita Boshnjak, Business Information Systems, Faculty of Economics, Put Mose Pijade 9-12, 24000, Subotica, Serbia and Montenegro, bzita@eccf.su.ac.yu

In this paper we described one possible application of data mining by neural networks for the analysis of how seriously the business has been affected by an unexpected market disturbance. Furthermore, we presented the results we've achieved applying one trained neural network for such a problem.

3 - A Test Of Financial Performance Resiliency Of Quality Against Non-quality Firms

Terri Friel, College of Business, Butler University, 4600 Sunset Ave, 46260, Indianapolis, IN, tfriel@butler.edu

Financial performance data during the major stockmarket downturn of 2001 were collected for MBNQA winners and Six Sigma companies and matched randomly with non-quality companies in similar industries. Discriminant analysis was used to test quality versus non-quality companies. Predictions were correctly made 70% of the time.

■ MC-14

Monday, 1:30-3:00pm
Sea Pearl II

Education, Innovation and Distance Learning

Cluster: Education, Innovation and Distance Learning
Contributed session

Chair: *Alvaro Hernandez*, Management Science and Engineering Department, Polytechnic School - University of Sao Paulo, Av. Prof. Almeida Prado, trav.2, n.128, Cidade Universitária, 05508-900, São Paulo, SP, Brazil, alvaro.hernandez@poli.usp.br

1 - Factors affecting the satisfaction of business students

Snjolfur Olafsson, Faculty of Economics and Business Administration, University of Iceland, Oddi, Is-101, Reykjavik, Iceland, snjolfur@hi.is, *Thorhallur Gudlaugsson*

In this paper we give an overview of factors that are believed to have much effects on business students satisfaction and discuss these relationships. The results are among other things based on studies of questioners used, research among students and published research in this field.

2 - Assigning DJs to Gigs

Zbigniew Przasnyski, College of Business Administration, Loyola Marymount University, One LMU Drive, 90045, Los Angeles, CA, zprzasny@lmu.edu

The paper describes a teaching case, based on a real-life problem, to schedule DJs to gigs in order to match the talents of each DJ with the unique requirements of each gig based on a preference ranking. The design of the model, results and teaching experience are discussed.

3 - Universities as entrepreneurship developers : The measurement of the perception of undergraduate students in Business Administration and Accounting programs

Pedro Steiner neto, Business, Federal University at Paraná, R. Pe. Anchieta, 1231, 80730-000, Curitiba, Pr., Brazil, pedrosteiner@ufpr.br, *Alexandre Junior*, *Roberto Cunha*, *Maria Teresinha Arns Steiner*

The role of universities as promoters of entrepreneurial development in individuals remains relevant for the society increasing need for entrepreneurship. The factor analysis results suggest that the students differ in their perceptions related to the teaching-learning process and characteristics of the entrepreneur profile developed at undergraduate programs.

4 - Transfer and Assesment of Corporate Knoweldge using Internet Technologies

Sasa Boshnjak, Business Information Systems, Faculty of Economics, Segedinski put 9 -12, 24000, Subotica, Serbia and Montenegro, bsale@eccf.su.ac.yu, *Zita Bosnjak*, *Viktor Pocajt*

Knowledge management are essential for maintaining permanent competitive advantages of business systems. In this article the methodology, methods and techniques used in the design and implementation of the COMPETTEST software system are described. COMPETTEST was developed as an Coorparate Assesment Knoweledge Tool and also as an Internet Distance Learnig solution.

5 - Teaching Queuing Theory with Spreadsheet Modeling and Simulation

Alvaro Hernandez, Management Science and Engineering Department, Polytechnic School - University of Sao Paulo, Av. Prof. Almeida Prado, trav.2, n.128, Cidade Universitária, 05508-900, São Paulo, SP, Brazil, alvaro.hernandez@poli.usp.br, *Marco Aurélio de Mesquita*

This paper describes the use of spreadsheet software as facilitating agent in teaching queuing theory. An M/G/1 is simulated through Excel/VBA and subsequently through dedicated simulation software. Despite the prompt results provided by the simulation software the former approach enable a deeper understanding of the underlying concepts.

■ MC-15

Monday, 1:30-3:00pm
Sea Pearl III

Column Generation Approaches for Transportation Problems

Cluster: Routing
Invited session

Chair: *Frédéric Semet*, Lamih, University of Valenciennes, Le Mont Houy, Istv 2, 59313, Valenciennes, Cedex 9, France, frederic.semet@univ-valenciennes.fr

1 - A column generation method for the consolidation transportation network design problem

Kei Komatsu, Department of Logistics and Information Engineering, Tokyo University of Marine Science and Technology, 2-1-6 Etsuujima Koto-ku, 135-8533, Tokyo, Japan, kkomatsu@e.kaiyodai.ac.jp, *Mikio Kubo*

We present a column generation approach for the consolidation transportation network design problem. The problem consists of designing a least expensive plan for shipping the multi-commodity from origins to destinations by using different types of vehicles. This model is extracted from a real world Japanese automobile maker.

2 - A Capacity Scaling Procedure for the Multi-Commodity Capacitated Network Design Problem

Mingzhe Chen, Graduate School of Marine Science and Technology, Course of Applied Marine Environmental Studies, Tokyo University of Marine Science and Technology, 2-1-6 Etchujima, 135-8533, Koto-Ku, Tokyo, Japan, cmzlj7126@hotmail.com, *Naoto Katayama*, *Mikio Kubo*

We present a capacity scaling procedure for the multi-commodity capacitated network design problem. This procedure consists in solving a linear approximation with adjusted arc capacities. At each iteration, new paths are added using a column generation approach. Numerical experiments show that our approach gives better solutions than the original method.

3 - Column Generation combined with Constraint Programming to solve a Technician Dispatch Problem

Cristián Cortés, Civil Engineering Department, Universidad de Chile, Blanco Encalada 2002, 5th floor, Santiago, Chile, ccortes@ing.uchile.cl, *Andrés Weintraub*, *Sebastián Souyris*

The scheduling problem for Xerox technicians, we deal with, is how to schedule the itineraries given travel and repair times and promised time windows. The problem is approached via Dantzig-Wolfe decomposition and Constraint Programming. Good Computational results on

real problems are compared with optimal bound obtained with Branch and Price.

■ **MC-16**

Monday, 1:30-3:00pm
Sea Pearl IV

Dynamic Programming

Cluster: Dynamic Programming
Invited session

Chair: *Alexei Piunovskiy*, Mathematical Sciences, The University of Liverpool, M & O Building, Peach street, L69 7zl, Liverpool, Merseyside, United Kingdom, piunov@liv.ac.uk

1 - A New Approach for Exploring Exhaustively the Pareto Set of Multi Criteria Markov Decision Processes with Finite State and Action Sets

Francesco di Pierro, Centre for Water Systems, University of Exeter, School of Mathematics, Engineering and Computer Science, Exeter EX4 4QF, Exeter, Devon, United Kingdom, F.Di-Pierro@ex.ac.uk, *Gianluca Dorini*

This paper introduces a new technique to explore the entire set of Pareto Optimal Policies of Multi Criteria Markov Decision Processes (MCMDPs). It combines the knowledge of the structural properties of the Pareto set of MCMDPs with concepts and tools drawn from Computational Geometry to effectively exploit it.

2 - Dynamic Programming in cricket

Stephen Clarke, Life and Social Sciences, Swinburne University of Technology, PO Box 218, 3122, Hawthorn, Vic, Australia, sclarke@swin.edu.au, *John Norman*

Cricket is a rich source of DP problems, but model realism gives rise to the curse of dimensionality. We discuss several examples of optimizing strategy: intended run rate; refusing available runs to protect the weaker batsman; using a night watchman; and altering batting order to counter a sticky wicket.

3 - Optimal strategies for betting on HI-LO

James Freeman, Manchester Business School, University Of Manchester, Booth Street West, M15 6pb, Manchester, jim.freeman@mbs.ac.uk

An economic assessment of the popular HI-LO gaming routine was recently achieved using decision analysis. A disadvantage now recognised with this approach is that the calculations relating to whether or not players should quit or continue playing HI-LO in any given round make no allowance for possible gains from future play. To overcome this drawback, the game has been reformulated using stochastic dynamic programming. Key details are presented for the new methodology (based on backward recursion) along with corresponding results for an existing test problem.

4 - Dynamic Programming in Constrained Markov Decision Processes

Alexei Piunovskiy, Mathematical Sciences, The University of Liverpool, M & O Building, Peach street, L69 7zl, Liverpool, Merseyside, United Kingdom, piunov@liv.ac.uk

We consider a discounted MDP supplemented with the requirement that another discounted loss must not exceed a specified value, almost surely. We show that the problem can be reformulated as a standard MDP and solved using the Dynamic Programming approach. A meaningful example on a controlled queue is solved.

■ **MC-17**

Monday, 1:30-3:00pm
Sea Pearl V

Interactive Methods and Web Tools II

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *Kaisa Miettinen*, Helsinki School of Economics, P.O. Box 1210, Fi-00101, Helsinki, Finland, miettine@hkkk.fi

1 - Interactive Techniques for Environmental Policies: A Case in the Andalusian Energy Sector.

Francisco Ruiz, Applied Economics (Mathematics), University of Málaga, Campus El Ejido s/n, School of Economics and Management, 29071, Málaga, Málaga, Spain, rua@uma.es, *Jose Manuel Cabello*, *Mariano Luque*, *Francisca Miguel*, *María del Mar Muñoz*, *Lourdes Rey*

The environmental issue is becoming a growing concern for policy decision-makers and the concept of sustainability has changed the way they face environmental problems. Rather than the internalization of environmental costs, the Ecological Economics approach suggests the simultaneous consideration of different criteria, which makes MCDM a powerful tool. In this paper, the electrical energy supply for the city of Seville is considered. Interactive techniques are used to determine the energy mix that best fits the economic, social and environmental criteria (ecological indicators) proposed by the Regional Ministry of Environment. The package PROMOIN has been used to solve the resulting problems.

2 - Mesta - Internet decision-support application for evaluation of alternative forest plans

Mikko Kurttila, Joensuu Research Centre, Finnish Forest Research Institute, P.o. Box 68, 80101, Joensuu, Finland, mikko.kurttila@metla.fi, *Jyrki Kangas*, *Pekka Leskinen*, *Karri Pasanen*, *Jouni Pykäläinen*

Mesta application includes objective enquiry from forest owner, creation of alternative forest plans and their comparisons. Comparison technique is based on multi-criteria acceptability voting, where acceptance thresholds are defined for criteria. Mesta is used independently by forest owners, who want to examine the production possibilities of their forest holding.

3 - Possibilities of Efficiency Increase in Interactive Multiobjective Chemical Process Design by Using Infeasible Methods

Jussi Hakanen, Mathematical Information Technology, University of Jyvaskyla, P.O. Box 35 (Agora), Fi-40014, University of Jyvaskyla, Finland, jhaka@mit.jyu.fi, *Kaisa Miettinen*

We study possibilities of improving efficiency of optimization in multiobjective chemical process design with NIMBUS by using infeasible methods. With infeasible methods we do not need to compute a steady-state for the process every time we want to evaluate the objective functions.

■ MC-18

Monday, 1:30-3:00pm
Sea Pearl VI

Flexible Manufacturing in the Auto Industry

Cluster: Flexible Manufacturing
Invited session

Chair: *Kathryn E. Stecke*, University of Texas at Dallas, United States, KStecke@utdallas.edu

1 - Closed-loop Supply Chains in the Automotive Industry

Frank Schultmann, Construction Management and Economics, University of Siegen, Paul-Bonatz-Strasse 9-11, 57076, Siegen, Germany, frank.schultmann@uni-siegen.de

The planning of a Closed-Loop Supply Chain in the Automotive Industry is presented. Different design options for a CLSC are put up. Reverse logistics aspects are modeled with vehicle routing planning. A problem-tailored algorithm is introduced and results of several CLSC scenarios are discussed.

2 - Evaluation Models for Assembly Line Problems

John Driscoll, School of Engineering, University of Surrey, School of Engineering, University of Surrey, Gu27xh, Guildford, Surrey, J.Driscoll@surrey.ac.uk

This paper reviews quantitative definitions of task difficulty within ill-structured assembly line balancing problems, identifying precedence strength, work element domination and work/cycle time relationships. This is matched to solution quality models, proposing variations of line and balance efficiency. The relationship possibilities between the two are examined for heuristic balancing methods.

3 - Production planning model that takes into consideration of the production adjustment in terms of accounting

Kosei Sugitani, Information and Physical Sciences, Osaka University, Yamadaoka1-5,Suita City,Osaka prefecture, 565-0871, Suita, Osaka, Japan, k-sugitani@ist.osaka-u.ac.jp, *Hiroshi Morita*, *Hiroaki Ishii*

Recently, as customers' needs are diversifying, it is required the efficient production planning that responds the demand change quickly in the productin field. We propose a new production planning model that takes into consideration of the production adjustment in terms of accounting such as ROA.

4 - Workstation Layouts for Mixed-model assembly lines

Erica Klampfl, Supply Chain Management, Ford Research & Advanced Engineering, SRL Bldg, MD #2122, 2101 Village Rd., Dearborn, MI, 48124, Dearborn, Michigan, United States, eklampfl@ford.com, *Giuseppe Rossi*, *Oleg Gusikhin*

The key to having a flexible automotive assembly plant is not only in the design, but also how quickly the workstation layouts can be rearranged and optimized. We describe a tool that supports efficient workstation layouts for mixed-model assembly lines and provide case studies that evaluate workstation flexibility.

■ MC-19

Monday, 1:30-3:00pm
Nautilus I

AHP02: Methodology I

Cluster: Analytic Hierarchy / Network Process
Invited session

Chair: *Jason Levy*, University of Hawaii, Honolulu, United States, jlevy@hawaii.edu

1 - AHP/ANP Measurement – Is it Dimensionless?

William Wedley, Faculty of Business Administration, Simon Fraser University, 8888 University Drive, V5a 1s6, Burnaby, British Columbia, Canada, wedley@sfu.ca

ANP/AHP is method of measurement. Paired comparisons are made of items belonging to an underlying scale possessing some unit. The ratio of the items cancels the unit leaving an absolute number with no dimension. We explore the incongruous conclusion that ANP/AHP is dimensionless measurement. The measurement unit is obscure.

2 - Criteria weights in SWOT analysis with the AHP

Diederik J.D. Wijnmalen, Systems & Support for Decisions & Operations, TNO Organisation for Applied Scientific Research, P.O. Box 96864, 2509 Jg, The Hague, Netherlands, wijnmalen@fel.tno.nl

This presentation addresses the way in which weights of individual SWOT factors and the four SWOT groups may be established and normalized, based on different perspectives, and perhaps should be adjusted once alternative actions or strategies have been defined that are to be evaluated on (a sub-set of) those factors.

3 - Application and Agreement of AHP and Logit model

Ozaki Toshimasa, Faculty of Commerce, Nagoya Gakuin University, 1350 Kamishinano-cho, 480-1298, Seto, ozaki@ngu.ac.jp

Based on the utility theory, Logit model led approximately to the agreement of AHP by numerically. Moreover, the corrected AHP was proposed and figured out that the amount of money is able to be displayed. So the corrected AHP could be useful in decision making.

4 - Dynamic Analytic Network Process: Improving Decision Support Information and Computer Technology

Tomas Feglar, Tomas FEGLAR, Vondrousova 1199, Prague, Czech Republic, feglar@centrum.cz, *Jason Levy*

The Dynamic Analytic Network Process is a relatively new approach and will be applied to problems in the ICT field. The overall result will be an improved framework and decision environment to improve large-scale (enterprise) level businesses. Our attention is focused on the classification of various ICT based innovations.

■ MC-20

Monday, 1:30-3:00pm
Nautilus II

Recent Developments In Decision Analysis

Cluster: Decision Analysis
Invited session

Chair: *John Butler*, Ohio State University, 2100 Neil Ave, 43215, Columbus, Ohio, United States, butler.267@osu.edu

1 - A Model of Subjective Probability Judgment

Robert Clemen, Fuqua School of Business, Duke University, Fuqua School of Business, Duke University, Box 90120, 27708-0120, Durham, NC, United States, clemen@mail.duke.edu, *Canan Ulu*

We present a Support-Theory-based model of probability judgment that incorporates empirical properties of subjective probabilities, such as binary complementarity, subadditivity, and partition dependence. Empirical evidence supports a special form of the model and suggests a simple method for adjusting subjective probabilities to remove the partition-dependence bias.

2 - Fundamental Objectives and Proxy Attributes in Preference Models

John Butler, Ohio State University, 2100 Neil Ave, 43215, Columbus, Ohio, United States, butler.267@osu.edu, *Jim Dyer*, *Jian-Min Jia*

Many applications of multiattribute preference theory require the decision maker to directly weight the attributes of the alternatives being evaluated. We compare the use of a multistage multiattribute preference model to estimate the weights on attributes with a simple direct weighting approach using simulation.

3 - Syndicates, Opinion Pools, and State-Dependent Utility

Robert Nau, Duke University, Fuqua School of Business, 27708-0120, Durham, NC, United States, robert.nau@duke.edu

This paper analyzes two related problems from the perspective of state-dependent expected utility: (i) pooling of opinions in a betting market, and (ii) project-selection and risk-sharing by a syndicate or group of individuals. Generalized logarithmic and linear opinion pools are derived in the special case of state-dependent HARA utility.

4 - Decision and Risk Analysis for Pharmaceuticals: Integrating Approval and Market Uncertainties

Sam Bodily, Darden School, 100 Darden Blvd., 22903, Charlottesville, Virginia, United States, bodilys@virginia.edu

Pharmaceutical companies value options using FDA approval probabilities at development stages of new molecular compounds. And, before launch, they may consider marketing, pricing, profit, and competitive uncertainties. Here we integrate approval and changing market uncertainties in a spreadsheet model to better evaluate options throughout the development process.

■ MC-21

Monday, 1:30-3:00pm

Lehua Suite

OR for Development Prize Competition I

Cluster: OR for Development Prize Finalist Sessions

Invited session

Chair: *L. Paul Fatti*, Statistics & Actuarial Science, University of the Witwatersrand, P.O. Wits, 2050, Johannesburg, South Africa, fatti@stats.wits.ac.za

1 - Introduction to the OR in Development Prize Competition

L. Paul Fatti, Statistics & Actuarial Science, University of the Witwatersrand, P.O. Wits, 2050, Johannesburg, South Africa, fatti@stats.wits.ac.za

A brief introduction to the prize and its history will be given, and the method by which this year's shortlisted papers were selected will be described.

2 - Intelligent Decision Support for R&D Project Selection in Public Organizations

Eduardo Fernandez, School of Computer Science, Autonomous University of Sinaloa, Republica de Brasil 2084 Poniente, Colonia Infonavit Humaya, 80010, Culiacan, Sinaloa, Mexico, eddyf@uas.uasnet.mx, *Jorge Navarro*, *Fernando Lopez*, *Rafael Olmedo*

This proposal is able to model preferences and beliefs from upper management and to reflect it during the project evaluation and selection process by using "intelligent" tools. A quantitative model of R&D portfolio's quality is optimized by an evolutionary algorithm for finding good solutions in problems of real size.

3 - Cultural Heritage Management - A Goal Programming Application To Wadilmeluk

Dania El-Iraqi, 65B M.F. Al-Saltisy st., Sector 7, Nasr City, in front of the "International Park", P.C. 11471, 11471, Cairo, Egypt, danna@aucegypt.edu, *Mohamed Osman*, *Hegazy Zaher Sabry*

The Valley of Kings faces serious cultural heritage management problems. Using goal-programming, the study tries to alleviate some of them. Two different scenarios are presented, suggesting how to best operate tombs to satisfy all stakeholders' objectives. Finally, parametric analysis is conducted to investigate possible changes employed by Egyptian decision makers.

4 - Integrated Bus Transit Scheduling for Beijing Bus Group Based On Regionalized Operation Mode

Yindong Shen, Computer Science, Wuhan University of Science & Engineering, 1 FangZhi Road, LuXiang, Hongshan District, 430073, Wuhan, Hubei, China, yindong2001@yahoo.co.uk, *Jiahong Xia*

This paper presents a pioneer application study of scheduling buses and crew using computers based on regionalized operation mode in China. Adapting existing scheduling methods and tailoring 2-opt heuristics and Tabu Search, an integrated bus transit scheduling system has been developed and successfully applied.

■ MC-22

Monday, 1:30-3:00pm

Kahili I

DEA01: Theoretical Issues on DEA I

Cluster: Data Envelopment Analysis and Performance Management

Invited session

Chair: *Victor Podinovski*, Warwick Business School, University of Warwick, Gibbet Hill Road, Cv4 7al, Coventry, United Kingdom, v.podinovski@warwick.ac.uk

1 - Spherical Frontier Dea Model Based On A Constant Sum Of Inputs

Jose Virgilio Guedes de Avellar, Organizacao, Instituto Tecnologico de Aeronautica, Pca mal Eduardo Gomes, 50, 12228-800, Sao Jose dos Campos, SP, Brazil, avellar@ita.br, *Armando Zeferino Milioni*, *Tania Nunes Rabello*

We present a DEA model in which fixed inputs are to be assigned to some DMUs, assuming the existence of a geometric place represented by a sphere that characterizes the DEA frontier. Under this assumption, it becomes relatively easy to find a way to distribute fixed inputs to all DMUs.

2 - Hyperbolic DEA: A Proportional Orientation Model

Thomas Sexton, College of Business, Stony Brook University, 317 Harriman Hall, 11794-3775, Stony Brook, New York, United States, Thomas.Sexton@StonyBrook.edu

We present a DEA model orientation that lies between the standard input and output orientations. The hyperbolic DEA model is appropriate when we seek to increase output levels and decrease input levels in a balanced fashion. We apply the hyperbolic DEA model to data on 70 U.S. blood centers.

3 - Global characterisation of returns to scale in nonconvex production technologies

Victor Podinovski, Warwick Business School, University of Warwick, Gibbet Hill Road, Cv4 7al, Coventry, United Kingdom, v.podinovski@warwick.ac.uk

Global returns to scale is a new concept suitable for efficiency analysis with an arbitrary underlying production technology, including the free disposal hull and other nonconvex technologies used in DEA. Its four types are indicative of the location of the most productive scale size of the unit under the assessment.

4 - Inefficiency evaluation based on an additive DEA model under imprecise data

Reza Kazemi Matin, Department of Mathematics, Azad University of Karaj,P.O.Box 31485-313, Karaj, Tehran, Iran., Tehran, Iran, Islamic Republic Of, rkmatin@kiau.ac.ir, *Abdollah Hadi Vencheh*

In IDEA, the corresponding DEA models become nonlinear, the number of decision variables increase dramatically and usually, the favorable results of models are take in several occasions. This paper introduces an approach based on an additive model in this inefficiency evaluation with the normal size of constraints and variables.

■ MC-23

Monday, 1:30-3:00pm

Kahili II

Radiation Treatment Planning Optimization

Cluster: Health Care

Invited session

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

1 - Errors in inverse treatment planning for radiation therapy

Robert Jeraj, Department of Medical Physics, University of Wisconsin - Madison, 1530 Medical Sciences Center, 1300 University Ave, 53706, Madison, WI, rjeraj@wisc.edu, *Paul Keall*, *Chuan Wu*

Optimisation problem in radiotherapy is prone to several errors, which cause that the optimal solution differs from the global solution. Different errors like dose calculation errors, optimiser convergence error and local minima errors will be described. Properties, magnitudes and clinical importance of the errors will be discussed on a clinical example.

2 - A Shared Cyberinfrastructure for Radiation Treatment Planning

Robert R. Meyer, Computer Sciences, University of Wisconsin-Madison, 1210 W. Dayton St., 53706-1685, Madison, WI, United States, rrm@cs.wisc.edu, *Leyuan Shi*, *Warren D'Souza*

Approximately one million new cases of cancer are reported each year in the United States, with many times that number occurring worldwide. About 40% of the people diagnosed with cancer in the U.S will undergo treatment with radiation therapy. The focus of our research is the development of combinatorial optimization approaches for the large-scale problems that arise in the optimization of radiation teletherapy and the development of a corresponding cyberinfrastructure that will enhance the worldwide coordination of researchers and clinicians concerned with radiation treatment planning.

■ MC-24

Monday, 1:30-3:00pm

Hibiscus I

Economics I

Cluster: Economics

Contributed session

Chair: *Roman Husek*, Econometrics, University of Economics, Winstona Churchilla 4, 130 67, Prague, HUSEK@VSE.CZ

1 - Optimal Investment Based on Q-Theory, Case of Czech Republic

Vaclava Pankova, Econometrics, University of Economics, Prague, W.Churchilla 4, 130 67 Praha 3, Prague, Czech Republic, PANKOVA@VSE.CZ

According to Tobin's Q-theory, value of Q as a ratio of market value of business capital assets to their replacement value, implies relevant optimal investment strategy to maximize expected profits. Measurement of Q presents problems in empirical implementation. Application performed under GACR 402/04/0756 to machinery panel data of Czech Republic.

2 - Modeling Growth Rates of Serbian Economy in Transition

Tibor Kis, Quantitative methods in economy, Faculty of Economics, Segedinski put 9-11, 24000, Subotica, Serbia, Serbia and Montenegro, tbkis@yahoo.com, *Marija Cileg*

There is interdependence between growth rates of an economy in successive periods; quality of growth influences the future development conditions. This paper deals with modeling short run and long run growth rates of Serbian economy in transition, with special attention to earlier structural brakes and contemporary economic problems.

3 - Sacrifice-Ratio Model of the Czech Economic Transformation

Roman Husek, Econometrics, University of Economics, Winstona Churchilla 4, 130 67, Prague, HUSEK@VSE.CZ, *Vaclava Pankova*

Minimizing of sacrifice ratio (SR) related to disinflation policy in Czech Republic is eligible subject to support of economic growth with the goal to converge to European standard. Under project GACR402/03/1299, using VAR model of inflation and output and Blanchard - Quah decomposition, SR of Czech economy is estimated.

■ MC-25

Monday, 1:30-3:00pm

Hibiscus II

Analytical Outreach to the Department of Defense

Cluster: Military Applications

Invited session

Chair: *Darrall Henderson*, Math, United States Military Academy, 626 Swift Road, MADN-Math, 10996, West Point, NY, darrall@stanfordalumni.org

1 - Economic Analysis in Support of Operation Iraqi Freedom

Darrall Henderson, Math, United States Military Academy, 626 Swift Road, MADN-Math, 10996, West Point, NY, darrall@stanfordalumni.org, *Neal Rappaport*

The process of economic reconstruction and development in Iraqi requires using analytical tools to understand the baseline conditions and to forecast the effects of proposed and alternative strategies. This must be done in an environment where security conditions are fluid and the rule of law is a work in progress.

2 - Support to Operation Iraqi Freedom - Analysis Supporting the Operational Art

Stephanie Tutton, Center for Army Analysis, US Army, 6001 Goethals Road, 22060, Fort Belvoir, VA, United States, stephanie.tutton@us.army.mil, *John Bott*

Military operations research analysts assist decision makers at all levels. The pace of operational planning and combat operations requires the analyst to quickly collect, interpret and assimilate data and information to aid combatant commanders. This briefing provides lessons learned from experience gained in support of Operation Iraqi Freedom.

3 - West Point Reaches out to the Army and Department of Defense

Darrall Henderson, Math, United States Military Academy, 626 Swift Road, MADN-Math, 10996, West Point, NY, darrall@stanfordalumni.org, *Edgar Rugenstein*

The Department of Mathematical Sciences, USMA has established research partnerships with several Department of Defense agencies, providing opportunities for faculty and students. Research topics range from the post-doctoral level at the Army Research Laboratory to undergraduate projects. This presentation will provide an overview of the program and highlight existing projects.

Monday, 3:30-5:00pm

■ MD-01

Monday, 3:30-5:00pm
Honolulu I

Operations Research in Agriculture II

Cluster: Renewable and Natural Resources

Invited session

Chair: *Andrew Higgins*, Level 3, QBP, CSIRO Sustainable
Ecosystems, 306 Carmody Road, St. Lucia, 4067, Brisbane, QLD,
Australia, andrew.higgins@csiro.au

1 - A dynamic agroecosystem model to predict green-house gas emission profiles under alternative mitigation strategies

Nathaniel Newlands, Environment, Agriculture and Agri-Food
Canada, Lethbridge Research Centre, 5403 - 1st. Avenue
South, P.O. Box 3000, T1j 4b1, Lethbridge, Alberta, Canada,
newlandsn@agr.gc.ca, *Henry Janzen*

Farms are complex systems, intensively managed, but not well-
understood. Finding ways to reduce harmful emissions of greenhouse
gases relies on an integrated understanding of coupled environmental
processes and farm operations. We present a systems approach to mod-
eling and optimizing control of net greenhouse gas farm emissions.

2 - A OR model for a Decision Support System for Ma-chinery Farm Planning

Beatriz Recio, Matematica Aplicada a la Ingeniería
Agronómica, ETSI Agronomos. UPM, Avd. de la
Complutense, 28007, Madrid, brecio@mat.etsia.upm.es,
Fernando Rubio, *Mariano Suarez de Cepeda*

A mixed 0-1 model for a real farm management, enables crop produc-
tion planning to be decided at the begining of the agricultural year. It
will be a medium term planning model more than a scheduling model.
It is the core of AgriSupport a DSS for farm management.

3 - Scheduling of road transport for sugarcane

Andrew Higgins, Level 3, QBP, CSIRO Sustainable
Ecosystems, 306 Carmody Road, St. Lucia, 4067, Brisbane,
QLD, Australia, andrew.higgins@csiro.au

Scheduling of road transport within a sugarcane system can be im-
proved through formulating and solving a mixed-integer linear pro-
gramming problem. Implementation was achieved at an Australian
sugar region which led to improved operational efficiencies as well
as better strategic decisions when applied within a wider value chain
analysis.

■ MD-02

Monday, 3:30-5:00pm
Honolulu II

The 7th EURO Working Group on Automated Timetabling Workshop: Rostering and Timetabling

Cluster: Scheduling and Timetabling

Invited session

Chair: *Dario Landa Silva*, Computer Science, University of
Nottigham, Jubilee Campus, Wollaton Road, Ng9 1hx,
Nottingham, jds@cs.nott.ac.uk

Chair: *Patrick De Causmaecker*, Industrieel Ingenieur, KaHo
St.-Lieven, IT-Group, Gebr.Desmetstraat 1, 9000, Gent, Flanders,
Patrick.DeCausmaecker@kahosl.be

1 - Adaptive Driver and Bus Scheduling

Vitali Gintner, Int. Graduate School of Dynamic Intelligent
Systems and Decision Support & OR Lab, University of
Paderborn, Warburger Str. 100, 33100, Paderborn, Germany,
vitali@upb.de, *Natalia Kliewer*, *Ingmar Steinzen*, *Leena Suhl*

Traditionally, driver and bus scheduling are solved sequentially. Conse-
quently, the generation of feasible duties is restricted by vehicle blocks
which results in infeasible or suboptimal driver schedules. The pro-
posed adaptive approach allows to recombine the given vehicle blocks
during driver scheduling resulting in still optimal vehicle schedules and
improved driver schedules.

2 - New Evolutionary Algorithm for Examination Timetabling Problem

Zahra Naji Azimi, Ferdowsi University, Iran, Islamic Republic
Of, najiazimi@yahoo.com, *Majid Salari*

In this approach we modify Scatter Search with our new methods and
solve the Examination Timetabling Problem. Also we solve this prob-
lem with existing methods such as SA and TS and compare results of
them with each other. Finally we Statistically conclude that our algo-
rithm works better.

3 - An Investigation on High Level Heuristics within a Graph Based Hyper-heuristic for Course and Exam Timetabling Problems

Rong Qu, CSiT, University of Nottingham, Jubilee Campus,
Wollaton Road, Ng81bb, Nottingham, United Kingdom,
rxq@cs.nott.ac.uk, *Edmund Burke*

This paper presents our work on investigating different searching meth-
ods within a graph based hyper-heuristic. Fundamental issues con-
cerning the neighborhood structures are discussed and performance
within the landscape of search is analysed. Experimental results on
both course and exam timetabling problems demonstrate the simplicity
and efficiency of this hyper-heuristic approach.

■ MD-03

Monday, 3:30-5:00pm
Honolulu III

Fictitious Play and It's Applications

Cluster: Stochastic Programming
Invited session

Chair: *Robert L. Smith*, Industrial and Operations Engineering, The University of Michigan, 48109, Ann Arbor, Michigan, United States, rlsmith@umich.edu

1 - A Fictitious Play Approach to Complex Systems Optimization

Robert L. Smith, Industrial and Operations Engineering, The University of Michigan, 48109, Ann Arbor, Michigan, United States, rlsmith@umich.edu

We explore in this talk a novel optimization paradigm inherited from game theory that animates the components of a complex system within a non-cooperative game of identical interest. The optimizations take place through individual best replies of the "players", thus vastly reducing the dimensionality of the optimization problem solved.

2 - Sampled Fictitious Play for a Class of Discrete Optimization Problems

Archis Ghate, Department of Industrial and Oper Engineering, University of Michigan, 1205 Beal Ave, 48109, Ann Arbor, Michigan, archis@umich.edu, *Marina Epelman*, *Robert L. Smith*

We propose a new version of the sampled fictitious play algorithm for solving discrete optimization problems defined on decision trees. This algorithm uses a novel, efficient method to ensure feasibility. Moreover, in each iteration, it requires a sample of size only one. We discuss convergence properties of this algorithm.

3 - Application of Sampled Fictitious Play to Continuous Optimization

Daniel Reaume, Research and Development, General Motors, GM R&D Center, Mail Code 480-106-359, 30900 Mound Road, Warren, MI, United States, daniel.reaume@gm.com, *Kenneth Agacinski*

In this talk we present a variant of sampled fictitious play developed for constrained, continuous, nonlinear optimiation. We will examine the empirical performance of the algorithm and its parameters on a suite of standard test problems.

■ MD-04

Monday, 3:30-5:00pm
Iolani I

Transportation and Pricing

Cluster: Nonlinear Programming
Invited session

Chair: *Tatiana Tchemisova*, Matemática, Aveiro Iniversity, Campus Universitário de Santiago, 3810-193 Aveiro, Aveiro, Portugal, tatiana@mat.ua.pt

1 - Endogenous Transportation Technology in a Cournot Differential Game with Intraindustry Trade

Luca Lambertini, Economics, University of Bologna, Strada Maggiore 45, 40125, Bologna, lamberti@spbo.unibo.it, *Luca Colombo*, *Andrea Mantovani*

We investigate a dynamic duopoly with trade. Firms invest to reduce transportation costs. In open-loop, investments and transportation costs are independent of relative country size. In closed-loop, R&D efforts are sensitive to country size, so that the firm located in the larger country invests more than the rival.

2 - Spot pricing framework for end-to-end assured bandwidth service contracts

Aparna Gupta, Decision Sciences & Engineering Systems, Rensselaer Polytechnic Institute, Troy, NY, United States, guptaa@rpi.edu, *Shivkumar Kalyanaraman*, *Lingyi Zhang*

We develop a pricing mechanism for end-to-end assured bandwidth service from a provider's perspective. The service is built using standard single-domain contracts over an SON architecture or through ISP collaboration. A nonlinear pricing framework is developed, which matches customers' demand characteristics, and recovers the provider's contractual and infrastructural costs.

3 - On Discrete Simulation for Mass Transportation

Tatiana Tchemisova, Matemática, Aveiro Iniversity, Campus Universitário de Santiago, 3810-193 Aveiro, Aveiro, Portugal, tatiana@mat.ua.pt, *Plakhov Alexander*

We use discrete optimization methods (in particular for solution of the transport problem) to obtain new results in solution of the one-dimensional mass transportation problem of Monge-Kantorovitch and apply these results for the body of minimal resistance problem

■ MD-05

Monday, 3:30-5:00pm
Iolani II

Marketing for Electronic Markets

Cluster: Auctions and e-markets
Invited session

Chair: *Steven Shugan*, Marketing, University of Florida, 2030 nw 24th Avenue, 32605, Gainesville, FL, sms@ufl.edu

Chair: *Paris Cleanthous*, Marketing, New York University, Stern School of Business, 44 W. 4th Street,, Suite 9-79, 10012-1126, New York, New York, United States, pcleanth@stern.nyu.edu

1 - A Network Modeling Approach for the Optimization of Internet-Based Advertising Strategies and Pricing with a Quantitative Explanation of Two Paradoxes

Lan Zhao, Mathematics and Computer Information Sciences, state university of New York, College at Old Westbury, Dept. of Math and CIS, SUNY/Old Westbury, 11568, Old Westbury, ny, United States, zhaol@oldwestbury.edu, *Anna Nagurney*

When a firm is advertising in n websites, the response on single website is a function of collective efforts in n websites. This paper provides a network model, the existence and uniqueness theorem, and the algorithm for the optimal Internet advertising strategy in highly interrelated Internet marketing places

2 - Substitutability between Landline and Cellular Services

Paris Cleanthous, Marketing, New York University, Stern School of Business, 44 W. 4th Street,, Suite 9-79, 10012-1126, New York, New York, United States, pcleanth@stern.nyu.edu

In this empirical study of consumer demand for landline versus cellular services, we first investigate the factors influencing consumers' decisions and, specifically, how these vary across demographic groups. We then classify different types of services as substitutes or complements and quantify the degree of substitutability or complementarity between them.

3 - The Internet: A Channels Perspective

Minakshi Trivedi, Marketing, University at Buffalo, Jacobs Management Center, University at Buffalo, North Campus, 14260, Buffalo, NY, mtrivedi@acsu.buffalo.edu

The electronic shopping option has considerably altered the playing field for academicians previously engaged in the game theoretic modeling of distribution channels. In this paper, we extend previous literature to incorporate the electronic option and study the impact this addition has on profitability and equilibrium issues.

■ MD-06

Monday, 3:30-5:00pm
Iolani III

Routing and Capacity Allocation

Cluster: Telecommunications and Network Design
Invited session

Chair: *Bernard Fortz*, Institut d'Administration et de Gestion, Université Catholique de Louvain, Place des Doyens 1, 1348, Louvain-la-Neuve, Belgium, bfortz@euro-online.org

1 - Multi-Period Traffic Routing in Satellite Networks

S. Raghavan, The Robert H. Smith School of Business, University of Maryland, 4345 Van Munching Hall, 20742-1815, College Park, MD, United States, raghavan@umd.edu, *Ioannis Gamvros*

We consider a multi-period traffic routing problem that arises in geostationary satellite networks. These networks are dynamic and their configuration significantly change from time period to time period. We develop a (multi-period) path-based multi-commodity integer programming formulation and develop a branch-price-and-cut solution procedure. Computational results for large-scale problems are presented

2 - Improving Throughput in Telecommunication Networks Through Incremental Demand Rerouting

Eli Olinick, Engineering Management, Information, and Systems, Southern Methodist University, Southern Methodist University, PO Box 750122, 75275, Dallas, Texas, olinick@engr.smu.edu

Network managers are reluctant to make wholesale changes to an established and reliable routing assignment; a complete modification to obtain an optimal assignment is viewed as highly risky. We consider the problem of making incremental changes to a given routing assignment to free up capacity to accommodate new point-to-point demands.

3 - Capacity Expansion for Internet Service Providers

Oliver Heckmann, Multimedia Communications Lab, Technische Universität Darmstadt, Merckstr. 25, 64283, Darmstadt, Germany, heckmann@kom.tu-darmstadt.de

Internet traffic is growing exponentially, roughly doubling every year. We investigate capacity expansion for Internet service providers. We analyse the influence on quality of service by simulations, solve the optimization problem resulting from the trade-off between costs and quality, and present a way to take reactive traffic into account.

■ MD-07

Monday, 3:30-5:00pm
Iolani V

MIS and Decision Theory Applications

Cluster: Management Information Systems
Invited session

Chair: *Shuichi Shinmura*, Jcom, Tokyo, Japan, shuichi.s@jcom.home.ne.jp

1 - The Perception of Data Accuracy

Leon Schwartz, Information & Communications Systems, Fordham University, 30 Briarcliff Drive, 10952, Monsey, NY, schwal@informeddecisionsgroup.com

Businesses lose more than $600 million a year because of poor data quality. Nonetheless, Data Quality initiatives are limited. Data quality may be too difficult to define and measure. This research attempts to quantify the subjective perception of "known" data accuracy to understand where/how much to invest in improvement efforts.

2 - Dynamic Workflow in Semantic Web

Timon Du, Decision Sciences and Managerial Economics, The Chinese University of Hong Kong, KKL 113, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong, 000, Shatin, timon@cuhk.edu.hk, *Jacqueline Wong*

In the conventional approach, the workflow process must be predefined before it is implemented. However, involving business users in the early stage of the design phase is neither efficient nor realistic in the dynamic business world. This study proposes a framework to implement a workflow in Semantics Web.

3 - Application of Dual Scaling for Performance Measurement

Tohru Ueda, Faculty of Engineering, Seikei University, 3-3-1 Kichijoji-Kitamachi, 180-8633, Musashino-Shi, Tokyo, Japan, ueda@is.seikei.ac.jp

In subjective performance measurement, paired comparison data or successive categories data are often utilized. AHP or conjoint analysis is not very appropriate for aggregated evaluation of these data, but Dual Scaling aims preferably aggregated evaluation. Application and easy formulation of Dual Scaling for these data are proposed.

4 - Why nobody uses MP models in the discriminant analysis

Shuichi Shinmura, Facultu of Economics, Seikei Univ., Kichijoji Kitamachi 3-3-1,, 180-8633, Musashinoshi, Tokyo, Japan, shinmura@econ.seikei.ac.jp

Statistical users do not use MP classification models, because no models showed its superiority compared with statistical methods. IP-OLDF

using integer programming is based on minimum misclassification number and is defined on the discriminant coefficient space. IP-OLDF offers much different new knowledge about discriminant analysis and is useful for it.

■ **MD-08**

Monday, 3:30-5:00pm
Iolani VI

Inventory Management in Information-Rich Supply Chains

Cluster: Supply Chain Management
Invited session

Chair: *Yossi Aviv*, Olin School of Business, Washington University, Campus Box 1133, 1 Brookings Drive, 63130, Saint Louis, MO, United States, aviv@wustl.edu

1 - Impact of Data Quality on Inventory Control Systems

Ozgun Baris Bekki, Industrial Engineering, Arizona State University, 919 E. Lemon Str. Apt. 228, 85281, Tempe, AZ, ozgun.bekki@asu.edu, *Esma Gel*, *Nesim Erkip*, *Anoop Thulaseedas*

Due to process inefficiencies, it is common to have discrepancies between the actual inventory in stock and the IT data. We estimate the economic impact of data quality problems in inventory control systems that use an optimal (Q,r) policy to manage inventory, and comment on reasonable strategies to minimize suboptimality.

2 - Execution in Retail Supply Chains

Nicole DeHoratius, Graduate School of Business, University of Chicago, 5908 S. Woodlawn Ave, 60637, Chicago, IL, nicole.dehoratius@chicagogsb.edu

Inventory record inaccuracy in retail stores is a major obstacle to the successful application of automated decision tools designed to support firm operations. We attribute the existence of inventory record inaccuracy in retail stores in part to specific distribution processes that fail to be executed correctly.

3 - Collaborative Forecasting and Inventory Management: Capacity Considerations

Yossi Aviv, Olin School of Business, Washington University, Campus Box 1133, 1 Brookings Drive, 63130, Saint Louis, MO, United States, aviv@wustl.edu

We study the potential benefits of collaborative forecasting in capacity-constrained supply chains. We propose a set of metrics that capture inventory considerations, production smoothing, and adherence-to-plans. The benefits primarily depend on the following characteristics: Supply response time, relative explanatory power of the supply chain partners, and internal service rate.

■ **MD-09**

Monday, 3:30-5:00pm
Iolani VII

Network Problems and Heuristics

Cluster: Metaheuristics
Invited session

Chair: *Hiro Ito*, School of Informatics, Kyoto University, Yosida Honmati, 606-8501, Kyoto, Japan, itohiro@kuis.kyoto-u.ac.jp

1 - Scale-free networks and network mining problems

Hiroyoshi Miwa, Informatics, Kwansei Gakuin University, 2-1, Gakuen, 669-1337, Sanda-shi, Hyogo, Japan, miwa@ksc.kwansei.ac.jp, *Naoki Masuda*, *Norio Konno*

It is well known that many real networks have power-law vertex degree distribution, short average path length, and high clustering. On such a network, efficient algorithms to solve some problems on mining information are required. We briefly review these topics and introduce our random graph models which generate realistic networks.

2 - An experimental study on the Web graph

Yushi Uno, Graduate School of Science, Osaka Prefecture University, 1-1 Gakuen-cho, 599-8531, Sakai, Osaka, Japan, uno@mi.cias.osakafu-u.ac.jp

The Web graph is a digraph induced by the hyperlink structure of WWW, and a large amount of research has revealed its complex topology. We present some new experimental observations on the topological structure of the Web graph that have not been reported so far. These results will give suggestions for designing web algorithms.

3 - Heuristics for the Minmax Tree Cover in Graphs

Hiroshi Nagamochi, Applied Mathematics and Physics, Kyoto University, Sakyo-ku, Yoshida, 606-8501, Kyoto, Kyoto, nag@amp.i.kyoto-u.ac.jp

Given an edge-weighted graph and an integer k, the minmax tree cover problem asks to find a set of k subtrees of the graph such that the union of the subtrees covers all vertices and the maximum weight of the subtrees is minimized. This talk surveys constant factor approximation algorithms for this problem.

■ **MD-10**

Monday, 3:30-5:00pm
Tapa Ballroom I

The Analytic Network Process for Decision-Making

Cluster: Tutorials
Invited session

Chair: *Thomas Saaty*, Katz Graduate School of Business, University of Pittsburgh, Pittsburgh, PA. 15260 USA, 15260, Pittsburgh, Pennsylvania, United States, saaty@katz.pitt.edu

1 - The Analytic Network Process for Decision-Making

Thomas Saaty, Katz Graduate School of Business, University of Pittsburgh, Pittsburgh, PA. 15260 USA, 15260, Pittsburgh, Pennsylvania, United States, saaty@katz.pitt.edu

Most complex decisions involve many interested parties with conflicting interests and objectives and many factors, especially intangible

ones like social, environmental and political influences alongside economic ones. All these factors need to be prioritized and integrated under common goals. Such complex decisions have benefits, opportunities, costs and risks that need to be assessed. How to put this together to make the most effective decision is the object of this tutorial. It will give you a new way of thinking about your problems. Participants will be exposed to a variety of applications and to the very usable SuperDecisions software that facilitates this way of decision-making.

■ MD-11

Monday, 3:30-5:00pm
Tapa Ballroom II

Combinatorial Aspects in Scheduling Applications

Cluster: Combinatorial Optimization
Invited session

Chair: *Gerd Finke*, Leibniz-imag, 46 avenue Felix Viallet, 38 031, Grenoble cedex, Gerd.Finke@imag.fr

1 - Structural analysis and solution approaches for resource-constrained project scheduling with general objective functions

Klaus Neumann, Economic Theory and Operations Research, University of Karlsruhe, 76128, Karlsruhe, Germany, neumann@wior.uni-karlsruhe.de, *Christoph Schwindt*

We consider project scheduling problems with general temporal constraints, limited renewable resources, and different classes of objective functions (regular, convexifiable, locally regular, and locally quasiconcave functions). We demonstate that the feasible region is a generally disconnected union of finitely many specific polyhedra. Exploiting that fact we show that for regular and convexifiable functions, a relaxation-based solution approach and for locally regular and locally quasiconcave functions, a tree-based approach are appropriate. We briefly touch upon corresponding (truncated) branch-and-bound methods.

2 - Maximizing the net present value of projects

Jürgen Zimmermann, Business Administration, TU Clausthal, Julius-Albert Str. 2, 38678, Clausthal-Zellerfeld, Germany, juergen.zimmermann@tu-clausthal.de

In practice, large projects have to be scheduled subject to temporal, resource, and budget constraints with the objective of maximizing the project net present value. In this contribution we discuss different enumeration schemes for branch-and-bound algorithms as well as neighborhood operators for local search procedures.

3 - Batch processing with interval graph compatibilities between tasks

Gerd Finke, Leibniz-imag, 46 avenue Felix Viallet, 38 031, Grenoble cedex, Gerd.Finke@imag.fr, *Vincent Jost*, *Maurice Queyranne*, *Andras Sebo*

We analyze batch-scheduling problems that arise in connection with certain industrial applications. The models concern processing on a single max-batch machine with the additional feature that tasks of the same batch have to be compatible. These compatibilities often define an interval graph, according to some practical conditions that we present. We consider several models with varying batch capacities and processing times and provide new polynomial time algorithms and complexity results.

4 - Linear Programming: A Tool for Solving Scheduling Problems

Peter Brucker, Mathematics/Informatics, University of Osnabrueck, Albrechtstr. 28, D 49069, Osnabrueck, Peter.Brucker@mathematik.uni-osnabrueck.de, *Svetlana Kravchenko*

Parallel machine scheduling problems with identical processing times and release dates are considered. For problems with open complexity status it is shown that they can be solved in polynomial time by solving first a corresponding linear program and then using the information provided by the program to construct an optimal schedule.

5 - Exact and Heuristic Algorithms for Optimization of Transfer Lines with Multi-Spindle Stations

Alexandre Dolgui, Industrial Engineering and Computer Science, Ecole des Mines de Saint Etienne, 158, cours Fauriel, 42023, Saint Etienne, France, dolgui@emse.fr, *Genrikh Levin*, *Nikolai Guschinsky*, *Xavier Delorme*

Optimization problems for transfer lines with multi-spindle workstations are considered. The goal is to choose spindle heads from a given set and to assign them to workstations while minimizing the line cost and satisfying technological constraints. Exact and heuristic algorithms are developed that are based on MIP and graphs.

■ MD-12

Monday, 3:30-5:00pm
Tapa Ballroom III

Passenger Railway Transportation

Cluster: Transportation
Invited session

Chair: *Dennis Huisman*, Econometric Institute, Erasmus University, Rotterdam, Netherlands, huisman@few.eur.nl

1 - Scheduling of the rolling stock during track maintenance

Gabriella Budai, Tinbergen Institute Rotterdam, Erasmus University Rotterdam, Burgemeester Oudlaan 50, 3062 Pa, Rotterdam, Netherlands, budai@few.eur.nl, *Dennis Huisman*, *Rommert Dekker*

In this paper we discuss the rolling stock rescheduling problem when some tracks are closed for operation during a few days due to maintenance projects on the infrastructure. We developed an algorithm consisting of three steps. The focus will be on the last step, the so-called rolling stock balancing problem.

2 - A Linear Programming Approach to the Train Timetabling Problem

Valentina Cacchiani, Deis, University of Bologna, Bologna, Italy, vcacchiani@deis.unibo.it, *Paolo Toth*, *Alberto Caprara*

We consider the Train Timetabling Problem, which aims at determining, for a given set of trains, an optimal timetable which does not violate track capacity. We propose a set packing model and describe exact and heuristic algorithms based on the linear programming relaxation. Computational results on real-world instances are presented.

3 - Railway Crew Scheduling - Practice and Theory

Tomas Gustafsson, Railway Solutions, Carmen Systems AB, Odins gatan 9, 411 03, Gothenburg, tomas.gustafsson@carmensystems.com

Crew planning for a large scheduled railway is a highly complex problem where OR-technigues can be applied in many areas. The many soft rules and conflicting quality criteria are especially challenging to translate into a mathematical model. Examples will be given from successful installations of the Carmen Crew Pairing System.

4 - The Rescheduling of Crew during Track Maintenance

Dennis Huisman, Econometric Institute, Erasmus University, Rotterdam, Netherlands, huisman@few.eur.nl

When tracks are outside service for maintenance for a certain period, trains cannot be operated at those tracks. The rolling stock and the crew need to be rescheduled. In this presentation, an algorithm to reschedule the crew will be discussed. Some computational results on real-world instances will be presented.

■ MD-13

Monday, 3:30-5:00pm
Sea Pearl I

Six Sigma and Quality

Cluster: Quality, Statistics and Reliability
Invited session

Chair: *Loon-Ching Tang*, Department of Industrial and Systems Engineering, National University of Singapore, National University of Singapore, ISE Dept, 1 Engineering Drive 2, Singapore 117576, 117576, Singapore, Singapore, isetlc@nus.edu.sg

1 - A Six Sigma Roadmap for Healthcare Services

Loon-Ching Tang, Department of Industrial and Systems Engineering, National University of Singapore, National University of Singapore, ISE Dept, 1 Engineering Drive 2, Singapore 117576, 117576, Singapore, Singapore, isetlc@nus.edu.sg

In this paper, we present a roadmap for process/service improvement in healthcare organizations by augmenting the existing DMAIC Six Sigma framework using operational research tools. The new roadmap is presented along with a case study on improving the operations of a retailed pharmacy in a hospital.

2 - U.S. Hospitals in 21st Century Need New Metrics

Andrew Ganti, Healthcare Technologies, General Electric, 300 Winged Terr. Dr., 94582, San Ramon, CA, andy.ganti@med.ge.com

U.S. Hospital IT departments have grown in technology, role, scope, name, size, budget, and status. With Lean Six Sigma applications, decision makers need process metrics IT hasn't provided. Topics cover: Hospital IT evolution and examples of key processes/metrics, dashboards and balanced scorecards. Intended audience includes: healthcare/IT managers, practitioners and researchers.

3 - Statistical Control Charts for Evidence Based Medicine Bundle and Composite Measures

James Benneyan, Industrial Engineering, Northeastern University, 334 Snell Engineering Center, 360 Huntington Avenue, 02115, Boston, MA, benneyan@coe.neu.edu

A mixed-population probability model is derived for healthcare composite and bundled measures and used to develop appropriate statistical control charts for this new type of quality measurement data. We compare properties of these new charts and illustrate applications to community-acquired pneumonia, myocardial infarction, ventilator-associated pneumonia, surgical-site infections, and pediatric care.

■ MD-14

Monday, 3:30-5:00pm
Sea Pearl II

An Educational Potpourri

Cluster: Education, Innovation and Distance Learning
Invited session

Chair: *Donna Llewellyn*, Center for the Enhancement of Teaching and Learning, Georgia Institute of Technology, 30332-0383, Atlanta, Georgia, United States, donna.llewellyn@cetl.gatech.edu

1 - Using Cases in an Introductory Operations Research Course

James Cochran, Department of Marketing and Analysis, Louisiana Tech University, PO Box 10318, 71272, Ruston, LA, United States, jcochran@cab.latech.edu

Use of small-scale cases in introductory operations research courses will be discussed. An approach to small-scale case development will be presented, implementation of the case approach will be considered, and results achieved through this approach will be addressed. Bowie Kuhn's Worst Nightmare (http://ite.pubs.informs.org/) will be used to illustrate various points.

2 - Perils and Pitfalls with a VTC Course

Anke Richter, Defense Resources Management Institute, Naval Postgraduate School, 699 Dyer Rd, Room 209A, 93943, Monterey, CA, arichter@nps.navy.mil

There is much of excitement about distance learning courses and the use of multiple technologies to facilitate learning. However, teaching in this environment also poses numerous pitfalls, which need careful consideration. The experiences with a videoteleconferencing course with multiple sites will be presented along with solutions to some common problems.

3 - Operations Research: A Link Connecting Engineering Faculty with High School Math Teachers and Students

Donna Llewellyn, Center for the Enhancement of Teaching and Learning, Georgia Institute of Technology, 30332-0383, Atlanta, Georgia, United States, donna.llewellyn@cetl.gatech.edu

Due to Georgia Tech's GK-12 program, many HS teachers/students wish to work with GT faculty. In the sciences, this partnering comes naturally, but it is harder to find placements for math teachers. OR can be a bridge between these teachers and engineering faculty. Lessons learned and ideas will be discussed.

■ MD-15

Monday, 3:30-5:00pm
Sea Pearl III

Capacitated Loading and Routing

Cluster: Routing
Invited session

Chair: *Juan José Salazar González*, Estadística e Investigación Operativa, Universidad de La Laguna (Tenerife), Av. Astrofísico Francisco Sánchez, s/n, 38271, La Laguna, Tenerife, Spain, jjsalaza@ull.es

1 - Ship Scheduling with flexible Cargo Sizes

Bjørn Nygreen, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Alfred getz vei 3, No-7491, Trondheim, Norway, bjorn.nygreen@iot.ntnu.no, *Geir Brønmo, Marielle Christiansen, Jens Lysgaard*

We describe a real tramp ship planning problem and its solution. A tramp shipping company has some certain contract cargoes to carry and some optional cargoes it can carry. The size of the cargoes is given in an interval and the company tries to maximize the profit from optional cargoes.

2 - On Hop-Indexed Reformulations for the Unit Demand Vehicle Routing Problem

Luis Gouveia, Deio, University of Lisbon, Campo Grande, Bloco C6, 1749-016, Lisbon, Portugal, legouveia@fc.ul.pt, *Maria Teresa Godinho, Thomas Magnanti*

We discuss two strategies for designing hop-indexed reformulations for the vehicle routing problem: one considers the "hop constrained shortest path from the depot to a given node" as the subproblem and the other considers the "hop constrained shortest circuit passing through the depot and a given node" as the suproblem.

3 - The problem of routing several vehicles while loading 2-dimensional items from customers

Juan José Salazar González, Estadística e Investigación Operativa, Universidad de La Laguna (Tenerife), Av. Astrofísico Francisco Sánchez, s/n, 38271, La Laguna, Tenerife, Spain, jjsalaza@ull.es, *Daniele Vigo, Manuel Iori*

It is the symmetric capacitated vehicle routing problem, in which each customer has given demand consisting in a lot of certain number of rectangulars. Vehicles have loading area and weight capacity. We propose a branch-and-cut approach for minimizing the routing cost that iteratively calls a branch-and-bound algorithm for checking loadings.

■ MD-16

Monday, 3:30-5:00pm
Sea Pearl IV

DP and Petri Nets

Cluster: Dynamic Programming
Invited session

Chair: *Art Lew*, ICS Dept, University of Hawaii, Post 317, 96822, Honolulu, Hawaii, United States, artlew@hawaii.edu
Chair: *Holger Mauch*, Information and Computer Science, University of Hawaii, 1680 East West Road, 96822, Honolulu, HI, United States, hmauch@hawaii.edu

1 - Time Petri Nets State Space Reduction Using Dynamic Programming and Time Paths

Louchka Popova-Zeugmann, Computer Science, Humboldt-Universität zu Berlin, Unter den Linden 6, D-10099, Berlin, Germany, popova@informatik.hu-berlin.de

The state space of an arbitrary TPN is reduced using a DP algorithm. Shortest/longest times between reaching two markings in a TPN can be viewed as solutions of two LP's. They can be solved using the reduced state space in polynomial/linear time by means of prevalent methods of graph theory.

2 - Using Timed Petrinets To Solve IRIS Scheduling Optimization

Matthias Werner, Communication and Operating System Group, TU Berlin, Sek. FR 6-3, Franklinstr. 28/29, 10587, Berlin, mwerner@cs.tu-berlin.de

We transform an IRIS (increasing reward with increasing service) real-time scheduling problem into a (possibly unbounded) Time Petri nets (TPN). Then, the associated longest path problem of the TPN state graph, where arc weight corresponds to gained reward (versus consumed time), can be tackled with DP.

3 - Dynamic Programming using Quantum Search for Optimizing Petri Net Models

Sanjeev Naguleswaran, School of Electrical and Electronic Engineering, University of Adelaide, Adelaide, 5005, Adelaide, South Australia, sanjeev@eleceng.adelaide.edu.au, *Olivier Buffet, Lang White*

A technique for modeling planning problems as Petri-nets is presented. The routing of tokens through the net is analogous to sequential decision making, such as in MDPs. Standard DP algorithms cannot in general, solve planning problems in polynomial time. Hence, reduced complexity optimization methods based on quantum search are considered.

4 - Decentralised Optimisation of Distributed Markov Decision Processes via Petri Net Unfoldings

Sarah Hickmott, Electrical and Electronic Engineering, The University of Adelaide, North Terrace, 5000, Adelaide, South Australia, Australia, shick@eleceng.adelaide.edu.au, *Lang White*

We present a new approach to optimisation of distributed MDPs modelled by Petri nets. Live nets lead to average cost-per-stage problems. The finite prefix of the unfolding is used to derive decentralised Bellman's equations associated with the net configurations, and the communcations between interacting parts of the system.

■ MD-17

Monday, 3:30-5:00pm
Sea Pearl V

Multilevel and Multiobjective Optimization in Engineering

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *Margaret Wiecek*, Department of Mathematical Sciences, Clemson University, 29634, Clemson, SC, United States, wmalgor@clemson.edu

1 - Effective Multicriteria Decision Making for Computationally Intensive Simulation Models

Achille Messac, Mechanical and Aerospace Engineering, Rensselaer Polytechnic Institute, Jec 2049, 110 8th Street, 12180, Troy, NY, United States, messac@rpi.edu, *Anoop Mullur*

Comprehensive design space exploration for effective decision-making is a computationally prohibitive task in the presence of numerically intensive simulations. The difficulty is compounded in the presence of multiple criteria and disciplines. An efficient multicriteria decision making tool – the Pseudo Response Surface method – is explored, which alleviates this computational burden.

2 - Tradeoff-based decomposition for large-scale multi-objective programs

Alexander Engau, Mathematical Sciences, Clemson University, O-106 Martin Hall, Box 340975, 29634, Clemson, SC, United States, aengau@clemson.edu, *Margaret Wiecek*, *Vincent Blouin*

The high dimensionality of systems due to a large number of performance criteria necessitates the development of decomposition for large-scale multiobjective programs. The overall performance is controlled through appropriate integration of tradeoff decisions made on subsets of criteria. The method is illustrated on an engineering design example.

3 - A Convex Cone-Based Approach to Modeling Preferences in Multiobjective Engineering Design

Brian Hunt, Department of Defense, United States, bhunt318@yahoo.com, *Margaret Wiecek*, *Vincent Blouin*

Multiobjective engineering design requires eliciting and utilizing designer preferences to select a preferred design. A framework for eliciting preferences and modeling them using convex polyhedral cones will be presented and applied to the multiobjective design of a four bar plane truss. Graphical and numerical results also will be shown.

4 - Lagrangian Dual Coordination for Analytical Target Cascading in Engineering Design

Margaret Wiecek, Department of Mathematical Sciences, Clemson University, 29634, Clemson, SC, United States, wmalgor@clemson.edu, *Wei Chen*, *Harrison Kim*

We propose a Lagrangian dual formulation and coordination for analytical target cascading (ATC), a hierarchical multilevel multidisciplinary design methodology. For the convex case, the optimal Lagrange multipliers from the dual formulation can be viewed as the weights for deviations in ATC. The algorithm finds the optimal solution and weights simultaneously.

■ MD-18

Monday, 3:30-5:00pm
Sea Pearl VI

FMS Scheduling and Other Issues

Cluster: Flexible Manufacturing
Invited session

Chair: *Kathryn E. Stecke*, University of Texas at Dallas, United States, KStecke@utdallas.edu

1 - Scheduling Algorithms for a Twin-Shuttle S/R Machine for AS/RS

Daniel R. Dooly, Computer Science, Southern Illinois Univ Edwardsville, Edwardsville, IL, United States, ddooly@siue.edu, *H. Felix Lee*

We present a scheduling algorithm for AS/RS (automated storage and retrieval systems) operating with twin-shuttles each of which can in one cycle store two parts (or loads) and retrieve two parts. We show that this method is more effective in increasing the throughput than the existing method.

2 - A Lexicographic Approach To Multi-objective Master Production Scheduling In Make-to-order Manufacturing

Tadeusz Sawik, Computer Integrated Manufacturing, AGH University of Science & Technology, Faculty of Management, Al.Mickiewicza 30, 30-059, Krakow, Poland, ghsawik@cyf-kr.edu.pl

A lexicographic approach and integer programming formulations are presented for multi-objective, production scheduling in make-to-order manufacturing. The objective is to minimize number of tardy orders and to level machine assignments. Some cutting constraints are derived. Numerical examples from the electronics industry and some computational results are provided.

3 - An Integrated Method for Cellular Manufacturing System Design and Operation

Ming Yuan Chen, Concordia University, Canada, mychen@me.concordia.ca

An integrated method is developed for manufacturing cell formation. It consists of heuristic algorithms, simulation and a BP neural network. The heuristics generate candidate cell formations to be evaluated by a simulation model. The simulation results are then used to train the neural network for optimal system design and operation.

■ MD-19

Monday, 3:30-5:00pm
Nautilus I

AHP03: Methodology II

Cluster: Analytic Hierarchy / Network Process
Invited session

Chair: *Eizo Kinoshita*, Meijo University, Nagoya, Japan, kinoshit@urban.meijo-u.ac.jp

1 - Weight Estimation Method for Multi-Evaluater Pairwise Comparison Graph

Keikichi Osawa, Nihon University, Narashino, Japan, k7oosawa@cit.nihon-u.ac.jp, *Masaaki Shinohara*

To solve the multi-evaluater AHP, we propose a logarithmic pairwise comparison error model, taking evaluater's specific characteristic in consideration, and then, the least square principle is applied to obtain estimates of object weight and evaluater weight. With the proposed method, the degree of overestimation and underestimation of each evaluater is also estimated.

2 - A new criterion of the Saaty's consistency index

Masanori Ozawa, Faculty of Science and Technology, Keio University, 3-14-1, Hiyoshi, Kohoku-ku, 223-8522, Yokohama, Japan, ozawa@ae.keio.ac.jp, *Yutaka Kato*

Some consistency indices are proposed for a pair-wise comparison matrix, but the Saaty's consistency index is generally used to test the reliability of the estimated weights. In this paper, We study the relations between the Saaty's consistency index 0.1 and the coefficient of determination.

3 - Inverse Sensitive Analysis of Pairwise Comparison Matrices

Kouichi Taji, Mechanical Science and Engineering, Nagoya University, Furo-cho, Chikusa-ku, 464-8603, Nagoya, Japan, taji@nuem.nagoya-u.ac.jp

Based on the eigenvector method of AHP, we propose the method estimating the pairwise comparison interval in which a given consistency index is satisfied. The objective of the method is to enable us to estimate consistent intervals and to detect a pairwise comparison error without computing eigenvalues.

4 - Logical Consistency vs Validity in Weight Estimation of AHP

Masaaki Shinohara, 1-2-1 Izumi-chou, Narashino, Chiba 275-8575, Japan, 275-8575, Chiba, m7sinoha@cit.nihon-u.ac.jp, *Keikichi Osawa*

Logical consistency measures, such as CI, and validity measures, such as distance to true weight, are calculated and correlation between the two is investigated in estimating weight from pairwise comparison data of various psychophysical experiments. Logical consistency and validity measures are shown to be non-correlated, or sometimes, negatively-correlated.

■ MD-20

Monday, 3:30-5:00pm
Nautilus II

Decision Analysis Arcade
Cluster: Decision Analysis
Invited session
Chair: *John Butler*, Ohio State University, 2100 Neil Ave, 43215, Columbus, Ohio, United States, butler.267@osu.edu

1 - The Performance of Simple Heuristics in Binary Multiattibute Choice

Manel Baucells, IESE Business School, Spain, mbaucells@iese.edu, *Juan A. Carrasco, Robin M. Hogarth*

In multi-attribute decision making, several studies report high performance rates of some simple heuristics. To understand this surprising performance, we observe that these heuristics are guaranteed to be correct in the presence of simple and cumulative dominance. While the rate of simple dominance decays quite rapidly as the number of attributes increases, the rate of cumulative dominance decays slowly. We conclude that the high persistence of cumulative dominance is the key explanatory factor of the performance success of these heuristics.

2 - Marginal analysis of multi-objective decision methods in the public sector

Eva Regnier, Defense Resources Management Institute, Naval Postgraduate School, 699 Dyer Road, 93940, Monterey, CA, eregnier@nps.edu

Various methods are used to make multi-objective decisions in the public sector. Each has different implications for the marginal trade-offs among costs and benefits/objectives. Several common procedures are reviewed, with examples from health, defense, and environmental protection, and their policy implications in a hierarchical budget allocation process are explored.

3 - Invariant Utility Functions (Generalized Zero-Switch Utility)

Ali Abbas, School of Engineering, University of Illinois at Urbana-Champaign, 104 South Mathews Ave, 61801, Urbana, Illinois, United States, aliabbas@uiuc.edu

We present an invariance approach for reasoning about utility functions. This approach provides a general method to determine the functional form of a utility function under a given transformation on the attributes. We then present invariant utility functions and show how they generalize the notion of zero-switch utility functions.

4 - Preference Modeling And Dynamic Resource Allocation In Not-for-profit Healthcare Organizations

Don Kleinmuntz, Business Administration MC-706, U of Illinois at Urbana-Champaign, 1206 S 6th St, 61820, Champaign, IL, United States, dnk@uiuc.edu

US hospitals allocate resources to achieve both financial and nonfinancial objectives. Investment analyses are challenging because subjective assessments ignore complex interactions of financial and nonfinancial criteria. A dynamic model of hospital capital investment is used to compare heuristic strategies to a normative strategy. Descriptive and prescriptive implications are considered.

■ MD-21

Monday, 3:30-5:00pm
Lehua Suite

OR for Development Prize Competition II
Cluster: OR for Development Prize Finalist Sessions
Invited session
Chair: *L. Paul Fatti*, Statistics & Actuarial Science, University of the Witwatersrand, P.O. Wits, 2050, Johannesburg, South Africa, fatti@stats.wits.ac.za

1 - A Framework Of Computational Systems And Optimisation Models For The Prevention And Combat Of Dengue

Marcos José Negreiros, Mestrado Profissional Em ComputaÇÃo, Universidade Estadual Do CearÁ, Av Paranjana, 1700 - Campus do Itaperi, 60740-000, Fortaleza, CEARÁ, Brazil, negreiro@graphvs.com.br, *Adilson Elias Xavier, Nelson Maculan Filho, Philippe Michelon*

This work presents a logistical methodology that uses Information Systems for the prevention and combat of dengue, one of the major tropical diseases. It includes Geographic Information, WEB-Based, Hand-Held and Decision Support Systems. The framework gives an overview of

the dengue logistical problematic and allows to optimize the combat process.

2 - AlWehhda Water Resource Management (AWRM) Project: The Path to Sustainable Development in Southern Sudan

Nazar M. Hassan, Mechanical Engineering Department, University of Khartoum, Faculty of Engineering & Architecture, P.O. Box 471, Khartoum, Sudan, Khartoum, Sudan, nmhassan05@yahoo.com

Development in Southern Sudan is but a daunting task due to economic, socio-political, and environmental reasons. Harnessing that "Flood Region" waters will seriously depend on the soundness of the engineering solutions proposed. We propose a water resource management scheme to rigorously pursue sustainable development and geopolitical stability in the region.

3 - A decision support methodology for increasing public investment efficiency in Brazilian agrarian reform

João Neiva de Figueiredo, Production and Systems Engineering Department, Federal University of Santa Catarina - UFSC, Campus Trindade - CTC/EPS, C.p. 476, 88010-970, Florianópolis, Santa Catarina, Brazil, jneiva@deps.ufsc.br, *Leonardo Melgarejo*, *Carlos Ernani Fries*

Agrarian reform programs have had limited success in developing countries. Challenges facing the Brazilian program are described and a methodology to overcome them is presented. The model uses multivariate analysis, DEA, and a consensus-building mechanism to improve new settlement success rates, identifying key drivers for relocated families to reach self-sufficiency.

4 - Requisite Decisions by Development Stakeholders: The Case of Kenyan NGOs

Florence Omosa, Operational Research, London School of Economics, Houghton Street, 53626, Nairobi 00200, Nairobi, Kenya, fomosa2001@yahoo.co.uk

NGOs in Kenya have faced various obstacles such as weaknesses of the approaches applied in project development. To overcome this shortcoming I developed and systematically applied a generative and participatory decision-making process, Kushauriana. Overall, Kushauriana improved the decision-making process of project development and of a project's performance and impact.

■ MD-22

Monday, 3:30-5:00pm
Kahili I

DEA02: Theoretical Issues on DEA II

Cluster: Data Envelopment Analysis and Performance Management
Invited session
Chair: *Maria Portela*, Rua Diogo Botelho, 1327, 4169- 005 Porto, Porto, Portugal, csilva@porto.ucp.pt

1 - Zero Weights and Non-Zero Slacks: Different Solutions to the Same Problem

Maria Portela, Rua Diogo Botelho, 1327, 4169- 005 Porto, Porto, Portugal, csilva@porto.ucp.pt, *Emmanuel Thanassoulis*

This paper re-assesses three independently developed approaches that aim at solving the problem of zero-weights or non-zero slacks in DEA.

The methods are weights restricted, non-radial and extended facet DEA models. We demonstrate the equivalence between these methods, both in their aim and in the solutions they yield. We also show that the aforementioned methods modify the frontier by extending existing facets or creating unobserved facets. Further we propose a new approach that uses weight restrictions to extend existing facets. This approach has some computational advantages, because extended facet models normally make use of mixed integer programming models.

2 - A comprehensive procedure for ranking DMUs in deterministic nonparametric DEA models

José Solana Ibáñez, Administration and Bussines Management, UCAM (Catholic University San Antonio of Murcia), Campus de los Jerónimos, s/n, 30107, Murcia, Spain, jsolana@pdi.ucam.edu, *Juan Gómez García*

This paper deals with the problem of designing a valid protocol for ranking DMUs in deterministic nonparametric DEA models. Our all-inclusive procedure to get an unbiased classification takes account of every necessary aspects to obtain an initial ranking with no subjective corruption and is illustrated with a real application.

3 - Applying DEA to Category Analysis

Maximo Bosch, Industrial Engineering, University of Chile, Republica 701, Santiago, Chile, mbosch@dii.uchile.cl, *Marcel Goic*, *Pablo Bustos*

To address the complexity of taking decisions on every sku, retailers organize their products in categories, which operate as BU and may have different strategic orientation. Performance is measured at several outputs :sales, margin, penetration. Inputs are space, promotions, assortment. An straightforward application of DEA to this problem is presented

4 - Assessing group performance with Malmquist Indices: the evaluation of the brand effect in retailing

Ana Camanho, Faculdade de Engenharia, Universidade do Porto, Demegi - Gein, Rua Dr. Roberto Frias, 4200-465, Porto, Portugal, acamanho@fe.up.pt, *Clara Vaz*

This study explores the differences in performance between two groups of grocery stores with different brands. The paper develops a Malmquist-type index to distinguish internal inefficiencies from those associated with the group (or brand) characteristics. A fundamental characteristic of the new index is to compare groups in a static setting.

■ MD-23

Monday, 3:30-5:00pm
Kahili II

Healthcare Modeling I

Cluster: Health Care
Invited session
Chair: *Michael Carter*, Mech & Ind Engineering, University of Toronto, 5 Kings College Rd, M5s 3g8, Toronto, ON, carter@mie.utoronto.ca

1 - A New Approach to Patient Safety in the Radiation Treatment Process for Cancer

David Cooke, University of Calgary, 2500 University Drive NW, T2n 1n4, Calgary, Alberta, Canada, dlcooke@ucalgary.ca, *Robert Lee*, *Peter Dunscombe*

This paper describes a novel approach to improve the safety of patients undergoing radiation treatment for cancer. The unique feature

of this research is the way in which a quantitative operations research approach to risk analysis is being integrated with a more qualitative operations management approach to risk management.

2 - Assignment-Based Tabu Search for Scheduling Physicians in an Emergency Room

Bernard Gendron, Diro, Université de Montréal, C.P. 6128, succ. Centre-ville, H3c 3j7, Montréal, Québec, Canada, gendron@iro.umontreal.ca, *Jacques Ferland, Jean-Robert Quevillon*

Scheduling physicians in an emergency room is a complex task, which requires taking into account a large number of conflicting rules. We present a tabu search approach based on a classical assignment structure. We have developed specific rules to explore the neighborhood in order to minimize constraints' violations.

3 - Patient Clustering to support Simulation of patient Flow in Hospital Emergency Departments

Andrzej Ceglowski, Faculty of IT, Monash University, Po Box 63, 3800, Clayton, VIC, Australia, red.ceglowski@infotech.monash.edu, *Leonid Churilov*

Simulation models of hospital emergency departments have promised much but fail to deliver. The models fail because of inadequate patient classification. The objective of this paper is to demonstrate the use of nonparametric clustering techniques for patient classification and how this supports simulation of patient flow in emergency departments.

4 - Is Breast Cancer Screening One Size Fits All? Mathematical Modeling to Explore the Impact of Race on Screening Policy

Julie Simmons Ivy, University of Michigan, 701 Tappan Street, 48109, Ann Arbor, MI, jsimmons@bus.umich.edu

We present a model for optimizing screening policy utilizing the theory of partially observable Markov decision processes. We explore influence of incidence and mortality rates on screening policy developed by POMDP model and determine the impact of race on breast cancer screening policy from a payer and patient perspective.

■ MD-24

Monday, 3:30-5:00pm

Hibiscus I

Economics II

Cluster: Economics

Contributed session

Chair: *Mustafa Karakul*, School of Admin. Studies, York University, 2nd Floor Atkinson Bldg. Rm 260A, 4700 Keele St., M3j 1p3, Toronto, ON, Canada, mkarakul@yorku.ca

1 - Dynamic Road Pricing and Network Equilibrium for Freeway Electronic Toll Collection System under Build-Operate-Transfer Arrangement

Mei-Shiang Chang, Department of Business Administration, Chung Hua University, No. 707, Sec. 2, Wu-Fu Road, Tung Shiang Li, 30067, Hsin Chu City, mschang@chu.edu.tw, *Che-Fu Hsueh*

A nonlinear programming model with a variational inequality constraint is proposed to determine time-varying tolls for freeway electronic toll collection system under build-operate-transfer arrangement.

A modified Nelder-Mead simplex algorithm integrated with nested diagonalization method is elaborated to solve this problem. Numerical results are given to demonstrate its validity.

2 - Why is it worth paying the Cost to make the Work Fun for the Agent?

Ryohei Matsumura, Valdes, Tokyo Institute of Technology, 2-12-1, Ookayama meguro-ku, 152-8552, Tokyo, ryomatsu@valdes.titech.ac.jp, *Norimasa Kobayashi*

In standard agency models, only monetary incentive motivates the agent to work more. This paper proposes an agency model in which the principal invests to make the work fun for the agent, in addition to wage incentive. Our model is consistent with the research findings in psychology.

3 - Pricing and Inventory Control of Substitutable Products

Mustafa Karakul, School of Admin. Studies, York University, 2nd Floor Atkinson Bldg. Rm 260A, 4700 Keele St., M3j 1p3, Toronto, ON, Canada, mkarakul@yorku.ca, *Lap Mui Ann Chan*

As companies introduce improved new products, it is crucial that they consider the substitutability of their products while making pricing and procurement decisions. In this paper, we address this issue in a single-period model that considers the joint pricing and procurement decisions of two one-way substitutable products.

4 - Approximate Representation of Risk for Risk Management

Otilija Sedlak, Quantitative Methods In Economics, Economic Faculty Subotica, Put Mosa Pijade 9-11, Ivana Sarica 14., 24000, Subotica, Serbia and Montenegro, otilijas@eccf.su.ac.yu, *Ciric Zoran*

Using a probabilistic method, usually it is difficult to obtain precise relation between events and probabilities of occurence. Fuzzy risk can be defined as an approximate representation to show risk with fuzzy theory. The benefit of fuzzy risk assessment is that saves more information for risk management.

■ MD-25

Monday, 3:30-5:00pm

Hibiscus II

Combat Analysis

Cluster: Military Applications

Invited session

Chair: *Bruce Simpson*, The Institute for Defense Analyses, Alexandria, VA, United States, bsimpson@ida.org

1 - Analysis in Support of the Campaign Plan for Operation Iraqi Freedom

Darrall Henderson, Math, United States Military Academy, 626 Swift Road, MADN-Math, 10996, West Point, NY, darrall@stanfordalumni.org

Combat analysts are currently deployed world wide to support ongoing military operations. This talk discusses analysis supporting military strategies related to political and military objectives in the Multi-National Force - Iraq area of responsibility. Strategic initiatives related to the campaign plan for Operation Iraqi Freedom are highlighted.

2 - Future Combat Systems Unit Set Fielding

William Klimack, Department of Systems Engineering, US Military Academy, Mahan Hall, 10996, West Point, NY, United States, william.klimack@us.army.mil, *David Sanders*

Differences in US Army Future Combat Systems from current equipment requires that it be fielded in unit sets. Decision Analysis was employed to recommend the best fielding course of action.

3 - Information Management in a Combat Operations Center

Michael Kwinn, Operations Research Center, US Military Academy, Department of System Engineering, 10996, West Point, NY, michael.kwinn@usma.edu, *Steve Henderson*

The 3rd Armor Cavalry Regiment deployed in February to Iraq. Prior to deployment, their commander recognized the need to improve his Tactical Operations Center management, especially in the area of information management. He asked the Oeprations Research Center of Excellence at West Point to help.

Tuesday, 9:00-10:30am

■ TA-01

Tuesday, 9:00-10:30am
Honolulu I

Forestry

Cluster: Renewable and Natural Resources
Invited session

Chair: *Darek Nalle*, College of Natural Resources, University of Idaho, 83844, Moscow, ID, United States, nalle@uidaho.edu

1 - Using Stand Centred Constraints for Integer Programming Models with Adjacency

Eldon Gunn, Industrial Engineering, Dalhousie Universityy, 5269 Morris St., B3j 2x4, Halifax, NS, Canada, eldon.gunn@dal.ca, *Evelyn Riohards*

We present a new formulation for adjacency in tactical forest management models. The formulation requires only a small number of constraints. Althoughnot all violations are eliminated, those that remain are few and easily dealt with. Problems of more than 6000 stands have been solved. The LP bounds are tight.

2 - A Real Options Approach to the Valuation of an Investment in Eucalyptus

M. Ricardo Cunha, Accounting and Finance Dept., Lancaster University and Universidade Catolica Portuguesa, LA1 4YX Lancaster, La1 4yx, Lancaster, United Kingdom, m.cunha@lancaster.ac.uk, *Dalila Martins Fontes*

We use exercise moment path dependent options to model optimal tree harvesting decisions. The option value is estimated using dynamic programming. The basic idea is to approximated the price by a binomial distribution and then establish a discrete-valued binomial lattice of possible future values. Results are provided for a case study involving the Portuguese forestry.

3 - Raw Material Sourcing Decisions for a Vertically Integrated Paper Mill

Jeffrey Ohlmann, Management Sciences, University of Iowa, 108 John Pappajohn Business Building, S372, 52242-1000, Iowa City, Iowa, United States, jeffrey-ohlmann@uiowa.edu, *Philip Jones*

To economically satisfy demand, a vertically integrated paper mill must appropriately manage its supply of raw materials from the forest to the finished product. In particular, we analyze the effect of land ownership and harvest rotation on the supply of wood fiber.

■ TA-02

Tuesday, 9:00-10:30am
Honolulu II

New Advances in Scheduling and Supply Chain Management

Cluster: Scheduling and Timetabling
Invited session

Chair: *C.t. Ng*, Department of Logistics, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, Hong Kong, Daniel.Ng@inet.polyu.edu.hk

1 - Scheduling Staging Operations in Distribution Centers

Guoqing Wang, Department of Business Administration, Jinan University, Guangzhou, China, tgqwang@jnu.edu.cn, *Xiongzhi Wang*

In this paper, we consider the problems of scheduling one or several forklifts which transport materials between storage and picking areas in distribution centers. The objective is to minimize the total travel distance of the forklifts. We either develop optimal algorithms or establish NP-hardness results for various system settings.

2 - Bicriteria Scheduling on a Batch Processing Machine

Lili Liu, Department of Logistics, The Hong Kong Polytechnic University, Hong Kong, Hong Kong, Hong Kong, 03902707r@polyu.edu.hk, *C.t. Ng*, *T.C. Edwin Cheng*

In this paper, we consider the problem of scheduling jobs on a batch processing machine so as to minimize a primary and a secondary criteria. We will provide optimal algorithms or NP-hardness proofs for various combinations of the primary and secondary criteria.

3 - A Dynamic Quantity-Price Game of MTO Outsourcing

Jia Yan, Department of Logistics, The Hong Kong Polytechnic University, M642, Li Ka Shing Tower, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, 000000, Hong Kong, Hong Kong, lgtjiay@polyu.edu.hk

We model a supply outsourcing system as a dynamic quantity-price game, where a stock-keeping distributor buys repetitive orders of non-perishable product from a make-to-order supplier. We investigate how the equilibirum is affected by factors such as market uncertainty, asymmetric information, inventory capacity, as well as supply capacity via simulation.

■ TA-03

Tuesday, 9:00-10:30am
Honolulu III

Non-Classical MCDA techniques and Applications

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *José Figueira*, School of Economics, University of Coimbra, Av. Dias da Silva, 165, Coimbra, Portugal, figueira@fe.uc.pt

1 - Evaluating the sustainability of a Nation using fuzzy MCDM approach

Yi-ting Liou, Bussiness Adiminstration, Kainan University, No. 1 Kainan Road Luzhu, Taoyuan County 338, 338, Taoyuan, Taiwan, ytliou@mail.knu.edu.tw

An index system to evaluate the sustainability of a nation is proposed. The parameters of sustainable assessment are constructed as uniformly decreasing or increasing functions, with relating the various levels during 1987 to 2003. It is important to choose the de-fuzzy function cause different sustain tendency can be resulted.

2 - On a fuzzy extension of the Choquet integral for ranking in Multiple Criteria Decision Aiding

Patrick Meyer, Service de Mathématiques Appliquées, University of Luxembourg, 162a, avenue de la Faïencerie, 1511, Luxembourg, Luxembourg, patrick.meyer@uni.lu, *Marc Roubens*

We present a MCDA approach to build a ranking on alternatives. The partial evaluations of the alternatives can be fuzzy numbers. We use a fuzzy extension of the Choquet integral to perform the aggregation. It is shown how to assess the parameters of the aggregator by the use of prototypes.

3 - Rough set approach to decision with a plurality of decision makers

Roman Slowinski, Institute of Computing Science, Poznan University of Technology, Laboratory of Intelligent Decision Support Systems, Street Piotrowo 3a, 60-965, Poznan, Poland, slowinsk@sol.put.poznan.pl, *Salvatore Greco*, *Benedetto Matarazzo*

We propose a Dominance Based Rough Set approach to decision with a plurality of decision makers (DM). On the basis of an input representing some exemplary decisions of a plurality of DMs, we induce a preference model expressed in terms of a set of "if..., then..." decision rules.

■ TA-04

Tuesday, 9:00-10:30am
Iolani I

Jordan Algebraic Approach in Optimization

Cluster: Conic Optimization
Invited session

Chair: *Masakazu Muramatsu*, University of Electro-Communications, Tokyo, Japan, muramatu@cs.uec.ac.jp

1 - A Homogeneous Model for Nonlinear Mixed Complementarity Problems over Symmetric Cones

Akiko Yoshise, Graduate School of Systems and Information Engineering, University of Tsukuba, Tsukuba, Ibaraki, 305-8573, Tsukuba, Ibaraki, Japan, yoshise@sk.tsukuba.ac.jp, *Yedong Lin*

We provide a homogeneous model for solving nonlinear mixed complementarity problems over symmetric cones. For a class of problems, the model has a bounded path and every accumulation point of the path gives information whether the original problem is solvable or strongly infeasible or other cases. We also show some optimization problems over symmetric cones whose optimality conditions can be cast as a problem in the class.

2 - Jordan-algebraic approach to convexity theorems for quadratic mappings

Leonid Faybusovich, Mathematics, University of Notre Dame, 255 Hurley Hall, 46556, Notre Dame, IN, United States, leonid.faybusovich.1@nd.edu

We use a unifying Jordan-algebraic approach to derive known and new results for the convexity of images for quadratic mappings. E.g. a new result is established for the convexity of the image of five and six quadratic forms (under certain structural assumptions). Applications to optimization problems are discussed.

3 - Sums of Squares and Semidefinite Programming Relaxations for Polynomial Optimization Problems with Structured Sparsity

Masakazu Muramatsu, University of Electro-Communications, Tokyo, Japan, muramatu@cs.uec.ac.jp, *Masakazu Kojima, Sunyoung Kim, Hayato Waki*

Unconstrained and inequality constrained sparse polynomial optimization problems (POPs) are considered. A correlative sparsity pattern graph is defined to bring out a certain sparse structure in the objective and constraint polynomials of a POP. Based on this graph, sets of supports for sums of squares (SOS) polynomials that lead to efficient SOS and semidefinite programming (SDP) relaxations are obtained. Numerical results for various test problems are included to exhibit improved performance of the SOS and SDP relaxations.

■ TA-05

Tuesday, 9:00-10:30am
Iolani II

Auctions I

Cluster: Auctions and e-markets
Invited session

Chair: *Paulo Correia*, Energy Department, Unicamp, C. Postal 6122, 13.083-970, Campinas, SP, Brazil, pcorreia@fem.unicamp.br

1 - The Microeconomics of Capacity-on-Demand Pricing

Phillip Yelland, Sun Microsystems Laboratories, 4150 Network Circle, 95054, Santa Clara, California, phillip.yelland@sun.com

Many IT vendors now supply certain products on a capacity-on-demand basis, allowing buyers to pay for processing and/or storage capacity above a base minimum only as and when the additional capacity is used. This paper examines a selection of microeconomic models designed to shed light on such pricing regimes.

2 - Fair Payments for Efficient Allocations in Public Sector Combinatorial Auctions

S. Raghavan, The Robert H. Smith School of Business, University of Maryland, 4345 Van Munching Hall, 20742-1815, College Park, MD, United States, raghavan@umd.edu, *Robert Day*

Motivated by the increasing use of auctions by governments, we consider the problem of fairly pricing goods in a combinatorial auction. We first demonstrate the strength of a mechanism that minimizes total payments among all possible bidder pareto-optimal core outcomes. Next, we describe a constraint-generation approach to compute these outcomes.

3 - Brazilian Electric Power Auction for Existing Capacity

Paulo Correia, Energy Department, Unicamp, C. Postal 6122, 13.083-970, Campinas, SP, Brazil, pcorreia@fem.unicamp.br

The Brazilian auction for existing electric power bought energy contracts of 8-years. It was a hybrid clock-dutch auction: a simultaneous descending clock phase followed by a simultaneous sealed-bid discriminatory one. The auction's volume was close to R$75 billions, purchasing 17,008 average-MW. This paper examines the auctions rules and its results.

■ TA-06

Tuesday, 9:00-10:30am
Iolani III

Network Design I

Cluster: Telecommunications and Network Design
Invited session

Chair: *Alper Atamturk*, Ieor, University of California-Berkeley, 4141 Etcheverry Hall, 94720-1777, Berkeley, CA, United States, atamturk@ieor.berkeley.edu

1 - 0-1 Reformulations of the Network Loading Problem

Bernard Gendron, Diro, Université de Montréal, C.P. 6128, succ. Centre-ville, H3c 3j7, Montréal, Québec, Canada, gendron@iro.umontreal.ca, *Antonio Frangioni*

We study reformulations of the Network Loading problem based on the multiple choice model, a generic approach to represent piecewise linear costs with 0-1 variables. We show that extended linking inequalities for this model are equivalent to the residual capacity inequalities derived for the model with general integer variables.

2 - A Study of Capacitated Fixed-Charge Path-Set Polyhedra

Alper Atamturk, Ieor, University of California-Berkeley, 4141 Etcheverry Hall, 94720-1777, Berkeley, CA, United States, atamturk@ieor.berkeley.edu, *Simge Kucukyavuz*

We describe strong valid inequalities for path relaxations of capacitated fixed-charge networks. We present easily computable lifting functions for a special case. A summary of computational experiments with the new inequalities is presented.

3 - Designing a m-ring-star network

Juan José Salazar González, Estadística e Investigación Operativa, Universidad de La Laguna (Tenerife), Av. Astrofísico Francisco Sánchez, s/n, 38271, La Laguna, Tenerife, Spain, jjsalaza@ull.es, *Roberto Baldacci, Mauro dell'Amico*

The Capacitated m-Ring-Star Problem (CmRSP) is to design a set of m rings passing through a depot and through transition points, and to assign each nonvisited customer to a visited point or customer. The problem has applications in the design of urban optical telecommunication networks. We present a branch-and-cut procedure.

■ TA-07

Tuesday, 9:00-10:30am
Iolani V

Financial Risk Management

Cluster: Management Information Systems
Invited session

Chair: *Rita D'Ecclesia*, Teoria Economica e Metodi Quantitativi per le Scelte politiche, Università di Roma, Piazza Aldo Moro 5, 00185, Roma, Italy, Italy, rita.decclesia@uniroma1.it

1 - Minimal risk trading strategies in commodities markets

Silvana Stefani, Metodi quantitativi, Università Milano Bicocca, Piazza Ateneo Nuovo 1 U6, I-20100, Milano, silvana.stefani@unimib.it, *Paolo Falbo*

We study a simmetric double bound trading strategy applied to a discrete mean reverting price process. Every value of the bound determines a finite probability to close the position before the maturity. We propose an analytical function to optimize trade excess returns for a minimal risk strategy.

2 - The influence of the business cycle on bankruptcy prediction

Suzan Hol, Norway Statistics, Kongens gate 6, 0033, Oslo, Norway, Suzan.Hol@ssb.no

We combine two fields of research on default prediction by empirically testing a bankruptcy prediction function where unlisted firms are evaluated on the basis of both movements in the business cycle and financial statement analysis, in the spirit of the credit risk model Credit Portfolio View.

3 - A Synthetic Measure of Cross-Sectional Risk and its Empirical Implications for Portfolio Risk Management

Andrea Roncoroni, Finance, Essec, Avenue Bernard Hirsch, BP 105, 95021, Cergy-Pontoise, France, roncoroni@essec.fr

We propose and test a risk measure quantifying the link between cross-sectional shape and market risk of interest-rate dynamics. We compare to the traditional cross-yield covariance in the US bond market. Cross-shape factors outperform cross-yield risk factors in terms of explanatory power of risk and hedging performance of multiple liabilities.

■ TA-08

Tuesday, 9:00-10:30am
Iolani VI

Supply Chain Management III

Cluster: Supply Chain Management
Invited session

Chair: *Mahesh Nagarajan*, Sauder School of Business, University of British Columbia, Henry Angus Building, Vancouver, British Columbia, Canada, mahesh.nagarajan@sauder.ubc.ca

1 - A Two-Stage Newsvendor Problem with a Service Constraint

Suresh Sethi, School of Management, SM30, University of Texas at Dallas, P.O. Box 830688, 75083, Richardson, TX, United States, sethi@utdallas.edu, *Alain Bensoussan, Qi Feng*

We obtain optimal ordering decisions for the newsvendor problem with service constraint and demand forecast update. The newsvendor orders an initial amount and adjusts it following the update. The service target is set before the demand update. Optimal policy properties and numerical results provide insights into the newsvendor's behavior.

2 - Information Sharing in a Supply Chain Under ARMA Demand

Avi Giloni, Sy Syms School of Business, Yeshiva University, 500 West 185th Street, BH 428, 10033, New York, New York, United States, agiloni@ymail.yu.edu, *Vishal Gaur, Sridhar Seshadri*

We study the value of information sharing in a supply chain under ARMA demand. We demonstrate how a manufacturer can determine when demand information is beneficial. When demand information is valuable, we provide a rule by which managers can determine when historical orders can be used to infer customer demand.

3 - Inventory and Sales Planning for Products with Warranty

Jayashankar Swaminathan, The Kenan-Flagler Business School, The University of North Carolina, The Kenan-Flagler Business School, Campus Box 3490, McColl Building, 27599-3490, Chapel Hill, North Carolina, United States, msj@unc.edu, *Vidyadhar Kulkarni, Wei Huang*

Manufacturers often have to plan for production of new products as well as the warranty parts. In this paper, we study inventory and sales planning when both new and products under warranty are taken into consideration.

4 - Transshipment of Inventories Among the Retailers: Myopic vs. Farsighted Stability

Greys Sosic, IOM Department, Marshall School of Business, University of Southern California, Bridge Hall 401, 90089, Los Angeles, CA, United States, sosic@marshall.usc.edu

Independent retailers are facing stochastic demands. After demand realization, some retailers may be left with residual demand/inventory. Inventory may be shared to fulfill unsatisfied demand, and the resulting profit is distributed among retailers. Retailers may form inventory-sharing subcoalitions. We analyze stable coalition structures with respect to myopic and farsighted stability.

■ TA-09

Tuesday, 9:00-10:30am
Iolani VII

Recent Advances in Metaheuristics

Cluster: Metaheuristics
Invited session

Chair: *Stefan Voss*, Wirtschaftsinformatik/Information Systems, University of Hamburg, Von-Melle-Park 5, 20146, Hamburg, Hamburg, Germany, stefan.voss@uni-hamburg.de

1 - Variable Neighbourhood Search for the Labeling Spanning Tree Problem

Monica Gentili, University of Salerno, P.te Don Melillo, Fisciano, 84084, Salerno, mgentili@unisa.it, *Raffaele Cerulli, Andreas Fink, Stefan Voss*

Given a graph G where each edge is assigned a label, the minimum labeling spanning tree problem consists in finding a spanning tree of G such that the number of different labels is minimized. We define different neighborhoods to implement a VNS resolution technique and show extensive experimental results.

2 - Sequential versus Simultaneous Maximization of Objective and Diversity

Stefan Voss, Wirtschaftsinformatik/Information Systems, University of Hamburg, Von-Melle-Park 5, 20146, Hamburg,

Hamburg, Germany, stefan.voss@uni-hamburg.de, *Peter Greistorfer, Arne Lokketangen, David Woodruff*

Often objective function and constraints are a very rough approximation to the goals of the decision makers. In these situations one might prefer to see at least two decisions that are dissimilar, yet both good. Such solutions can be generated sequentially or simultaneously. We explore the tradeoffs between these approaches.

3 - Similarity and Distance Functions to Support VRP Search

David Woodruff, UC Davis, Davis, United States, dlwoodruff@ucdavis.edu, *Arne Lokketangen*

Consider the family of vehicle routing problems (VRP). Our goal in this paper is the specification of similarity measures between solutions to a VRP instance. Such measures can have many applications; some of them will be outlined in the talk.

4 - Simulation of Double Rail Mounted Gantry Cranes - A Performance Analysis

Stefan Voss, Wirtschaftsinformatik/Information Systems, University of Hamburg, Von-Melle-Park 5, 20146, Hamburg, Hamburg, Germany, stefan.voss@uni-hamburg.de, *Robert Stahlbock, Rene Eisenberg, Dirk Steenken*

Automated double rail mounted gantry cranes (DRMGs) represent one of the latest designs of storage equipment in modern automated container terminals. In this paper we discuss the different optimization problems inherent to DRMGs, identify performance dependencies on adjacent systems and measure the performance of basic optimization models by simulation.

■ TA-10

Tuesday, 9:00-10:30am

Tapa Ballroom I

Intermodal Transportation: Issues, Some Models, Many Challenges

Cluster: Tutorials

Invited session

Chair: *Janny Leung*, Systems Engineering & Engineering Management Dept., The Chinese University of Hong Kong, Shatin, NT, Hong Kong, janny@se.cuhk.edu.hk

Chair: *Raymond Cheung*, Industrial Engineering & Engineering Management, Hong Kong University of Science & Technology, Clearwater Bay, Kowloon, rcheung@ust.hk

Chair: *Tore Grünert*, GTS Systems and Consulting GmbH, Raiffeisenstr. 10, 52134, Herzogenrath, Germany, gruenert@gts-systems.de

1 - Intermodal Transportation: Issues, Some Models, Many Challenges

Teodor Gabriel Crainic, Management and Technology, Univ. du Québec à Montréal, C.P. 8888, succ. Centre-Ville, H3c 3p8, Montréal, Québec, Canada, theo@crt.umontreal.ca

In its most simple definition, intermodal transportation corresponds to the movement of people or goods using a chain of modes which connect at intermodal terminals. In this talk, we focus on freight intermodal transportation which is becoming the backbone of international and continental trade. Even in this restricted sense, intermodal transportation is many things to many people, from dedicated-rail services

that move massive quantities of containers and trailers over long distances to national planning, from the planning of intermodal terminals to defining transportation policy for the European Community. And thus, to fit within a reasonable time span, the transportation of cargo using containers is the main topic of the presentation. Following a brief overview on intermodal freight transportation, we examine a number of planning issues associated to carriers and intermodal facilities involved in container transportation together with models and methods dedicated to these issues. Perspectives on research directions, challenges, and opportunities conclude the talk.

■ TA-11

Tuesday, 9:00-10:30am

Tapa Ballroom II

Packing and related problems

Cluster: Combinatorial Optimization

Invited session

Chair: *Andrea Lodi*, D.e.i.s., University of Bologna, Viale Risorgimento 2, 40136, Bologna, Italy, alodi@deis.unibo.it

Chair: *Silvano Martello*, Deis, University of Bologna, Viale Risorgimento 2, 40136, Bologna, Italy, smartello@deis.unibo.it

1 - A Cutting Plane Approach for the Two-Dimensional Orthogonal Non Guillotine Cutting Stock Problem

Roberto Baldacci, Dismi, University of Modena and Reggio Emilia, Viale A. Allegri, 15, 42100, Reggio Emilia, Italy, baldacci.roberto@unimore.it, *Marco Boschetti*

The Two-Dimensional Orthogonal Non-Guillotine Cutting Stock consists in orthogonally cutting a rectangular container into rectangular pieces, each with size/value, with the objective of maximizing the value of cut pieces. We propose a two-level approach: (1) a subset of pieces is selected, (2) we check its feasibility. Computational results are reported.

2 - Exact Algorithms for the 2-Dimensional Strip Packing Problem with Rotations

Mitsutoshi Kenmochi, Department of Applied Mathematics and Physics, Kyoto University, Yoshidahonmachi, Sakyo-ku, 606-8501, Kyoto, Japan, kenmochi@amp.i.kyoto-u.ac.jp, *Takashi Imamichi, Koji Nonobe, Mutsunori Yagiura, Hiroshi Nagamochi*

We examine various strategies for exact approaches to the 2-dimensional strip packing problem (2SP) with rotations and propose a new branching rule in branch-and-bound algorithms for the perfect packing problem (PP), which is a special case of 2SP. This rule is very effective especially for feasible instances of PP.

3 - Packing rectangles into a square

Michele Monaci, D.e.i., University of Padova, Via Gradenigo 6/A, 35131, Padova, Italy, monaci@dei.unipd.it, *Alberto Caprara, Andrea Lodi, Silvano Martello*

The Square Packing Problem consists of packing a given set of rectangular items into a unique square bin such that: all items are orthogonally packed; items do not overlap; and the square side is minimized. We discuss lower bounds, and preliminary computational results on several variants of the problem.

■ TA-12

Tuesday, 9:00-10:30am
Tapa Ballroom III

Maritime Transportation

Cluster: Transportation
Invited session

Chair: *Marielle Christiansen*, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Alfred Getz vei 3, N-7491, Trondheim, Norway, Marielle.Christiansen@iot.ntnu.no

1 - A multiple-port containership stowage problem

Mabel Chou, Decision Sciences, National University of Singapore, 1 Business Link, BIZ 1, #04-08, 117592, Singapore, bizchoum@nus.edu.sg, *Joan Boo, I A Karimi*

We consider a containership stowage problem that occurs in container terminals. We propose a model that deals with practical issues where there is limited research. Our objective is to minimize the number of container shifts in a circular route with constraints related to the positions of containers on a containership.

2 - Contract Selection and Tank Allocation in a Terminaling and Storage Facility

I A Karimi, Chemical & Biomolecular Engineering, National University of Singapore, 4 Engineering Drive 4, 117576, Singapore, cheiak@nus.edu.sg

Temporary storage of chemicals for transshipment, trade, break-bulk, or routine manufacturing is a service that many shippers and 3PL companies offer for chemical logistics. In this paper, we present a methodology for contract selection and tank allocation for a given planning horizon to maxiize the profit for a logistics provider.

3 - A Hybrid Continuous Time Model for Marine Transportation of Multiple Bulk Products with Specialized Shipping Cost Structure

Kevin Furman, Corporate Strategic Research, ExxonMobil Research & Engineering, 1545 Route 22 East, 08801, Annandale, NJ, United States, kevin.c.furman@exxonmobil.com, *Marco Duran*

In the routing, scheduling and inventory management of bulk products, continuous time models can reduce the combinatorial complexity at the expense of additional constraints. We propose a hybrid approach that incorporates the strengths of both continuous and discrete time models by differentiating on a port specific basis. An MILP formulation is developed and illustrated through example cases.

4 - LNG supply chain optimization

Marielle Christiansen, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Alfred Getz vei 3, N-7491, Trondheim, Norway, Marielle.Christiansen@iot.ntnu.no

When planning the routing and scheduling of liquefied natural gas(LNG) ships, it is necessary to consider larger part of the LNG supply chain. Therefore, we present a planning problem including models and solution approaches integrating the inventory management at the liquefaction plants and regasification terminals and the routing and scheduling.

■ TA-13

Tuesday, 9:00-10:30am
Sea Pearl I

Simulation and Quality Management

Cluster: Quality, Statistics and Reliability
Invited session

Chair: *Jeff Hong*, Hkust, Kowloon, Hong Kong, hongl@ust.hk

1 - Using Simulation to Improve Assembly Operations Performance

Bernardo Villarreal, Ingeniería Industrial, Universidad De Monterrey, I. Morones Prieto 4500 Pte., 66238, Sn Pedro Garza Garcia, N.L., Mexico, bvillarreal@udem.edu.mx

The present work describes the utilization of simulation to guide the improvement efforts during the redesign and operation of an assembly line system in a Mexican manufacturing facility. Initially, simulation is applied to assess the operating feasibility of modifying the actual system structure to a new one that is more amenable to a JIT working environment. Once the assembly lines start operations, the model is also used to identify areas with the greatest improvement potential.

2 - Designing Reliable Systems via Simulation with SREMS

Javier Faulin, Department of Statistics and OR, Public University of Navarra, Los Magnolios Building, 1st Floor, Campus Arrosadía., 31006, Pamplona, Navarra, Spain, javier.faulin@unavarra.es, *Angel Juan, Vicente Bargueño*

Designing reliable systems is an important task for managers and engineers. In this paper we present some ideas behind a simulation-based method SREMS, which provides good estimates of system reliability and system failure time parameters. Furthermore, it allows identifying those components that play a critical role in the system durability.

3 - Simulation Factor Screening With Controlled Sequential Bifurcation in the Presence of Interactions

Hong Wan, School of IE, Purdue University, 315 N. Grant Street, 47907-2023, West Lafayette, IN, United States, hwan@purdue.edu, *Barry L. Nelson, Bruce Ankenman*

This talk will present CSB-X, a factor-screening method for discrete-event simulations. CSB-X controls both the power and the Type I Error for screening main effects even when two-factor interactions are present. A new fully sequential hypothesis-testing procedure is introduced that greatly improves the efficiency of the screening.

■ TA-14

Tuesday, 9:00-10:30am
Sea Pearl II

OR MAGIC: Math, Art and Games in the Classroom

Cluster: Education, Innovation and Distance Learning
Invited session

Chair: *Martin Chlond*, Information and Finance, University of Central Lancashire, Corporation Street, Pr7 2he, Preston, mchlond@uclan.ac.uk

1 - An Introduction to OR MAGIC: Math, Art and Games in the Classroom

Martin Chlond, Information and Finance, University of Central Lancashire, Corporation Street, Pr7 2he, Preston, mchlond@uclan.ac.uk

This session will promote the use of unusual and interesting applications of OR modeling techniques. The purpose is to encourage use these offbeat examples in a classroom setting to capture the attention of students and stimulate motivation to learn. Examples are taken from games, recreational mathematics and Opt Art.

2 - Opt Art: Using Optimization to Create Pictures, Portraits, and Other Works of Art

Robert Bosch, Mathematics, Oberlin College, 10 North Professor St., King Building 205, 44074, Oberlin, Ohio, bobb@cs.oberlin.edu

"Opt Art" stands for art constructed with the aid of mathematical optimization techniques. We will present several examples of Opt Art, including: domino portraits via integer programming, pointillism via linear programming, and continuous line drawings via the "solution" of large-scale traveling salesman problems.

3 - Let's Make A Deal (Or At Least Simulate A Few)

John Ruggiero, Economics and Finance, University of Dayton, 517 Miriam Hall, 45469-2251, Dayton, Ohio, ruggiero@notes.udayton.edu

Based on the game show "Let's Make a Deal," a popular puzzle in probability theory was developed. In this paper, spreadsheet modeling and VBA are used to simulate the Monty Hall game.

4 - Educational OR/MS Games: why and how

Moshe Sniedovich, Mathematics and Statistics, The University of Melbourne, Richard Berry Building, 3052, Parkville, VIC, Australia, m.sniedovich@ms.unimelb.edu.au

In this presentation we examine the role that games and puzzles can play in OR/MS courseware. The discussion is based on extensive experience with mathematically oriented introductory and advanced OR/MS courses and focuses on the educational content of games. Specific dynamic programming and integer programming games are analyzed.

■ TA-15

Tuesday, 9:00-10:30am
Sea Pearl III

Vehicle Routing with Time Windows

Cluster: Routing
Invited session

Chair: *Jorge Riera-Ledesma*, Estadística, Investigación Operativa y Computación, DEIOC-Universidad de La Laguna, C/ Astrofísico Francisco Sánchez s/n, 38271, La Laguna, Spain, jriera@ull.es

1 - Efficient Local Search for Multi-Depot/Heterogeneous Fleet Vehicle Routing Problems with Complex Side Constraints

Stefan Irnich, Operations Research, RWTH Aachen, Templergraben 64, 52062 Aachen, 52062, Aachen,

Afghanistan, sirnich@or.rwth-aachen.de, *Tore Grünert*, *Birger Funke*

Nearly all (meta)heuristics for VRP rely on local search(LS). Standard LS procedures build a neighbor solution first and check its feasibility afterwards. Typically, the feasibility check causes an extra effort of O(n) for instances of size n. We present new techniques to search neighborhoods of size O(nk) in O(nk) time.

2 - New Decision Rules In Construction Models For Vehicle Routing Problems With Time Windows.

Eduardo Guillén, Economic Analysis and Business Administration, University of La Coruña, E.U. Diseño Industrial. Dr. Vazquez Cabrera S.N., 15403- Ferrol Spain, 15403, Ferrol, Spain, edugs@udc.es, *Manuel Martinez*, *Susana Barbeito*

A series of new decision rules for constructing routes in VRPTW are presented. These rules are integrated in an algorithm for solving the Solomon benchmark problems. Both the mathematical model and the solutions for the 56 problems are presented, providing in some cases better solutions than the original model.

3 - Analysis of Oil Pipeline Distribution Subject to Delivery Time-Windows

Phongchai Jittamai, School of Industrial Engineering, Suranaree University of Technology, 111 University Avenue, Muang District, 30000, Nakhon Ratchasima, Thailand, jittamai@ccs.sut.ac.th, *Alberto Garcia-Diaz*

The single-source oil pipeline distribution with delivery time-windows is modeled as multicommodity network flow structure with additional time-window constraints. The main focus is the investigation of operating issues, problem complexity and the solution approach to compute input schedule that yields minimum total time deviation from delivery time-windows.

■ TA-16

Tuesday, 9:00-10:30am
Sea Pearl IV

Computational DP

Cluster: Dynamic Programming
Invited session

Chair: *Art Lew*, ICS Dept, University of Hawaii, Post 317, 96822, Honolulu, Hawaii, United States, artlew@hawaii.edu

1 - Automated Solution of Dynamic Programming Problems with DP2PN2Solver

Holger Mauch, Information and Computer Science, University of Hawaii, 1680 East West Road, 96822, Honolulu, HI, United States, hmauch@hawaii.edu

The DP2PN2Solver software automates the tasks a user encounters when solving a discrete optimization problem by means of dynamic programming. The problem specification, including the functional equation, is first parsed and transformed into an intermediate Petri net ("Bellman Net") representation and finally translated into executable code that solves the problem.

2 - Distributed Actor-Based Approach to the Optimal Polygon Triangulation Problem with Visualization Using Colored Petri Nets

Boleslaw Mikolajczak, Computer and Information Science Department, University of Massachusetts Dartmouth, 287 Old Westport Road, Dartmouth, MA 02747, 02747, Dartmouth, MA, bmikolajczak@umassd.edu

A dynamic programming optimization problem of polygon triangulation is being considered in this paper. First, we specify the problem visually and formally using colored Petri nets. The visualization provides natural decomposition options for a designer of a distributed implementation of the polygon triangulation problem. Secondly, several of these decompositions are implemented within the Actor-based distributed programming paradigm using the ActorFoundry environment from the University of Illinois at Urbana-Champagne. Performance analysis of these implementations in terms of execution times, speedups and efficiencies is presented.

3 - Adaptive Resource Allocation Technique to Stochastic Multimodal Projects: A Distributed Platform Implementation in JAVA

Anabela Tereso, Systems and Production Department, Minho's University, 4800-058, Guimarães, Portugal, anabelat@dps.uminho.pt, *Joao Mota, Rui Lameiro*

This paper presents the implementation of the dynamic programming model (introduced in a previous paper) for the resolution of the adaptive resource allocation problem in stochastic multimodal project networks. A distributed platform using an Object Oriented language, JAVA, is used in order to take advantage of the available computational resources.

■ TA-17

Tuesday, 9:00-10:30am

Sea Pearl V

Optimization and Radiation Oncology

Cluster: Multi-Criteria Decision Analysis

Invited session

Chair: *Allen Holder*, Mathematics, Trinity University, 715 Stadium Drive, 78212, San Antonio, Texas, United States, aholder@trinity.edu

1 - A Greedy, Least-Squares Approach for IMRT Fluence Map Optimization

Yin Zhang, Dept. of CAAM, Rice University, 6100 Main Street, Rice University, 77005, Houston, Texas, United States, yzhang@caam.rice.edu, *Michael Merritt*

The combinatorial nature of dose-volume constraintsi in IMRT poses significant challenges to fluence map optimization. We introduce a greedy approach based on a least-squares formulation which treats dose distributions as primary independent variables and beamlet intensities as secondary. We will present theoretical and computational results for the proposed approach.

2 - Models for Radiation Therapy Treatment Planning

Edwin Romeijn, 303 Weil Hall, University of Florida, 32611, Gainesville, FL, United States, romeijn@ise.ufl.edu, *James Dempsey, Jonathan Li*

We discuss the relationship between dose distribution dominance and criteria that are separable in the dose received by individual points in the patient in the context of optimization models for radiation therapy treatment planning. We also show that many proposed criteria are equivalent to separable criteria in a multi-criteria optimization setting.

3 - Planning Radiotherapy Treatments via Multiple Objective Programming

Allen Holder, Mathematics, Trinity University, 715 Stadium Drive, 78212, San Antonio, Texas, United States, aholder@trinity.edu

Linear programming models have been used to design radiotherapy treatments since the middle 1960s. Most models rely on the discrete radon transform, but differ in their objectives. We show how to incorporate multiple objectives in a manner that provides meaningful solution information. Specifically, we define a multiple objective optimal partition and use this construct to reduce the number of variables.

■ TA-19

Tuesday, 9:00-10:30am

Nautilus I

AHP04: Applications of the ANP

Cluster: Analytic Hierarchy / Network Process

Invited session

Chair: *Mujgan Sagir Ozdemir*, Industrial Engineering Department, Osmangazi University, Osmangazi University Engineering and Architecture Faculty, Industrial Engineering Department Bademlik, 26030, Eskisehir, mujgano@ogu.edu.tr

1 - Multi Criteria Faculty Course Assignment Problem: Modelling and Solving

Rafail Gasimov, Industrial Engineering, Osmangazi University, Bademlik, 26030, Eskisehir, Turkey, gasimovr@ogu.edu.tr, *Mujgan Sagir Ozdemir*

A new approach for solving the multi criteria faculty course assignment problem is provided that ensures an optimum solution. The Analytic Network Process is used to determine the weights of different objectives. The problem is scalarized by using the conic scalarization approach. A real life application is included.

2 - A Strategic Model for Performing Pilgrimage (Alhaj) Safely: An Application of The Analytic Network Process

Asma Bahurmoz, Business Administration, King Abdulaziz University, P.O. Box 9550, 21423, Jeddah, Saudi Arabia, bahurmoz@kaau.edu.sa

Many solutions have been proposed for safe Pilgrimage, knowing that the problem is very complex, it involves many actors, and many entangled criteria and elements. This paper presents The Analytic Network Process as a sound methodology to structure Alhaj problem and disentangle its complexity and to identify the best strategy.

3 - Interdependent Transportation Infrastructure Project Selection Using A Combined Analytic Network Process and Goal Programming Approach

Wann-Ming Wey, Graduate School of Architecture and Urban Design, Chaoyang University of Technology, 168 Gifeng E.

Rd., Wufeng, 413, Taichung County, Taiwan, wmwey@mail.cyut.edu.tw

Transportation Infrastructure project selection means identifying some alternative projects in order to maximize the net benefit and allocating resources among those alternatives within the given constraints. This research aims at developing an integrated approach for interdependent TI project selection problems using Fuzzy Delphi, Analytic Network Process concept and Zero-One Goal Programming.

4 - Assignment Problem in Turkish Armed Forces

Mujgan Sagir Ozdemir, Industrial Engineering Department, Osmangazi University, Osmangazi University Engineering and Architecture Faculty, Industrial Engineering Department Bademlik, 26030, Eskisehir, mujgano@ogu.edu.tr, *Orcun Sayin*

In every five years, Turkish Armed Forces personnel are asked to fill a city preference form before their assignment. Since they are usually assigned to their first or second choice, these preferences become very important on their career. An Analytic Network Process model is used to decide the best city.

■ TA-20

Tuesday, 9:00-10:30am
Nautilus II

Analysis of the Risks and Consequences of Terrorist Events

Cluster: Decision Analysis
Invited session

Chair: *Detlof von Winterfeldt*, University of Southern California, Los Angeles, CA, United States, detlof@aol.com

1 - CREATE: The Homeland Security Center for Risk and Economic Analysis of Terrorist Events

Detlof von Winterfeldt, University of Southern California, Los Angeles, CA, United States, detlof@aol.com

CREATE is the first university-based center of excellence funded by the Department of Homeland Security. Since early 2004, CREATE researcher have conducted analyses of the risks, consequences, emergency response, and economic consequences of terrorism. This presentation gives an overview of the activities of CREATE.

2 - A Risk Analysis of Dirty Bomb Attacks in the LA/Long Beach Harbors

Heather Rosoff, University of Southern California, Los Angeles, CA, United States, rosoff@usc.edu

This analysis examines 36 scenarios of possible dirty bomb attacks in the LA/Long Beach harbors. Using project risk analysis tools, we estimates the success probability of such an attack. Plume models are used to estimate cancer deaths. An input-output model provides estimates of the consequences of a prolonged port shutdown.

3 - Evaluating the Security of the Global Containerized Supply Chain

Henry Willis, Rand Corporation, Pittsburgh, PA, United States, hwillis@rand.org, *David Ortiz*

Containerized shipping is a driving force of the global economy. The vulnerability of this system to terrorist attack is widely recognized and new security measures have therefore proliferated. This paper defines a framework for assessing the effects of these measures and reviews the balance of current container security risk-reduction efforts.

4 - OR for Designing Response Plans to Catastrophic Events

Richard Larson, Mit, Boston, United States, rclarson@MIT.EDU

Building on OR models of urban police, fire and ambulances, we discuss modeling response to catastrophes including terrorist attacks. First responder resources are overwhelmed, so 2nd and possibly 3rd tier responders are deployed. The goal is to provide a decision tool to assess the quality of alternative emergency response plans.

■ TA-21

Tuesday, 9:00-10:30am
Lehua Suite

Numerical Methods for Internet Congestion Systems

Cluster: Applied Probability
Invited session

Chair: *Don Gross*, Systems Engineering & Operations Research, George Mason University, 4400 University Dr., MS 4A6, 22030, Fairfax, VA, United States, dgross1@gmu.edu

Chair: *John Shortle*, Systems Engineering & Operations Research, George Mason University, 4400 University Dr., MS 4A6, 22030, Fairfax, VA, jshortle@gmu.edu

1 - VoIP Performance Modeling - A Discussion

Martin Fischer, Mitretek Systems, 3150 Fairview Park Drive, 22042, Falls Church, VA, mfischer@mitretek.org, *Denise Masi*

In this presentation we will discuss the overall problem of performance modeling of Voice over IP systems. Our discussions will focus on potential queue disciplines to support meeting the required quality of service (QoS) for voice and the availability of models to evaluate the voice QoS metrics. In addition, we present a discussion of models for the voice packet arrival process.

2 - Investigations into Physical Power-law Models for Internet Packet Bursts Using the Renormalization Group

Neil Gunther, Consulting Services, Performance Dynamics, 4061 East Castro Valley Blvd, Castro Valley, 94552, Castro Valley, California, njgunther@perfdynamics.com

We seek to determine physical models of long-range dependence in the burst patterns of Internet traffic, from those power laws that are unphysical. The main tool used to make such discriminations is the Renormalization Semi-Group. Numerical examples will be presented.

3 - Traffic Measurement on IP Networks 1995-Present

Kevin Thompson, Cise/sci, National Science Foundation, Suite 1145, 4201 Wilson Blvd, 22230, Arlington, VA, kthompso@nsf.gov

This talk surveys studies and results of IP traffic measurement over the last 10 years. Methods and findings across a range of measurement projects are described, including the speaker's papers on characterizing traffic on a core backbone. Current NSF-funded activities in network measurement rounds out the talk.

■ TA-22

Tuesday, 9:00-10:30am
Kahili I

DEA03: Theoretical Issues on DEA III

Cluster: Data Envelopment Analysis and Performance Management
Invited session

Chair: *Ali Emrouznejad*, Statistics and Operational Research, Coventry University, Mis, Priory Street, Cv1 5fb, Coventry, United Kingdom, ali@DEAzone.com

1 - A new framework for solving DEA problems

Gautam Appa, Operational Research, London School of Economics, Houghton Street, London, Wc2a 2ae, London, United Kingdom, g.appa@lse.ac.uk, *H. Paul Williams*

We provide an alternative framework for solving DEA models based on the Fourier-Motzkin Elimination method which provides all possible optimal weights for all DMUs at one go. A two phase approach minimizes extra computational work compensated by improved methods for i) calculating cross-efficiencies, ii) sensitivity analysis and iii) weight flexibility.

2 - A Variant of DEA-based Window Analysis With Pooled Data

Robert Wilken, Economic Department, Institut fuer Anlagen und Systemtechnologien, Am Stadtgraben 13-15, 48143, Muenster, Germany, robert.wilken@uni-muenster.de

Dynamic models have become a widely-spread framework in efficiency measurement. We develop a variant of DEA-based Window Analysis (WA). The variant determines for every decision-making unit (DMU) and window one optimal weighting structure, nevertheless allowing for period-specific efficiency values. We compare our variant with traditional WA using the cross-efficiency concept.

3 - New tools for Managing Performance of Organizational Units

Ali Emrouznejad, Statistics and Operational Research, Coventry University, Mis, Priory Street, Cv1 5fb, Coventry, United Kingdom, ali@DEAzone.com

This paper presents a newly developed software which includes many of the most recent DEA models: All types of returns to scale (NIRS/NDRS/CRS/VRS); Weight restriction; Panel data; Analysis of categorical data (multiple categories); Malmquist Index; Supper efficiency; Automated removal of super-efficient outliers; Cross efficiency calculation; Statistical tests and many more.

4 - Data Envelopment Analysis (DEA) - versus - Discriminant Analysis (DA)

Amit Chandra Majumdar, Professor & Head : MBA (Evening), Indian Institute of Social Welfare & Business Management, Management House, College Square West, 700073, Calcutta, West Bengal, India, acmajumdar@iiswbm.edu, *Shyama Prasad Mukherjee*

It is possible to apply Discriminant Analysis (DA) to provide a common set of weights for all DMUs based on their inputs and outputs. The paper attempts a comparative study involving both DEA and DA in a situation covering seventeen DMUs for which data on inputs and outputs could be collected over a period of four years.

■ TA-23

Tuesday, 9:00-10:30am
Kahili II

Healthcare Modeling II

Cluster: Health Care
Invited session

Chair: *Michael Carter*, Mech & Ind Engineering, University of Toronto, 5 Kings College Rd, M5s 3g8, Toronto, ON, carter@mie.utoronto.ca

1 - Capacity reservation for primary care clinics with patient choice

Diwakar Gupta, Mechanical Engineering, University of Minnesota, Graduate Program in IE, 111 Church Street S.E., 55455, Minneapolis, MN, United States, guptad@me.umn.edu

Many US clinics have implemented advanced-access systems, which allow patients to choose a same-day or a future appointment. We describe a dynamic model for reserving capacity for same-day patients, accounting for patients' preferences and show that simple critical number policies are either optimal or near optimal.

2 - Use of Statecharts for modeling patient flow in surgical care

Boris Sobolev, Health Care & Epidemiology, University of British Columbia, Vancouver, BC, Canada, sobolev@interchange.ubc.ca, *Christos Vasilakis*, *Adrian Levy*

We use Statecharts formalism for finite state machines to describe patient flow in surgical care. Surgical service delivery is modelled as asynchronous parallel processes which update common data elements for subordination and coordination between machines. We present an example of policy analysis for two-specialist surgical service.

3 - An asynchronous event-driven model of surgical process scheduling

Christos Vasilakis, Health Care and Epidemiology, University of British Columbia, C2E2, VGH Research Pavilion, 828 W 10th Ave, V5z 1l8, Vancouver, British Columbia, Canada, christos@interchange.ubc.ca, *Boris Sobolev*, *Adrian Levy*, *Serge Boyko*

Satecharts formalism was used to develop asynchronous event-driven models of surgical process scheduling. We introduce basic finite-state machines that represent managerial processes in forming the operating room schedule. Models for two scheduling systems, centralized wait list and individual wait lists per surgeon, are discussed.

4 - Simulation of patient flows in a mental health care setting: a case study

Jan Vissers, Technology Management, Eindhoven University of Technology, PO Box 513, 5600 MB Eindhoven, 5600 Mb, Eindhoven, Netherlands, j.m.h.vissers@tm.tue.nl, *Jan van der Eijk*, *Hans De Veen*, *Bert Jan Roosenschoon*

The paper addresses the problem of bed blocking in mental health care. Support was sought for the effects of an extra ward for long stay clients on the throughput. A simulation model was built, using a description of resource demand resulting from groups of clients that follow similar trajectories.

■ TA-24

Tuesday, 9:00-10:30am

Hibiscus I

Finance I

Cluster: Finance

Contributed session

Chair: *Inguruwatte M Premachandra*, Finance and Quantitative Analysis, University of Otago, PO Box 56, Dunedin, New Zealand, 9001, Dunedin, ipremachandra@business.otago.ac.nz

1 - The relation between option pricing and optimization problems

Michi Nishihara, Applied Mathematics and Physics, Kyoto University, Yoshidahonmachi, Sakyoku, 606-8501, Kyoto, Japan, michi@amp.i.kyoto-u.ac.jp, *Mutsunori Yagiura*, *Toshihide Ibaraki*, *Hiroshi Nagamochi*

We investigate the option pricing problem based only on the no-arbitrage assumption, without assuming any stochastic model. We theoretically extend Bertsimas and Popescu's results that the problem can be solved efficiently via convex programming. Furthermore we confirm that our results are practical from computational results using real data.

2 - Managing equity portfolios with multiple benchmarks

Akifumi Isogai, 5-6, Shiba 2-chome, Minato-ku, 105-0014, Tokyo, isogai@mtec-institute.co.jp

This paper studies portfolio optimization problems that fund managers impose not only the market tracking-error control but the market segment tracking-error controls. We modify the standard mean-tracking-error-variance model, and show that, from some aspects, the modified model is better than the standard model using the Japanese stock data.

3 - A soft approach for VaR-based portfolio management

Chunhui Xu, Management Information Science, Chiba Institute of Technology, Narashino, 275-0016, Chiba, Japan, xchunhui@yahoo.co.jp

Portfolio optimization is hard when measuring risk by Value-at-Risk. We first formulate a single-stage portfolio optimization problem and introduce our soft approach in solving this complicated optimization model. Then we illustrate with experiments that we lead to a smaller VaR while keeping the portfolio performance above the market average.

4 - Multiperiod ALM Optimization Model for a Household

Norio Hibiki, Administration Engineering, Keio University, 3-14-1 Hiyoshi, Kohoku-ku, 223-8522, Yokohama, Japan, hibiki@ae.keio.ac.jp, *Katsuya Komoribayashi*, *Nobuko Toyoda*

Asset and liability management tools can be used for giving an financial advice for individual investors. We describe the multiperiod optimization model to determine an optimal set of asset mix, life insurance and fire insurance in conjunction with their life cycle and characteristics. The investor example is solved to illustrate some of the ALM features.

5 - Predicting Corporate Bankruptcy

Inguruwatte M Premachandra, Finance and Quantitative Analysis, University of Otago, PO Box 56, Dunedin, New Zealand, 9001, Dunedin,

ipremachandra@business.otago.ac.nz, *Gurmeet Singh Bhabra*, *Robert Buchanan*

This article examines the efficiency of the Data Envelopment Analysis (DEA) technique as a model for bankruptcy prediction compared to the Logistic Regression approach (LR). Using a sample of bankrupt and matched non-bankrupt firms in our analysis we found that DEA is superior to the LR in some cases.

■ TA-25

Tuesday, 9:00-10:30am

Hibiscus II

Methods and Analyses

Cluster: Military Applications

Invited session

Chair: *Patrick Driscoll*, Systems Engineering, U.S. Military Academy, Mahan Hall, 4th Floor, 10996, West Point, New York, United States, patrick.driscoll@usma.edu

1 - Assessing Human Behavior Representation Models

Simon Goerger, Systems Engineering, U.S. Military Academy, West Point, New York, United States, simon.goerger@usma.edu

Given the key role of models and simulations in assisting decision-makers, the credibility of simulations is paramount. This work presents the results of a study designed to identify consistency issues and recommendations for mitigating issues with using subject matter experts during the face validation of human behavior representation models.

2 - Considerations of Quality & Reliability in Designing a Common Operating Picture

Patrick Driscoll, Systems Engineering, U.S. Military Academy, Mahan Hall, 4th Floor, 10996, West Point, New York, United States, patrick.driscoll@usma.edu, *Edward Pohl*, *Michael Tortorella*

We introduce a general framework for designing a common operating picture based on the notion of manufacturing information products. Product quality criteria and general reliability structures will be discussed.

3 - Heuristic Approaches to the Moving-Target TSP: Support Ship Routing in a Deployed Task Group

Sam Hewitt, Defence Science and Technology Laboratory, Portsdown West, Portsdown Hill Road, Po17 6ad, Portsmouth, Hampshire, United Kingdom, samhewitt@lycos.co.uk

The problem of determining the minimum route for a replenishment vessel to visit all the ships in a deployed naval task group is considered. Since the ships are moving and constantly changing their relative positions, the Moving-Target Travelling Salesman Problem provides a useful analogy. Alternative heuristic solution methods are compared.

Tuesday, 11:00am-12:30pm

■ TB-01

Tuesday, 11:00am-12:30pm
Honolulu I

OR in Forest Management

Cluster: Renewable and Natural Resources
Invited session

Chair: *David Martell*, Faculty of Forestry, University of Toronto, 33 Willcocks Street, M5s 3b3, Toronto, Ontario, martell@smokey.forestry.utoronto.ca

1 - Adaptive optimization of forest management in a stochastic world

Peter Lohmander, Forest Economics, Suas, Umea, Sweden, S-901 83, Umea, Sweden, plohmander@hotmail.com

Management decisions should be based on the sequentially revealed information concerning prices, growth, physical damages etc.. Future flexibility is valuable in a stochastic world and is optimized. Stochastic dynamic programming, stochastic scenario tree optimization and optimization of adaptive control functions with stochastic simulation of the objective function are relevant alternatives.

2 - A Multi-Year Model for Examining the Timber Market Impacts from Mechanical Fuel Treatments

Robert Huggett, Jr., Forestry Sciences Lab, SRS, USDA Forest Service, P.O. Box 12254, 27709, Research Triangle Park, NC, United States, rhuggett@fs.fed.us, *Jeffrey Prestemon*, *Karen Abt*

We analyze the market effects of a multi-year hazardous fuels treatment program in the Southern and Western U.S . Alternate treatment scenarios are examined including interface priority, risk priority, and different subsidy levels. The return interval for treatments is considered.

3 - A Simulation Model for Large Forest Fire Management

David Martell, Faculty of Forestry, University of Toronto, 33 Willcocks Street, M5s 3b3, Toronto, Ontario, martell@smokey.forestry.utoronto.ca, *Justin Podur*

Forest fire management is an important aspect of forest management in Ontario. Most fires are controlled while they are small; some escape initial attack and become large fires. A simulation model is developed to determine optimum levels of resources allocated to large fire management.

■ TB-02

Tuesday, 11:00am-12:30pm
Honolulu II

Scheduling Decisions in Supply Chain Management

Cluster: Scheduling and Timetabling
Invited session

Chair: *Xiao-qiang Cai*, Department of Systems Engineering and Engineering Management, The Chinese University of Hong Kong, Shatin, NT, Hong Kong, Hong Kong, xqcai@se.cuhk.edu.hk

1 - Centralized vs. Decentralized Supply Chain Scheduling and Due-Date Quotation

Phil Kaminsky, Industrial Engineering and Operations Research, University of California, 4135 Etcheverry Hall, 94720-1777, Berkeley, CA, United States, kaminsky@ieor.berkeley.edu, *Onur Kaya*

We develop efficient approaches for job sequencing and due date quotation in make-to-order centralized and decentralized supply chains, and theoretically and computationally characterize the effectiveness of these approaches. We characterize the relative performance of centralized and decentralized supply chains, and develop a variety of partial-information-exchange-based approaches that help to improve the performance of decentralized systems.

2 - Purchasing Policies of Fresh Product with Random Arrivals

Xiaolin Xu, Department of Systems Engineering & Engineering Management, The Chinese University of Hong Kong, N.T.,Shatin, Hong Kong, P.R. China, 00000, Hong Kong, China, xlxu@se.cuhk.edu.hk, *Xiao-qiang Cai*

We study a problem where a distributor purchases a fresh product from different manufacturers, to sell it at a whole-sale market. Due to certain uncontrollable factors, the arrival time of the product from each manufacturer is random. The whole-sale market opens for trading only in a short interval each day, and so any fresh product arriving earlier has to wait and faces the risk of decay. The distributor wishes to determine the optimal schedule and quantity to order from each manufacturer. We obtain the optimal static and dynamic policies.

3 - Application of Nash Bargaining Solution to a Scheduling Problem Involving Negotiation between Two Manufacturers

Quanle Chen, Department of Systems Engineering & Engineering Management, The Chinese University of Hong Kong, Shatin, N.T. Hong Kong, Hong Kong, Hong Kong S. A. R., China, qlchen@se.cuhk.edu.hk, *Xiao-qiang Cai*

Two manufacturers negotiate to partition a set of jobs that they have jointly bidden from a customer. Each manufacturer has to take into account his own processing capacity and the job requirements, when he is considering whether a partition is beneficial to him. The overall objective is to achieve a partition of the jobs into two subsets, which are considered fair and acceptable to both players. We apply the Nash Bargaining Solution (NBS) to this problem. Algorithms that combine the calculations of NBS and optimal processing schedules are developed.

4 - Component Procurement for the Loss-Averse Manufacturer with Emergent Purchase Opportunity

Houcai Shen, Management Science and Engineering, Nanjing University, Hankou Road No. 22, 210093, Nanjing, China, hcshen@nju.edu.cn

Based on the prospect theory, we study the decision behavior of the engineer-to-order manufacturer who makes the component procurement under uncertain environment. Based on this model, we discuss the effect of the manufacturer's loss aversion, the demand uncertainty and the emergent supply price, etc.

■ TB-03

Tuesday, 11:00am-12:30pm
Honolulu III

Stochastic Programming II

Cluster: Stochastic Programming
Invited session

Chair: *Gautam Mitra*, School of Information Systems, Computing and Mathematics, Carisma, Brunel University, Uxbridge, Ub8 3ph, United Kingdom, gautam.mitra@brunel.ac.uk

1 - Stochastic Programming Extensions to AMPL

Robert Fourer, Industrial Engineering and Management Sciences, 2145 Sheridan Road, 60208-3119, Evanston, IL, United States, 4er@iems.northwestern.edu

It is widely agreed that extensions to algebraic modeling languages would do much to encourage and support modeling of optimization under uncertainty. But which extensions would be most useful? We describe varied proposals for stochastic programming extensions to the AMPL language, comparing their merits and identifying potential barriers to implementation

2 - Modelling and discretization tools for stochastic programs

Teemu Pennanen, Management Science, Helsinki School of Economics, Pl 1210, 101, Helsinki, Finland, pennanen@hkkk.fi, *Petri Hilli*

We describe a modeling and discretization framework for stochastic programs. Our framework supports nonlinear multistage stochastic programs where uncertainty is modeled by a general class of stochastic processes (including multivariate VARMA, VEqC, GARCH) instead of scenario trees. Our implementation is based on quasi-Monte Carlo methods and AMPL modeling language.

3 - Scenario Generation (SG) for Stochastic Programming (SP) and Simulation: A Modelling Perspective

Gautam Mitra, School of Information Systems, Computing and Mathematics, Carisma, Brunel University, Uxbridge, Ub8 3ph, United Kingdom, gautam.mitra@brunel.ac.uk, *Nico Di Domenica*, *Patrick Valente*, *Cormac Lucas*

We present approaches to SG which are used in two stage and multistage dynamic SP models. We investigate modelling structure and software issues of integrating an SG with an optimisation model. We consider how the Expected Value and SP decision model results are evaluated within a descriptive framework of simulation

■ TB-04

Tuesday, 11:00am-12:30pm
Iolani I

Semidefinite Programming / Conic and Convex Optimization

Cluster: Conic Optimization
Invited session

Chair: *Jiawei Zhang*, Stern School of Business, IOMS-Operations Management, New York University, 44 West 4th St., Suite 8-66, 10012, New York, NY, jzhang@stern.nyu.edu

Chair: *Jean-Louis Goffin*, Faculty of Management, McGill University, 1001 Sherbrooke Ouest, H3a1g5, Montreal, Quebec, Canada, Jean-Louis.Goffin@McGill.ca

1 - On Matrix Convex Functions and Semidefinite Programming

Shuzhong Zhang, Chinese University of Hong Kong, Shatin New Territories, Hong Kong, zhang@se.cuhk.edu.hk

In the literature, the so-called matrix monotone and matrix convex functions have been well studied. We discuss the impact of (nonlinear) matrix convex functions for SDP. As one example, we present a new proof for the matrix concavity of the logarithmic function, and discuss its implications for SDP.

2 - On Approximating Complex Quadratic Optimization Problems via Semidefinite Programming Relaxations

Jiawei Zhang, Stern School of Business, IOMS-Operations Management, New York University, 44 West 4th St., Suite 8-66, 10012, New York, NY, jzhang@stern.nyu.edu, *Anthony Man-Cho So*, *Yinyu Ye*

In this paper we present semidefinite programming (SDP) models for a class of discrete and continuous quadratic optimization problems in the complex Hermitian form. These problems capture a class of well–known combinatorial optimization problems, as well as problems in control theory.

3 - Concepts of Flexibility & Convex Risk Measures

Hans-Jakob Lüthi, D-math, Ethz, IFOR, Clausisustrasse 45, 8092, Zürich, Switzerland, luethi@ifor.math.ethz.ch

Due to their axiomatic foundation and their favorable computational properties convex risk measures are a powerful tool in risk management. The embedded duality concepts support the design of alternative risk measures, leads to strong duality in portfolio optimization context, and generates an axomatic framework for a notion of operational flexibility.

4 - Conic column generation

Jean-Louis Goffin, Faculty of Management, McGill University, 1001 Sherbrooke Ouest, H3a1g5, Montreal, Quebec, Canada, Jean-Louis.Goffin@McGill.ca

Dantzig-Wolfe column generation can be extended to the case where columns belong to a general self-dual cone. By duality this leads to cutting plane type method where the cutting planes may be linear, SOCC or SDP, thus leading to approximating an NDO function by SOCC or SDP cuts.

■ TB-05

Tuesday, 11:00am-12:30pm
Iolani II

Auctions II

Cluster: Auctions and e-markets
Invited session

Chair: *Roy Kwon*, Mechanical and Industrial Engineering, University of Toronto, 5 Kings College Road, M5s 3g8, Toronto, Ontario, Canada, rkwon@mie.utoronto.ca

1 - Bidder optimization based combinatorial auctions

Roy Kwon, Mechanical and Industrial Engineering, University of Toronto, 5 Kings College Road, M5s 3g8, Toronto, Ontario, Canada, rkwon@mie.utoronto.ca

The future of resource allocation will involve computational agents that will bid on behalf of human agents. In many environments agents will bid on several different resouces to accomplish its goal. We present a combinatorial auction decomposition framework for computational agents.

2 - Revenue Equivalence Theorem revisited: does stability of revenue matter to the auctioneer?

Fernando Beltran, Isom, University of Auckland, 7 Symonds Street, Old Choral Hall, 0000, Auckland, New Zealand, f.beltran@auckland.ac.nz, *Natalia Santamaría*

The Revenue Equivalence Theorem states that different auctions generate the same expected revenue to the auctioneer as long as certain conditions are met. We investigate issues of stability of the revenue generated in simulated auctions. We argue that the auctioneer is not indifferent between auction formats, as the theorem asserts.

3 - Bidding procedure for a selling agent in the Brazilian electricity demand auction

Paulo Correia, Energy Department, Unicamp, C. Postal 6122, 13.083-970, Campinas, SP, Brazil, pcorreia@fem.unicamp.br, *Fernando C. Munhoz*

This work presents a bidding model for a selling agent of electricity in the demand auction organized in Brazil until June of 2004. The auction is analyzed as a dynamic game and an optimization model is used to the seller gets optimal bids allocation into the bilateral contracts.

■ TB-06

Tuesday, 11:00am-12:30pm
Iolani III

Network Design II

Cluster: Telecommunications and Network Design
Invited session

Chair: *Janny Leung*, Systems Engineering & Engineering Management Dept., The Chinese University of Hong Kong, Shatin, NT, Hong Kong, janny@se.cuhk.edu.hk

1 - On the Uncapacitated K-commodity Network Design Problem with Zero Flow Cost

Janny Leung, Systems Engineering & Engineering Management Dept., The Chinese University of Hong Kong, Shatin, NT, Hong Kong, janny@se.cuhk.edu.hk, *Ada Ng*, *Trilochan Sastry*, *Xiao-qiang Cai*

In this paper, we solve the 3-commodity network design problem with zero flow cost by finding a minimum weighted tree from a constructed graph. Then we generalize the method to solve the K-commodity problem and show that it can be solved in polynomial time, if K is fixed.

2 - Optimal Design of Regions for Organ Transplantation

Nan Kong, Industrial Engineering, University of Pittsburgh, 1070 Benedum Hall, 15261, Pittsburgh, PA, United States, nkong@ie.pitt.edu, *Andrew Schaefer*, *Brady Hunsaker*

Transplantable organ allocation in the U.S. has been a contentious issue for decades. Our objective is to cluster Organ Procurement Organizations (OPOs) such that transplant efficiency is maximized. We model this problem as a set partitioning problem and consider several solution techniques including branch and price.

3 - On a Diameter-Constrained Steiner Tree Problem

Luis Gouveia, Deio, University of Lisbon, Campo Grande, Bloco C6, 1749-016, Lisbon, Portugal, legouveia@fc.ul.pt, *Thomas Magnanti*, *Cristina Requejo*

We derive and study models for the following version of the Minimum Steiner Tree Problem: find a minimal Steiner tree spanning a set of required nodes R such that the maximum number of intermediate nodes in R in any tree path does not exceed a specified value.

4 - Ant-based Clustering Algorithms

Yu-chiun Chiou, Feng Chia University, Taichung, Taiwan, ycchiou@fcu.edu.tw

This paper proposes and validates ant-based clustering algorithms (ACA). For investigating the performance of the proposed ACA, the comparison with agglomerative method, k-means method, and genetic clustering algorithm is also conducted. The results show that ACA outperforms than any other algorithms both in term of effectiveness and robustness.

■ TB-07

Tuesday, 11:00am-12:30pm
Iolani V

IS in Tourism

Cluster: Management Information Systems
Invited session

Chair: *Azuma Ohuchi*, Graduate School of Engineering, Hokkaido University, North 13, West 8, Kita-ku, 060-8628, Sapporo, Japan, ohuchi@complex.eng.hokudai.ac.jp

1 - Tourism research in Japan

Azuma Ohuchi, Graduate School of Engineering, Hokkaido University, North 13, West 8, Kita-ku, 060-8628, Sapporo, Japan, ohuchi@complex.eng.hokudai.ac.jp

The present states of tourism research in Japan will be surveyed. It might be said it is poor. But it is changing rapidly due to the champagne "visit Japan" by Japanese government. For example, The society of Tourism Informatics was established to research tourism from the view point of informatics.

2 - Development of tourism activity analysis system based on GPS log data

Mitsuyoshi Nagao, Information Initiative Center, Hokkaido University, North 11, West 5, Kita-ku, 060-0811, Sapporo, nagao@iic.hokudai.ac.jp, *Hidenori Kawamura*, *Masahito Yamamoto*, *Azuma Ohuchi*, *Azuma Ohuchi*

In this paper, we propose a tourism activity analysis system based on GPS log data in order to realize effective tourism policy and strategy which is suitable for current tourism environment in Japan. We confirm its effectiveness through experiment using the GPS log data collected from actual tourists.

3 - Construction of Community Web for Art Tourism

Hajime Saito, Faculty of Information Media, Hokkaido Information University, 59-2 Nishinopporo, Ebetsu, Hokkaido, Japan, hajime@do-johodai.ac.jp, *Azuma Ohuchi*

Art-Tourism is a new tourism related to art contents these are field sculpture, music, photograph, and so on. We join in an art-tourism project in Society for Tourism Informatics, Japan. We are constructing a community web to support art tourism project. The web site can provide people with art information.

4 - A Location-based Search Engine for Official Web-sites

Masahito Yamamoto, Graduate School of Information Science and Technology, Hokkaido University, North 14, West 9, Kita-ku, 060-814, Sapporo, Japan, masahito@complex.eng.hokudai.ac.jp, *Hidenori Kawamura*, *Azuma Ohuchi*

We present a location-based search engine for official accommodations websites. Official website are defined as a website built by owners of the accommodation, which is very useful for tourists. A large number of the official websites are automatically collected by our developped robot program.

■ TB-08

Tuesday, 11:00am-12:30pm
Iolani VI

Game Theoretic Models in Supply Chains

Cluster: Supply Chain Management
Invited session
Chair: *Qing Li*, Dept. of ISMT, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, imqli@ust.hk

1 - Competition and Cooperation in a Multi-Supplier single-Assembler Supply Chain with Complementary Products

Daniel Granot, University of British Columbia, Vancouver, Canada, daniel.granot@sauder.ubc.ca, *Shuya Yin*

We analyze two contracting systems between an assembler and her suppliers: push and pull. In push, the suppliers are the leaders, while in pull, the assembler is the leader. We investigate various aspects of the two systems, including alliance formation, profit allocation and members' preferences over the two systems.

2 - Information Sharing and Confidentiality in Supply Chains

Hongtao Zhang, Ismt, Hong Kong Univ of Sci & Tech, Clear Water Bay, Kowloon, imhzhang@ust.hk

Producers have private information about the demand and each may choose to reveal it to the supplier. The supplier may keep the received information confidential or disclose it to some or all producers. Higher confidentiality harms the supplier but benefits the producers and the supply chain as a whole.

3 - Accurate Response, Reactive Capacity and Inventory Competition

Qing Li, Dept. of ISMT, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, imqli@ust.hk, *Albert Ha*

An important component of any accurate response program is the creation of more reactive capacity. While the operational benefits of reactive capacity are well understood, little is known about its benefits in a competitive environment. This work investigates the role of reactive capacity in inventory competition with demand substitution.

■ TB-09

Tuesday, 11:00am-12:30pm
Iolani VII

Heuristic and Metaheuristic Algorithms for Combinatorial Optimization I

Cluster: Metaheuristics
Invited session
Chair: *Mutsunori Yagiura*, Applied mathematics and physics, Kyoto university, Yoshida Honmachi Sakyo-ku, Kyoto, 606-8501, Kyoto, Japan, yagiura@amp.i.kyoto-u.ac.jp
Chair: *Koji Nonobe*, Applied Mathematics and Physics, Kyoto University, 606-8501, Kyoto, Japan, nonobe@amp.i.kyoto-u.ac.jp

1 - An iterated local search algorithm for irregular packing problem

Shunji Umetani, Systems Engineering, The University of Electro-Communications, 1-5-1 Chofugaoka, Chofu-shi, 182-8585, Tokyo, Japan, umetani@se.uec.ac.jp, *Mutsunori Yagiura*, *Shinji Imahori*, *Koji Nonobe*, *Toshihide Ibaraki*, *Takashi Imamichi*

The irregular packing problem requires to specify a cutting plan for a set of various shapes from a rectangular area to minimize the trim loss. We proposed a local search algorithm based on a fast neighborhood search.

2 - An effective local search algorithm for strip packing problem

Shinji Imahori, Information science and technology, University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo, 113-8656, Tokyo, Japan, imahori@simplex.t.u-tokyo.ac.jp, *Mutsunori Yagiura*, *Toshihide Ibaraki*

The strip packing problem is to pack given rectangles without overlap in the strip. For this problem, we propose an effective local search algorithm using a coding scheme called Bounded Sliceline Grid.

3 - A stochastic search approach for very large-scale neighborhood

Dushyant Sharma, Ioe, University of Michigan, 1205 Beal Ave., 48109, Ann Arbor, MI, dushyant@umich.edu

We describe a stochastic neighborhood search approach for combinatorial optimization based on perturbing the objective function. We present conergence results similar to simulated annealing for this approach and also present computational results on the Quadratic Assignment Problem for this approach.

4 - A New Hybrid Heuristic for the Capacitated Clustering Problem

Hassan Ghaziri, Aub Osb, Bliss St., 1000, Beirut, ghaziri@aub.edu.lb

In this talk a new hybrid heuristic for the capacitated clustering problem is presented. A combined constructive heuristics with a local search procedure is introduced. An entropic guidance principle is used to enhance the heuristic. Computational results from the literature are benchmarked with this new technique to validate its power.

■ TB-11

Tuesday, 11:00am-12:30pm
Tapa Ballroom II

Vehicle Routing

Cluster: Combinatorial Optimization
Invited session

Chair: *Richard Eglese*, Management Science, Lancaster University, Dept. Management Science, Lancaster University, Lancaster, Lancashire, United Kingdom, R.Eglese@lancaster.ac.uk

1 - Reachability Cuts for the Vehicle Routing Problem with Time Windows

Jens Lysgaard, Department of Accounting, Finance and Logistics, Aarhus School of Business, Fuglesangs Alle 4, 8210, Aarhus V, Denmark, lys@asb.dk

We introduce a class of cuts, called reachability cuts, for the Vehicle Routing Problem with Time Windows (VRPTW). Computational results on well-known VRPTW instances suggest that reachability cuts can be highly useful as cutting planes for certain VRPTW instances.

2 - School Bus Routes Planning: A Case Study with Hybrid Genetic Algorithms

Leon Li, Logistics, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, Hong Kong, lgtleon@polyu.edu.hk

This paper describes hybrid Genetic Algorithms in solving the school bus routing problem. It is formulated as a multi-objective problem to minimize the number of school buses required, the total student travel time and total bus travel time. It also aims at balancing the loads between school buses.

3 - Vehicle routing and scheduling with time-varying travel times

Richard Eglese, Management Science, Lancaster University, Dept. Management Science, Lancaster University, Lancaster,

Lancashire, United Kingdom, R.Eglese@lancaster.ac.uk, *William Maden*

A heuristic is presented for the Vehicle Routing Problem with capacity and time window constraints. Results are given using a road network in the north west of England and actual time-varying travel times using Road Timetable information from ITIS holdings plc.

■ TB-12

Tuesday, 11:00am-12:30pm
Tapa Ballroom III

Passenger Vehicular and Ferry Services

Cluster: Transportation
Invited session

Chair: *Hong K. Lo*, Civil Engineering, Hong Kong University of Science and Technology, Hong Kong, Hong Kong, cehklo@ust.hk

1 - Simulation of Pedestrians for Integrated Transport Systems

Michael Bell, Imperial College, London, United Kingdom, m.g.h.bell@imperial.ac.uk, *Sonal Ahuja*, *Tom van Vuren*

Methodology to include pedestrians in modelling, and economic appraisals of integrated transport schemes is proposed. Simulation model consisting of interactions of pedestrians with traffic signals and traffic is presented. A methodology for dynamic routing of pedestrian movements to replicate their path choices on city scale is proposed.

2 - Solution of the Dial-a-Ride Problem (DARP) with multi-dimensional capacity constraints

K I Wong, Civil and Environmental Engineering, Impreial College London, Centre for Transport Studies, Department of Civil and Environmental Engineering, South Kensington Campus, Imperial College London, Sw7 2az, London, United Kingdom, ka.wong@ic.ac.uk, *Michael Bell*

In Dial-a-Ride problems, scheduling is made more complicated by special user requirements and an inhomogeneous vehicle fleet. The transportation of elderly and handicapped people is an important example, as space for wheel chairs is limited and a lift is required. Suitable heuristics are proposed, and applications to freight are considered.

3 - Multi-fleet Ferry Routing and Scheduling with Passengers' Choices for Differential Services

Zhiwei Wang, Civil Engineering, Hkust, Hong Kong, China, cewzw@ust.hk, *Hong K. Lo*

The study formulates a multi-fleet ferry routing and scheduling model with mode choices. Ferry services with different operation characteristics and passengers with different preferred arrival time-windows are considered in the model. Mathematically, the model is formulated as a mixed integer nonlinear program and is solved via a heuristic algorithm.

■ TB-13

Tuesday, 11:00am-12:30pm
Sea Pearl I

Reliability and Quality

Cluster: Quality, Statistics and Reliability
Invited session

Chair: *David W. Coit*, Dept. of IE, Rutgers University, Piscataway, NJ 08854-8018, Piscataway, NJ, United States, coit@rci.rutgers.edu

Chair: *Jose Emmanuel Ramirez-Marquez*, Department of Systems Engineering and Engineering Management, Stevens Institute of Technology, Nj, Usa, Hoboken, New Jersey, United States, jmarquez@stevens.edu

1 - An Estimation Model of Quality Characteristics Indices for CNT-BLU/CNT-FED Production

Chyuan Perng, Industrial Engineering and Enterprise Information, Tunghai University, No.181, 3Sec., Zhong-Gang Rd., 40704, Tai-Zhong, Taiwan, tzyyp@pchome.com.tw, *Zih-Ping Ho*

This research tries to look at back light module unit (BLU) and field emission display (FED) application of Carbon Nanotube (CNT). An estimation model of quality characteristics indices for CNT-BLU/CNT-FED production is our target to create an analytical model to predict the quality characteristics by using Bayesian networks techniques.

2 - Uncertainty Assessment in Electric Powe Distribution Systems

Jose Emmanuel Ramirez-Marquez, Department of Systems Engineering and Engineering Management, Stevens Institute of Technology, Nj, Usa, Hoboken, New Jersey, United States, jmarquez@stevens.edu, *David W. Coit*

For electric power systems, methods that assess the propagation of component-level reliability uncertainty to the system-level are limited. Current methods use sensitivity analysis or Monte-Carlo simulation to describe how component and system uncertainty interact. This study presents methods to assess how component reliability uncertainty propagates to system-level uncertainty.

3 - Correlated multiple response optimization based on random effects models for both conditional mean and variance

So Young Sohn, Ise, Yonsei university, Shinchon-dong, 134, Sudaemoon-gu, 137-049, Seoul, Korea, Republic Of, sohns@yonsei.ac.kr

We consider a robust parameter design of multiple stream processes where the responses of each process are correlated and some variation is exhibited in both conditional mean and variance of performances of simultaneously operated multiple stream processes.

4 - Component Criticality Indices for Power System Reliability

Jose Emmanuel Ramirez-Marquez, Department of Systems Engineering and Engineering Management, Stevens Institute of Technology, Nj, Usa, Hoboken, New Jersey, United States, jmarquez@stevens.edu, *David W. Coit*

For complex electric power systems, assessing uncertainty relies on Monte-Carlo simulation or sensitivity analysis techniques that are computationally inefficient. This study introduces mathematical expressions for quantifying the impact of parameter uncertainty on asset criticality and system reliability. Furthermore, evaluating techniques for quantifying component criticality within the system architecture are proposed.

■ TB-14

Tuesday, 11:00am-12:30pm
Sea Pearl II

SpORts in the OR Classroom

Cluster: Education, Innovation and Distance Learning
Invited session

Chair: *James Cochran*, Department of Marketing and Analysis, Louisiana Tech University, PO Box 10318, 71272, Ruston, LA, United States, jcochran@cab.latech.edu

1 - Optimizing Team Travel in the NCAA basketball tournament

Cole Smith, Systems and Industrial Engineering, University of Arizona, Tucson, AZ, United States, cole@sie.arizona.edu

We introduce methods for reducing the expected travel time required by men's NCAA basketball teams, subject to the rules involved in assigning seeded teams to neutral locations. These ideas can be used either as an optimization case study, or in a sophisticated integer programming project.

2 - Bodymass Comparisons in Powerlifting: An Exercise in Nonlinear Modeling

Martin Chlond, Information and Finance, University of Central Lancashire, Corporation Street, Pr7 2he, Preston, mchlond@uclan.ac.uk

A brief historical background to bodymass comparisons in powerlifting will be presented and a suite of educational materials will be demonstrated and used to analyse a dataset of current world records, fit a variety of curves to the data and interpret output.

3 - Using Sports Scheduling to Teach Integer and Constraint Programming

Michael Trick, Tepper School of Business, Carnegie Mellon University, Gsia 3431b, Carnegie Mellon University, 15213, Pittsburgh, PA, United States, trick@cmu.edu

Sports scheduling provides an excellent application for illustrating important issues in integer and constraint programming modeling and solution. I illustrate some examples from my MBA courses.

4 - Using Strat-O-Matic Board Games to Teach Basic Probability for Statistics

James Cochran, Department of Marketing and Analysis, Louisiana Tech University, PO Box 10318, 71272, Ruston, LA, United States, jcochran@cab.latech.edu

We demonstrate how to use the popular Strat-O-Matic baseball board game to explain basic probability concepts. Concepts illustrated include the classical and relative frequency approaches, discrete probability distributions (especially the discrete uniform distribution), transformations and sample spaces, laws of multiplication and addition, conditional probability, randomization, independence, and Bayes' theorem.

■ TB-15

Tuesday, 11:00am-12:30pm
Sea Pearl III

Column Generation Approaches for Routing Problems

Cluster: Routing
Invited session

Chair: *Frédéric Semet*, Lamih, University of Valenciennes, Le Mont Houy, Istv 2, 59313, Valenciennes, Cedex 9, France, frederic.semet@univ-valenciennes.fr

1 - The Pickup and Delivery Problem with Transfers: Formulation and Solution Approaches

Cristián Cortés, Civil Engineering Department, Universidad de Chile, Blanco Encalada 2002, 5th floor, Santiago, Chile, ccortes@ing.uchile.cl, *Claudio Contardo*, *Matamala Martin*

A novel MILP formulation for a complex Pickup and Delivery problem is proposed. In this formulation, a passenger may transfer from one vehicle to another. The solution methods implemented are dynamic programming, Benders decomposition and insertion heuristic based. Solvable instances vary from small to medium scale (30-50 clients).

2 - New Refinements for the Solution of Vehicle Routing Problems with Column Generation

Michel Gendreau, Centre de recherche sur les transports, Université de Montréal, C.P. 6128, succ. Centre-ville, H3c 3j7, Montreal, Quebec, Canada, michelg@crt.umontreal.ca, *Dominique Feillet, Louis-Martin Rousseau*

We propose some refinements to improve the capabilities of column generation approaches for the VRPTW, with a focus on the solution of the subproblem: introduction of Limited Discrepancy Search, manipulations of the state graph, and lower bounds that allow the elimination of a substantial number of labels during the search.

3 - A column generation algorithm for the m-peripatetic salesman problem

Frédéric Semet, Lamih, University of Valenciennes, Le Mont Houy, Istv 2, 59313, Valenciennes, Cedex 9, France, frederic.semet@univ-valenciennes.fr, *Eric Duchenne, Gilbert Laporte, Michel Gendreau*

In the m-peripatetic salesman problem, the aim is to determine m edge disjoint Hamiltonian cycles of minimum total cost on a graph. In this talk, a column generation algorithm is presented and compared with some of the best available branch-and-cut methods on randomly generated and TSPLIB Euclidean instances.

■ TB-16

Tuesday, 11:00am-12:30pm
Sea Pearl IV

Nonstochastic and Nonadditive Dynamic Programming

Cluster: Dynamic Programming
Invited session

Chair: *Seiichi Iwamoto*, Department of Economic Engineering, Faculty of Economics, Kyushu University, Fukuoka 812-8581, Japan, 812-8581, Fukuoka, iwamoto@en.kyushu-u.ac.jp

1 - Dynamic pricing of Pacific option

Seiichi Iwamoto, Department of Economic Engineering, Faculty of Economics, Kyushu University, Fukuoka 812-8581, Japan, 812-8581, Fukuoka, iwamoto@en.kyushu-u.ac.jp

We introduce a Pacific option as a mixture of American option and Asian option. When a stock process is terminated at stopping time, the Pacific option with an exercise price is evaluated as maximum value of zero price and the exercise price subtracted from the stopped average price. We consider a dynamic valuation method of the Pacific option on the binomial model. Our dynamic pricing is a path-dependent method. This is nothing but dynamic programming without optimization. We derive a backward reucrisve relation. Some numerical illustrations are shown. We compare Pacific option with American option, Asian option and others.

2 - Optimal Stopping under Threshold Probability — Simple Criteria —

Kazuyoshi Tsurusaki, Faculty of Economics, Nagasaki University, 4-2-1 Katafuchi, 850-8506, Nagasaki, Nagasaki, Japan, turusaki@net.nagasaki-u.ac.jp, *Takayuki Ueno, Seiichi Iwamoto*

In this paper, we consider three optimal stopping problems with simple criteria which are terminal, additive, and minimum. Our objective function is the threshold probability that the stopped terminal/additive/minimum reward satisfies a level value. We show that dynamic programming and invariant imbedding yield optimal stopping rules.

3 - Markov decision processes with minimum criteria of random rewards.

Yoshio Ohtsubo, Dept. of Mathematics, Kochi University, 2-5-1 Akebono, 780-5820, Kochi, ohtsubo@math.kochi-u.ac.jp

We consider Markov decision processes where a criterion is a minimum function. The policy depends upon a history and the reward is random and depends upon current state and action and a next state. We give an optimality equation and show that there exist an optimal policy.

4 - On Infinite-Stage Nondeterministic Decision Models

Toshiharu Fujita, Faculty of Engineering, Kyushu Institute of Technology, Kitakyushu 804-8550, 804-8550, Kitakyushu, Japan, fujita@comp.kyutech.ac.jp, *Seiichi Iwamoto*

We consider infinite-stage decision processes with nondeterministic transition system. Under the system, a single state yields more than one state with nonnegative weight in the next stage. Furthermore the concepts 'stopping time' and 'stopping region' are introduced to our models and we apply the result to maximum linear equations.

■ TB-17

Tuesday, 11:00am-12:30pm
Sea Pearl V

Theory of Multicriteria Optimization

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *Christiane Tammer*, Mathematics and Computer Science, Martin-Luther-University Halle-Wittenberg, Theodor-Lieser-Str. 5, D-06120, Halle, Germany, tammer@mathematik.uni-halle.de

1 - A set valued approach for duality in linear vector optimization

Frank Heyde, Department of Mathematics and Computer Sciences, Martin-Luther-University of Halle-Wittenberg, Theodor-Lieser-Str. 5, D-06099, Halle (Saale), Germany, heyde@mathematik.uni-halle.de, *Andreas Hamel*, *Andreas Loehne*, *Kristin Winkler*, *Christiane Tammer*

We develop a duality theory for linear vector optimization problems using a set valued dual function. We develop the theory very close to the scalar case. Especially, in contrast to known results, we avoid the appearance of a duality gap in case of b=0.

2 - An interacive framework for different methods in multiobjective optimization

Petra Weidner, Fakultät N, HAWK Hildesheim/Holzm./Göttingen, Von-Ossietzky-Str. 99, D-37085, Göttingen, Germany, weidner@hawk-hhg.de

An algorithmic framework for the interactive solution of multicriteria optimization problems is presented that can use different scalarizations and reach each vector of a set being dense in the efficient point set without assuming convexity.

3 - Lagrangian Conditions for Vector Optimization on Banach Spaces

Christiane Tammer, Mathematics and Computer Science, Martin-Luther-University Halle-Wittenberg, Theodor-Lieser-Str. 5, D-06120, Halle, Germany, tammer@mathematik.uni-halle.de

We develop Lagrangian multiplier rules for vector optimization problems using non-convex scalarization schemes. Moreover, we demonstrate that the Lagrangian multipliers are in fact subgradients of certain convex functions that are generated by non-convex scalarization schemes

■ TB-18

Tuesday, 11:00am-12:30pm
Sea Pearl VI

OR for Process Industries I

Cluster: OR for Process Industries
Invited session
Chair: *Goutam Dutta*, Production and Quantitative Methods Area, Indian Institute of Management, Wing 3, PMQ Area, Vastrapur, I.I.M, Ahmedabad, 380015, Ahmedabad, Gujarat, India, goutam@iimahd.ernet.in

1 - An Optimization-Based Decision Support System for Strategic Planning in a Process Industry

Goutam Dutta, Production and Quantitative Methods Area, Indian Institute of Management, Wing 3, PMQ Area, Vastrapur, I.I.M, Ahmedabad, 380015, Ahmedabad, Gujarat, India, goutam@iimahd.ernet.in, *Robert Fourer*

A generic multi-period optimization-based decision support system (DSS) for strategic planning in process industries is presented. Built on materials, facilities, activities, time periods and storage areas, this DSS requires little direct knowledge of optimization techniques to be used effectively. Results based on data from an Indian pharmaceutical company are discussed.

2 - Coal Blending Models for Optimum Cokemaking and Blast Furnace Operation

Francis Vasko, Mathematics & Computer Science, Kutztown University, 170 Lytle Hall, 19530, Kutztown, PA, United States, vasko@kutztown.edu

Since coal properties important for both optimum cokemaking and blast furnace operation do not combine linearly and are not completely understood, determining an optimum coal blend very difficult. In this paper, a solution methodology is developed that utilizes both mathematical programming and binary decision trees to solve this problem.

3 - Using a Genetic Algorithm Approach to Schedule a Meltshop in the Steel Industry

Francis Vasko, Mathematics & Computer Science, Kutztown University, 170 Lytle Hall, 19530, Kutztown, PA, United States, vasko@kutztown.edu

The scheduling of a meltshop at an integrated steel plant is a very complex logistical problem because it requires the synchronization of several steelmaking furnaces, degassing facilities, ladle treatment stations, and continuous casters. We discuss the combination of a domain-specific heuristic with a genetic programming approach in a scheduling model.

■ TB-19

Tuesday, 11:00am-12:30pm
Nautilus I

AHP05: Evaluation applications

Cluster: Analytic Hierarchy / Network Process
Invited session
Chair: *Eizo Kinoshita*, Meijo University, Nagoya, Japan, kinoshit@urban.meijo-u.ac.jp

1 - Analysis of the evaluation technique of the social infrastructure development using AHP

Shiro Kawai, Urban And Regional Planning, Soken,inc, 1-10-1, SINOTOU-chou, ATUTA-ku, SS101,3-12, KANOKO-chou, CHIKUSA-ku, 456-0018, Nagoya, AICHI, Japan, kawai@soken.co.jp

The purpose of this research is clarifying development ranking of the social infrastructure for which citizens ask using a scientific technique. For this reason, it was shown that the development target of the infrastructure expressed hierarchical using the outcome index can be ranked by AHP.

2 - Program Evaluation of a Local Government: in the Context of Public-sector Reform

Yuji Sato, Mie Chukyo University, Graduate School of Policy Science, 1846, Kubo, Mie Chukyo University, 515-8511, Matsusaka, Mie, Japan, ysatoh@mie-chukyo-u.ac.jp

This study proposed rational matching of projects of autonomy with sectors in public-sector reform. In the re-formation, delegating authorities from public sector to alternative sectors would be crucial issues. In this study, the matching was implemented by characterizing alternative sectors, and evaluating projects; both of which were conducted using AHP.

3 - Development of the evaluation methodology with decision-making theories for future electricity supply in Japan

Hiroki Shiotani, FBR Cycle Analysis Group, O-arai Engineering Center, Japan Nuclear Cycle Development Institute, 4002 Narita-cho, 319-1393, O-arai-machi, Higashi-Ibaraki-gun, Ibaraki-ken, Japan, shiotani@hq.jnc.go.jp, *Kiyoshi Ono*, *Atsushi Suzuki*, *Minoru Sonoyama*

A methodology is developed to evaluate the characteristics of Fast Reactor (FR) Cycle and other power generation systems for future Japanese energy supply. Some decision-making theories including analytic hierarchy process and multi-attribute utility theory are used. According to this study, a FR cycle system will be a promising energy source.

4 - Evaluation of Human Feelings Using AHP

Taki Kanda, Service Management, Bunri University of Hospitality, 311-1 Kashiwabarashinden, 3501336, Sayama, Saitama, kanda@bunri-c.ac.jp

When we feel something, we firstly conscious the existence of objects by sense organs, percept them based upon our knowledge, recognize them through our experience or learning and finally feel variously. Thus human feelings have hierarchy structure. Here perceiving this it is discussed to evaluate human feelings using AHP.

■ TB-20

Tuesday, 11:00am-12:30pm
Nautilus II

Preference Programming with Incomplete Information

Cluster: Decision Analysis
Invited session

Chair: *Ahti Salo*, Systems Analysis Laboratory, Helsinki University of Technology, P.O. Box 1100, Otakaari 1 M, 2015, Hut, Finland, ahti.salo@hut.fi

1 - Contingent Portfolio Programming for the Management of Risky Projects

Ahti Salo, Systems Analysis Laboratory, Helsinki University of Technology, P.O. Box 1100, Otakaari 1 M, 2015, Hut, Finland, ahti.salo@hut.fi, *Janne Gustafsson*

We present a framework called Contingent Portfolio Programming (CPP) for supporting the management of a risky portfolio of multi-period projects. The CPP framework allows risks to be managed through staged decision-making and diversification. We also show how it can be used to determine the value of projects through inverse optimization.

2 - RPM - Robust Portfolio Modeling for Project Selection

Pekka Mild, Systems Analysis Laboratory, Helsinki University of Technology, Otakaari 1 M, P.O. Box 1100, 2150, Espoo, Finland, pekka.mild@hut.fi, *Ahti Salo*

We present the RPM methodology for selecting project portfolios in the presence of multiple criteria and incomplete information. In RPM, a core index is derived by computing all non-dominated portfolios, in order to convey which projects can be accepted or rejected, and how further preference elicitation efforts should be focused.

3 - Robust Portfolio Modeling for Scenario-Based Project Appraisal

Juuso Liesiö, Systems Analysis Laboratory, Helsinki University of Technology, P.O.Box 1100, 02015 Hut, Espoo, Finland, juuso.liesio@tkk.fi, *Pekka Mild*, *Ahti Salo*

We introduce a project selection model which admits incomplete information about the decision maker's risk attitude, scenario probabilities and scenario-specific project performance levels. Based on the computation of all non-dominated portfolios, the model provides robust decision recommendations and helps determine which projects are sensitive to the arrival of new information.

4 - Incomplete Ordinal Information in Value Tree Analysis

Antti Punkka, Systems Analysis Laboratory, Helsinki University of Technology, Sal, Tkk, P.O.Box 1100, 02015, Tkk, Finland, antti.punkka@tkk.fi, *Ahti Salo*

We develop the RICHER method which admits incomplete ordinal information about alternatives and attributes in value trees. Such preference information is captured through paired set of alternatives (or attributes) and associated rankings. Computational challenges due to the non-convexity of corresponding feasible regions are resolved by developing an equivalent MILP formulation.

■ TB-21

Tuesday, 11:00am-12:30pm
Lehua Suite

Risk Processes

Cluster: Applied Probability
Invited session

Chair: *Steve Drekic*, University of Waterloo, Waterloo, Ontario, Canada, sdrekic@math.uwaterloo.ca

1 - Some Analytical Methods for Insurance Risk Models

Sheldon Lin, Statistics, University of Toronto, Toronto, Ontario, Canada, sheldon@utstat.utoronto.ca

I will discuss some analytical methods my collaborators and I have developed in recent years for insurance risk models. One of the advantages for using analytical methods is they require little probabilistic reasoning and can be understood by non-probabilists. These methods allow us to utilize results in analysis and differential equations.

2 - Lundberg-type Bounds in Ruin Theory Under the Sparre Andersen Model: A Martingale Approach

Hailiang Yang, Statistics and Actuarial Science, University of Hong Kong, Pokfulam Road, Hong Kong, Hong Kong, hlyang@hkusua.hku.hk

We discuss three cases of the Sparre Andersen risk model: the ordinary renewal process, stationary renewal process, and s-delayed renewal process. By constructing an exponential martingale, Lundberg-type bounds for the joint distribution of the surplus before and at ruin are obtained. This talk is based on joint work with Andrew Ng.

3 - Dividend Strategies for a Modified Risk Process

David Dickson, Centre for Actuarial Studies, Faculty of Economics and Commerce, University of Melbourne, 3010, Melbourne, Victoria, Australia, dcmd@unimelb.edu.au

We consider a classical risk process modified by a dividend barrier. Under this modification, some of the insurer's premium is paid as dividends to shareholders once the surplus exceeds the dividend barrier. We will consider questions such as setting the level of the dividend barrier and the rate of dividend payment.

4 - Algorithmic Analysis of the Sparre Andersen Model in Discrete Time

Steve Drekic, University of Waterloo, Waterloo, Ontario, Canada, sdrekic@math.uwaterloo.ca

We show that the delayed Sparre Andersen model in discrete time can be analyzed as a doubly infinite, right skip-free Markov chain. Matrix analytic methods are used to establish a computational procedure for calculating probability distributions of ruin-related quantities of interest. This talk is based on joint work with Attahiru Alfa.

■ TB-22

Tuesday, 11:00am-12:30pm

Kahili I

DEA04: Theoretical Issues on DEA IV

Cluster: Data Envelopment Analysis and Performance Management

Invited session

Chair: *Lifen Wu*, Curtin Business School, Curtin University of Technology, GPO Box U1987, 6845, Perth, Western Australia, Australia, WuL@cbs.curtin.edu.au

1 - Parametric Transformations and Multiplier Form of Fractional Programming DEA Models

Lifen Wu, Curtin Business School, Curtin University of Technology, GPO Box U1987, 6845, Perth, Western Australia, Australia, WuL@cbs.curtin.edu.au

The parametric solutions provide parametric solutions between those from input- and output-oriented models for constant returns to scale DEA models and global optimal solutions which are better than those from input- and output-oriented BCC models. A multiplier form of the variable returns to scale DEA model is revealed.

2 - Inter-temporal DEA analysis

Taraneh Sowlati, Wood Science, University of British Columbia, 2931-2424 Main Mall, V6t1z4, Vancouver, BC, Canada, taraneh.sowlati@ubc.ca

In any type of inter-temporal analyses either locally or globally, since DMUs in different periods are compared against each other, it is assumed that no technological changes exist within the periods of study. This paper presents a new approach using nonparametric statistical tests to examine frontier shift.

3 - DEA based auctions

Peter Bogetoft, Department of Economics, KVL, Denmark, Rolighedsvej 25, 1958, Frederiksberg C, Copenhagen, Denmark, pb@kvl.dk, *Kurt Nielsen*

We design a multi-dimensional tender auction using DEA. We select an agent to perform a project characterized by multiple attributes. The optimal project is settled by balancing the costs to the provider with the benefits to the buyer. This is done within a context of asymmetric information and strategic behaviour.

■ TB-23

Tuesday, 11:00am-12:30pm

Kahili II

Modelling Health and Social Care Systems: current acheivements and future challenges

Cluster: Health Care

Invited session

Chair: *Peter Millard*, Hscmg, University of Westminster, 12 Cornwall Road, Cheam, Sutton, Sm2 6dr, London, United Kingdom, phmillard@tiscali.co.uk

Chair: *Sally McClean*, School of Computing and Information Engineering, University of Ulster, Faculty of Informatics, University of Ulster at Coleraine, Bt52 1sa, Coleraine, N. Ireland, United Kingdom, si.mcclean@ulster.ac.uk

1 - Simulating Coxian Phase-type Distributions for Patient Survival

Adele Marshall, Dept of Applied Mathematics and Theoretical Physics, Queen's University of Belfast, David Bates Building, Queen's University of Belfast, Bt7 1nn, Belfast, Northern Ireland, United Kingdom, a.h.marshall@qub.ac.uk, *Mariangela Zenga*

Coxian Phase-type distributions are a special type of Markov model that can be used to represent the survival time of patients in hospital in terms of phases through which patients progress until they eventually leave the system completely. This paper simulates Coxain phase-type models for the representation of patient survival.

2 - Using Markov Modelling to Cost Healthcare Systems

Sally McClean, School of Computing and Information Engineering, University of Ulster, Faculty of Informatics, University of Ulster at Coleraine, Bt52 1sa, Coleraine, N. Ireland, United Kingdom, si.mcclean@ulster.ac.uk, *Peter Millard*

Markov modelling of a Healthcare System is carried out by fitting phase-type models to data from administrative databases. A Markov reward approach then allows us to determine the cost distribution at any time. The model can thus be used to facilitate a systems approach to healthcare planning and costing.

3 - Utilizing Hospital Census Data to Model and Understand Patient Flow and Occupancy

Gary W. Harrison, Department of Mathematics, College of Charleston, 66 George Street, 29424, Charleston, South Carolina, United States, harrisong@cofc.edu

All hospitals keep a daily patient census, but few utilize this data fully. Organizing it into an occupancy profile showing the number of patients with each current length of stay each day yields models of the admission and multi-stage discharge processes and thus trends and confidence intervals for future occupancy.

4 - A Time Dependent Dynamical System for modelling patient flow.

Elia El-Darzi, Harrow School of Computer Science, University of Westminster, Watford Road, Northwick Park, Ha1 3tp, Harrow, United Kingdom, eldarze@westminster.ac.uk, *Florin Gorunescu, Marina Gorunescu*

The empirical distribution of duration of stay of inpatients in geriatric hospitals may be described by exponential equations. This paper introduces a kinetics dynamic system which models the flow of patients through hospitals by a first order differential equations system with time-dependent parameters.

5 - Nosokinetics: measuring time past, in time present, to predict time future

Peter Millard, Hscmg, University of Westminster, 12 Cornwall Road, Cheam, Sutton, Sm2 6dr, London, United Kingdom, phmillard@tiscali.co.uk, *Thierry Chaussalet*

Nosokinetics is the science / subject of measuring and modelling flow in health and social care systems. Degrees of difficulty, staff learnt behaviour and available resources,inside and outside hospitals, all contain dimensions of time. Change takes time. A coherent theoretical background is essential if operational modelling is to succeed.

■ TB-24

Tuesday, 11:00am-12:30pm

Hibiscus I

Finance II

Cluster: Finance

Contributed session

Chair: *Kamyar Moud*, Canadian Imperial Bank of Commerce, Commerce Court East 9 - 21 Melinda St., M5l 1a2, Toronto, Ontario, Canada, kamyar.moud@cibc.ca

1 - A portfolio optimization model with non-linear market impact costs

Hitoshi Takehara, Institute of Policy and Planning Sciences, University of Tsukuba, 1-1-1 Tennoudai, 305-8573, Tsukuba, Ibaraki, Japan, takehara@shako.sk.tsukuba.ac.jp

I estimate the price impacts function by using the tick-by-tick transaction data of individual securities listed on the Tokyo Stock Exchange. I also propose a nonlinear programming model for the optimal trading strategy and compute the trading costs to maintain the Fama-French style benchmark portfolios.

2 - Valuation of Financial Instruments and Application to Input Cost Management: A model of Human Capital

Januj Juneja, Seton Hall University, South Orange, NJ, United States, junejaja@shu.edu

Employing concepts and methods traditionally used in the valuation of financial instruments, this paper develops a non-linear utility-based model of human capital. It presents underlying quantitative framework for the human capital output measure function, provides some applications, suggests methods for data collection, and gives ideas for further research.

3 - Identifying Returns' Distributions by Using Mixed Distributions

Kangrong Tan, Faculty of Economics, Kurume University, 1635 Mii, Kurume City, Fukuoka, Japan, 839-8502, Kurume, Fukuoka, Japan, tan_kouyuu@kurume-u.ac.jp, *Meifen Chu*

We demonstrate a heuristic method on how to identify returns' distributions in share markets. Firstly, we show our modeling theory by using mixed distributions, and the way to optimize the combination of the mixed distributions. Then we apply it to the real share markets.

4 - Multi-stage approach in Risk management and financial planning

Kamyar Moud, Canadian Imperial Bank of Commerce, Commerce Court East 9 - 21 Melinda St., M5l 1a2, Toronto, Ontario, Canada, kamyar.moud@cibc.ca

We investigate benefits of using recourse. We formulate and solve multi-stage models for portfolio optimization using AMPL/CPLEX system. We show that increasing desired minimum expected return leads to higher volatility of portfolio returns over the investment horizon. We show that higher transaction cost results in more volatile returns.

■ TB-25

Tuesday, 11:00am-12:30pm

Hibiscus II

Modeling and Simulation to C2 Interoperability Advances

Cluster: Military Applications

Invited session

Chair: *Niki Goerger*, Systems Engineering, Usma/erdc, Attn Madn-se, United States Military Academy, 10996, West Point, NY, niki.goerger@usma.edu

1 - Battle Management Language: A Methodology for Unambiguously Describing Military Missions

Andreas Tolk, Virginia Modeling Analysis & Simulation Center (VMASC), Old Dominion University, 1 Old Dominion University, 23529, Norfolk, Virginia, United States, atolk@odu.edu, *Martin Kleiner, Michael Hieb*

Military Command and Control is often infused with ambiguity, confusion and error in combat and training. A major factor is a lack of common understanding of specific missions, particularly in Joint and Combined operations. Battle Management Language (BML) is a methodology to remove ambiguity and precisely describe these missions.

2 - Defining a Common Operational Picture for Ground Vehicle Mobility

John Willis, TRADOC Analysis Center, Attn: Atrc-rdm, Box 8695, 93943, Monterey, CA, United States, john-willis@us.army.mil, *Paul Richmond, Curtis Blais, Niki Goerger*

This paper focuses on development of a ground vehicle movement ontology to support the mobility Common Operational Picture for the U.S. Army's Future Force "assured mobility" concept. We present an analysis of ground vehicle movement parameters and algorithms, identifying requirements and commonalities across Battle Command and Modeling and Simulation systems.

3 - Web Services for Multilateral Interoperability

Andreas Tolk, Virginia Modeling Analysis & Simulation Center (VMASC), Old Dominion University, 1 Old Dominion University, 23529, Norfolk, Virginia, United States, atolk@odu.edu

The Command and Control Information Exchange Data Model (C2IEDM) is the reference model for NATO's operational C2 systems. A C2IEDM/XML schema describes the coalition namespace in the DoD XML repository. The recommended web service architecture, prototypically implemented at Old Dominion University, enables configurable data mediation services making systems C2IEDM compliant.

Tuesday, 1:30-3:00pm

■ TC-01

Tuesday, 1:30-3:00pm
Honolulu I

OR Applications in Forestry - Forest Management

Cluster: Renewable and Natural Resources
Invited session
Chair: *Mikael Rönnqvist*, Department of Finance and Management Science, Norwegian School of Economics and Business Administration, No-5045, Bergen, Norway, mikael.ronnqvist@nhh.no

1 - A decision support system for forest road investments including a mixed integer programming model

Mikael Frisk, The Forestry Research Institute of Sweden, Uppsala Science Park, Se-75183, Uppsala, Sweden, mikael.frisk@skogforsk.se, *Mikael Rönnqvist*, *Jenny Karlsson*

We describe a decision support system for forest road investments. A mixed integer programming model and a GIS-based application has been developed to facilitate the identification of the most profitable road investments. The system has been tested on a real road investment planning problem of a large Swedish forest company.

2 - Solving the Temporal Area Restriction Model

Andrés Weintraub, University of Chile, Santiago, Chile, aweintra@dii.uchile.cl, *David Ryan*, *Juan Pablo Vielma Centeno*

We present an algorithm for the adjacency harvest scheduling problem where harvesting blocks are formed starting with smaller basic cells. We extend previous work to allow for multiple periods through use of constraint branching and elastisizing the volume constraints with dynamic penalties combined with heuristics. Computational experience is reported.

3 - The Area Restricted Forest Harvesting Problem

Alastair McNaughton, Mathematics, University of Auckland, Private bag 92019, Auckland, 001, Auckland, a.mcnaughton@auckland.ac.nz

A new algorithm is proposed for the area restricted forest harvesting problem. A column generation model is used. Adjacency issues are addressed by introducing the concept of a new concept called a nuclear set. Numerical trials indicate that this is an efficient algorithm for moderately sized applications.

■ TC-02

Tuesday, 1:30-3:00pm

Honolulu II

Deterministic Scheduling

Cluster: Scheduling and Timetabling

Invited session

Chair: *Chris Potts*, School of Mathematics, University of Southampton, So17 1bj, Southampton, Hampshire, United Kingdom, C.N.Potts@maths.soton.ac.uk

Chair: *Alistair Clark*, Faculty of Computing, Engineering and Mathematical Sciences, University of the West of England, Frenchay Campus, Coldharbour Lane, Bs16 1qy, Bristol, United Kingdom, Alistair.Clark@uwe.ac.uk

1 - Beam search algorithms for the weighted tardiness scheduling problem

Jorge Valente, Faculdade de Economia, Universidade do Porto, Rua Dr. Roberto Frias, 4200-464, Porto, Portugal, jvalente@fep.up.pt, *Rui Alves*

We present beam search algorithms for the single machine weighted tardiness scheduling problem with sequence-dependent setups. These algorithms include the classical beam search procedure, as well as the filtered and recovering variants. The algorithms are tested on a set of randomly generated instances and compared with an existing dispatch heuristic.

2 - Two Due Date Assignment Problems In Scheduling A Single Machine

George Steiner, Management Science and Info. Sys., McMaster University, 1280 Main W. MGD 415, L8s 4m4, Hamilton, Ontario, Canada, steiner@mcmaster.ca, *Dvir Shabtay*

We study minimizing the sum of weighted earliness, tardiness and due date assignment penalties. In the second problem, we consider minimizing the weighted number of tardy jobs and due date assignment costs. We prove that both problems are strongly NP-hard and give polynomial solutions for some important special cases.

3 - Rescheduling for Multiple New Orders

Chris Potts, School of Mathematics, University of Southampton, So17 1bj, Southampton, Hampshire, United Kingdom, C.N.Potts@maths.soton.ac.uk, *Nicholas Hall*, *Zhixin Liu*

After scheduling some original jobs on a single machine, a set of new jobs arrives. These new jobs are to be inserted into the existing schedule with the objective of minimizing the maximum lateness, where constraints limit the resulting disruption. We propose approximaton and branch-and-bound algorithms. Computational tests are presented.

4 - A project management model for joint short-term scheduling and longer-term planning

Alistair Clark, Faculty of Computing, Engineering and Mathematical Sciences, University of the West of England, Frenchay Campus, Coldharbour Lane, Bs16 1qy, Bristol, United Kingdom, Alistair.Clark@uwe.ac.uk, *Danielle Hendricksen*

A project management model is developed for joint short-term detailed scheduling and medium-to-long term provisional planning when activity data is uncertain. The project horizon is adjusted as time rolls forward with ensuing updates of activity durations and resource estimates.

Several model formulations and rapid heuristic solution methods are explored.

■ TC-03

Tuesday, 1:30-3:00pm

Honolulu III

Stochastic Programming III

Cluster: Stochastic Programming

Invited session

Chair: *Gautam Mitra*, School of Information Systems, Computing and Mathematics, Carisma, Brunel University, Uxbridge, Ub8 3ph, United Kingdom, gautam.mitra@brunel.ac.uk

1 - An Efficient Algorithm for Solving Convex-Convex Quadratic Fractional Programs

Rei Yamamoto, Department of Industrial and Systems Engineering, Chuo University, MTB Investment Technology Institute Co., Ltd, 5-6, Siba 2-chome, Minato-ku Tokyo 105-0014 Japan, 105-0014, Tokyo, rei@kc.chuo-u.ac.jp, *Hiroshi Konno*

This research is concerned with an efficient algorithm for solving a convex-convex type quadratic fractional program. This is a typical non-concave maximization problem with multiple local maxima. The algorithm to be proposed here is a combination of (i) classical Dinkelbach's approach, (ii) integer programming approach, (iii) standard nonlinear programming algorithm.

2 - Risk Control in a Speculative Financial Market

Leonard MacLean, Business Administration, Dalhousie University, 6152 Coburg Road, B3h 3j5, Halifax, Nova Scotia, lmaclean@mgmt.dal.ca

In a financial market the exhuberance generated by excess returns on investment can lead to a price bubble. An approach to controlling the risk from overvaluation of stocks is presented in this paper. The methodology involves upper and lower control limits on the trajectory of accumulated capital.

3 - MPL/SPInE Stochastic Extensions for the MPL Modeling System

Bjarni Kristjansson, Maximal Software, Inc., 2111 Wilson Boulevard, 22201, Arlington, Virginia, United States, bjarni@maximalsoftware.com

We will demonstrate MPL/SPInE stochastic extensions for the MPL Modeling System, resulting from collaboration between Brunel University and Maximal Software. MPL/SPInE supports scenario-based recourse problems and handles both two-stage and multi-stage problems. Several formulations of stochastic models in MPL will be demonstrated, including manufacturing, power systems, and asset-liability management models.

4 - Numerical Analysis of discretizations of multistage stochastic programming

Petri Hilli, Management Science, Helsinki School of Economics, Runeberginkatu 22-24, 00100, Helsinki, Finland, hilli@hkkk.fi, *Teemu Pennanen*

Many stochastic programming models are infinite-dimensional optimization problems whose solution often requires discretization e.g. by sampling. This paper studies numerically the convergence properties

of discretizations based on quasi-Monte Carlo (QMC) methods. In our tests, QMC and other variance reduction techniques clearly outperform crude Monte Carlo method.

■ TC-04

Tuesday, 1:30-3:00pm
Iolani I

Issues in Supply Chain Management

Cluster: Operations Management
Invited session

Chair: *Frank Y Chen*, Department of Systems Engineering & Engineering Management, Chinese University of Hong Kong, Hong Kong, China, yhchen@se.cuhk.edu.hk

1 - Supply Chain Aperiodicity, Bullwhip and Stability Analysis with Jury's Inners

Stephen Disney, Cardiff Business School, Cardiff University, Colum Drive, Cf10 3eu, Cardiff, Wales, United Kingdom, disneysm@cardiff.ac.uk

We generalize the OUT policy by the addition of two independent proportional controllers in the policy's feedback loops. This generalisation allows us to eliminate the bullwhip problem, but introduces stability and aperiodicity issues in the supply chain. We use a novel method by Jury (1974) to study these issues.

2 - Optimal Policy of Joint Pricing and Inventory Control for a Periodic-Review System with Batch Ordering

Ying Wei, Department of Systems Engineering and Engineering Management, the Chinese University of Hong Kong, Shatin, Hong Kong, Hong Kong, ywei@se.cuhk.edu.hk, *Frank Y Chen*

In this periodic review problem, the order quantity is required to be a multiple of certain batch. The operating characteristics of the (r,Q,p) system are analyzed, and an efficient algorithm that optimizes (r, Q, p) is developed. The policy performance is then compared numerically with the (s,S,p) policy.

3 - Optimal Concurrent Manufacturing and Pricing Operations with Batch Demand

L Chen, Chinese University of Hong Kong, Hong Kong, China, lxchen@se.cuhk.edu.hk, *Y Feng*

We analyze an optimal production and pricing management problem in which demand is sensitive to price changes and comes in sequences of compound Poisson processes. A threshold production and pricing policy is shown optimal among all admissible policies. A computational procedure is yielded to optimize the threshold policies.

4 - Risk Aversion of Commitment-Option Contracts with Information Updates

Houmin Yan, Chinese University of Hong Kong, Hong Kong, China, yan@se.cuhk.edu.hk, *Hanqin Zhang*

Most supply chain models focus on the optimization of the expected value. We study a class of commitment-option supply contracts in a Conditional Value-at-Risk (CVaR) framework. We show that a CVaR trade-off analysis with advanced reservation and information updates can be carried out efficiently.

■ TC-05

Tuesday, 1:30-3:00pm
Iolani II

Dynamic Pricing in the Service Industry

Cluster: Dynamic Pricing & Revenue management
Invited session

Chair: *Duk Young Yoon*, Hankuk Aviation University, 200-1 Hwajun-dong, 412-791, Koyang-shi, seomjingang@hotmail.com

1 - Revenue Management and e-Business Impacts on Distribution Channel in Airlines

Duk Young Yoon, Hankuk Aviation University, 200-1 Hwajun-dong, 412-791, Koyang-shi, seomjingang@hotmail.com

From the growth of Internet technology, many e-commerce principles have been introduced in airline industry. In this paper, we focus on the impacts of airline e-business and RM being implemented in airline distribution channels.

2 - BSC model for measuring the performance of RM in Airlines

Yoonsook Song, 106-203 Ilsan-dong Ilsan-gu Goyang-si, 412-791, Kyunggi-do, songys05@hanmail.net, *Moon-Gil Yoon*, *Hui Young Lee*

Airline Revenue Management was generally measured by the simple financial performance. However, the financial performance could not evaluate the overall perspective of RM activities. This study applies the Balanced Score Card model to pursue the possibility of performance measurement on the overall process for RM activity in airlines.

3 - Stochastic dynamic programing model for RM with diversion, cancellation and no-show

Moon-Gil Yoon, Business Administration, Hankuk Aviation University, 200-1 Hwajun-dong, 471-712, Koyang-shi, Kyunggi-do, Korea, Republic Of, mgyoon@mail.hangkong.ac.kr, *Hui Young Lee*, *Duk-Young Yoon*

The concept of revenue management has been used widely in the hotel and the air transportation industries, and considered as a good system for managing a perishable asset. This paper deals with the problem of allocating airline seats among nested fare classes with diversion, cancellation and no-show for dynamic decision.

■ TC-06

Tuesday, 1:30-3:00pm
Iolani III

Network Design III

Cluster: Telecommunications and Network Design
Invited session

Chair: *Luis Gouveia*, Deio, University of Lisbon, Campo Grande, Bloco C6, 1749-016, Lisbon, Portugal, legouveia@fc.ul.pt

1 - Network Design with Single Path Minimum Weight Routing

Amaro de Sousa, University of Aveiro, Institute of Telecommunications, Campus Universitário, 3810-193, Aveiro, Portugal, asou@det.ua.pt, *Carlos Lopes*, *Luis Gouveia*

We address the multi-commodity capacitated network design problem where each commodity is routed through a single path given by a minimum weight routing protocol. We propose different variants of Integer Linear Programming models and study their efficiency when using standard ILP solving techniques.

2 - Rings networks design

Irene Loiseau, Departamento de Computación-, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Pabellón I - Ciudad Universitaria, 1428, Buenos Aires, Argentina, irene@dc.uba.ar, *Nelson Maculan Filho*

We present a column generation algorithm for the network design problem of determining a minimum cost set of cycles on a graph, that cover pairs of nodes where demands are to be satisfied. Cycles are bounded in length, number of edges and capacity. Columns are generated solving a MIP problem.

3 - Network Design with Multiple Hop-Constrained Node Disjoint Routing

Amaro de Sousa, University of Aveiro, Institute of Telecommunications, Campus Universitário, 3810-193, Aveiro, Portugal, asou@det.ua.pt, *Luis Gouveia*, *Pedro Patrício*

We address the multi-commodity capacitated network design problem with maximum delay survivable routing, i.e., each demand is splitted by multiple hop-constrained node disjoint commodities. We propose an ILP model based on a hop-index model and study the tradeoffs between design cost and degree of survivability for different number of splitting commodities.

■ TC-07

Tuesday, 1:30-3:00pm
Iolani V

Next Generation e-Biz

Cluster: Management Information Systems
Invited session

Chair: *Jong Woo Kim*, School of Business, Hanyang University, 17 Haengdang-dong, Seongdong-gu, 133-791, Seoul, Korea, Republic Of, kjw@hanyang.ac.kr

Chair: *Sung Joo Park*, Graduate School of Management, Korea Advanced Institute of Science and Technology, Seoul, Korea, Republic Of, sjpark@kgsm.kaist.ac.kr

1 - Assessing Level of Ubiquitous Computing Services for Ubiquitous Business Design: An Exploratory Study

Ohbyung Kwon, College of Management and Internaltion Relations, 1, Sochen-ri, Giheung-eup, 449-701, Gyeonggi-do, obkwon@khu.ac.kr, *Jihoon Kim*

Now we are entering into a new era of enterprise computing called ubiquitous network business. This paper illustrates how ubiquitous computing technology can be combined with legacy computer-based

systems, along with thoughts on relevant ubiquitous commerce issues. We propose a layered model showing assess levels of ubiquitous computing services.

2 - A Case-Based Reasoning approach for Retrieving Engineering Change Knowledge in Collaborative Product Development

Hong Joo Lee, Graduate School of Management, Korea Advanced Institute of Science and Technology, Supex Bldg., 285, CheongryangriDong, Dongdaemungu, 130722, Seoul, Korea, Republic Of, hjlee@kgsm.kaist.ac.kr, *Sung Joo Park*, *Jong Woo Kim*

The purpose of this paper is to design a case retrieval mechanism to facilitate the reuse of the engineering change knowledge generated in collaborative product development. Representations of engineering change knowledge and the case retrieval mechanism are linked with domain ontologies for retrieving knowledge more semantically.

3 - An Analysis on the Relationship between the Number of Ratings and the Performance of Collaborative Filtering

Jong Woo Kim, School of Business, Hanyang University, 17 Haengdang-dong, Seongdong-gu, 133-791, Seoul, Korea, Republic Of, kjw@hanyang.ac.kr, *Hong Joo Lee*

In Collaborative Filtering (CF)-based e-commerce personalization, customers' rating information on products is the main source to provide personalized recommendation. In this study, using the publicly available two data sets, EachMovie and MovieLens data sets, we analyze the relationship of the number of ratings of customers on products to the performance of CF.

■ TC-08

Tuesday, 1:30-3:00pm
Iolani VI

Pricing Issues in Supply Chains

Cluster: Supply Chain Management
Invited session

Chair: *Candace Yano*, University of California, Berkeley, United States, yano@ieor.berkeley.edu

1 - Risk Aversion in Inventory Management

Xin Chen, Department of Mechanical and Industrial Engineering, University of Illinois Urbana-Champaign, 224 Mechanical Engineering Bldg, MC-244, 1206 West Green Street, 61801, Urbana, IL, xinchen@uiuc.edu, *David Simchi-Levi*, *Melvyn Sim*, *Peng Sun*

We propose a framework for incorporating risk aversion in multi-period inventory models as well as multi-period models that coordinate inventory and pricing strategies. The framework is extended to models in which the decision maker has access to a (partially) complete financial market and can hedge its operational risk through trading financial securities.

2 - Bricks-and-Mortar vs. Clicks-and-Mortar: An Equilibrium Analysis

Xiaona Zheng, Fuqua School of Business, Duke University, 1 Towerview Drive, 27708, Durham, NC, United States, xz17@duke.edu, *Fernando Bernstein*, *Jeannette Song*

This paper studies traditional retailers' incentives to launch an Internet channel. In a duopoly setting, we identify the equilibrium channel structure, and investigate how launching the Internet channel affects firm profitability and productivity, as well as consumer welfare. Finally, we consider a market with "outside goods" and different consumer segments.

3 - Rationing and Dynamic Pricing for Multiple Class Deterministic Demand

Qing Ding, School of Business, Singapore Management University, 469 Bukit Timah Road, Singapore 259756, 259756, Singapore, dingqing@smu.edu.sg, *Panos Kouvelis*, *Joseph Millner*

We consider a firm allocating inventory to multiple customer classes. The firm either fulfills demand or offers a price discount to induce the demand to wait for fulfillment from the next reorder. We solve the problem in an EOQ-like environment and illustrate the profitability of studied rationing and discounting policies.

4 - Pricing in a Two-Supplier, One-Retailer Supply Chain with Capacity Constraints and Information Asymmetry

Candace Yano, University of California, Berkeley, United States, yano@ieor.berkeley.edu

We consider a scenario with two dominant, capacitated suppliers who set wholesale prices for their differentiated but competing products, and a retailer who sets retail prices that jointly determine retail demands. We explore the effects of realistic types of information asymmetry on prices and the profit distribution among the parties.

■ TC-09

Tuesday, 1:30-3:00pm
Iolani VII

Heuristic and Metaheuristic Algorithms for Combinatorial Optimization II

Cluster: Metaheuristics
Invited session

Chair: *Mutsunori Yagiura*, Applied mathematics and physics, Kyoto university, Yoshida Honmachi Sakyo-ku, Kyoto, 606-8501, Kyoto, Japan, yagiura@amp.i.kyoto-u.ac.jp

Chair: *Koji Nonobe*, Applied Mathematics and Physics, Kyoto University, 606-8501, Kyoto, Japan, nonobe@amp.i.kyoto-u.ac.jp

1 - A proposal of an access point allocation algorithm for wireless distribution system in wireless LAN

Nobuo Funabiki, Department of Communication Network Engineering, Okayama University, 3-1-1 Tsushimanaka, 700-8530, Okayama, funabiki@cne.okayama-u.ac.jp, *Eiji Kumano*, *Toru Nakanishi*

Wireless distribution system (WDS) provides wireless connections between access points (APs) for a large-scale wireless LAN. We formulate the AP allocation problem in WDS for feasible allocations with minimum costs, and present its heuristic algorithm consisting of allocating APs in a regular interval and improving them by random perturbations.

2 - A heuristic optimization approach to panoramic image generation from multiple cameras

Megumi Isogai, Department of Communication Network Engineering, Okayama University, 3-1-1 Tsushimanaka, 700-8530, Okayama, Japan, megu-i@infsys.cne.okayama-u.ac.jp, *Nobuo Funabiki*

We propose a two-stage panoramic image generation algorithm based on a local search method. Our algorithm consists of the approximate calibration stage using coordinates of feature points, and of the detailed calibration stage using every pixel information in overlapped regions, to accurately synthesize images from different cameras into one image.

3 - A Development Framework for Rapid Meta-heuristics Hybridization

Hoong Chuin Lau, School of Information Systems, Singapore Management University, 80 Stamford Road, 178902, Singapore, Singapore, hclau@smu.edu.sg

We present a generic framework (MDF) that reduces development time through reuse and support of user-defined strategies and hybridization of meta-heuristics. We propose a novel way of defining hybridization with the use of the "request and response" metaphor. Different hybrid schemes can now constructed with MDF using minimal coding.

■ TC-10

Tuesday, 1:30-3:00pm
Tapa Ballroom I

The Logical Analysis of Data: Combinatorial Optimization and Applications

Cluster: Tutorials
Invited session

Chair: *Silvano Martello*, Deis, University of Bologna, Viale Risorgimento 2, 40136, Bologna, Italy, smartello@deis.unibo.it

1 - The Logical Analysis of Data: Combinatorial Optimization and Applications

Peter L. Hammer, Rutcor, Rutgers, The State University of New Jersey, 640 Bartholomew Road, 08854, Piscataway, NJ, United States, hammer@rutcor.rutgers.edu

After briefly presenting the main ideas of the combinatorial optimization-based methodology of LAD, we shall describe:

(1) its main components: binarization of numerical data, extraction of "support sets" of key variables, identification of specific positive and negative "patterns", integration of patterns into full "models", which approximate the positive and negative universes and allow for the classification (e.g. diagnosis or prognosis) of new observations and the analysis of structural features (e.g. importance and nature of variables), with significant practical consequences (e.g. on choice of therapies);

(2) various associated linear and nonlinear binary optimization problems, with exact and approximate solution methods;

(3) medical applications, including diagnosis of ovarian cancer, prognosis of breast cancer, risk stratification among cardiac patients, classification of interstitial pneumonia types, design of biomaterials;

(4) applications to business and economics, including a demystified country credit risk rating system;

(5) LAD's novelty, advantages and disadvantages;

(6) ongoing research and open problems.

■ TC-11

Tuesday, 1:30-3:00pm

Tapa Ballroom II

Combinatorial optimization in scheduling and logistics

Cluster: Combinatorial Optimization

Invited session

Chair: *Erwin Pesch*, FB 5 - Institute of Information Systems, University of Siegen, Hoelderlinstr. 3, 57068, Siegen, Germany, pesch@fb5.uni-siegen.de

1 - Berth allocation as a moldable task scheduling problem.

Jacek Blazewicz, Instytut Informatyki, Politechnika Poznanska, ul.Piotrowo 3a, 60-965, Poznan, jblazewicz@cs.put.poznan.pl, *T.C. Edwin Cheng, Maciej Machowiak, Ceyda Oguz*

The allocation problem of berths to the incoming ships is modelled by moldable tasks scheduling problem. This model considers the tasks as the ships and the processors as quay cranes assigned to these ships. Since the duration of berthing for a ship depends on the number of quay cranes allocated to it, the use of moldable task scheduling model is substantiated. A suboptimal algorithm, which starts from the continuous version of the problem to obtain a feasible solution to the discrete version of the problem, is presented. The computational experiments showed that the algorithm has a very good average behavior.

2 - A Generic Model of a Manufacturing System for Various Planning and Execution Systems

Nico Vandaele, Applied Economics, University of Antwerp, Belgium, nico.vandaele@ua.ac.be

We propose a generic queueing model of a manufacturing system in order to provide the necessary planning information at the aggregate business planning level. This information is independent of the planning approach used (MRP, TOC, Scheduling, Kanban/JIT, CONWIP, POLCA, ...). We also report on industrial applications for some of them.

3 - Solution Methods for Two-Machine Flow Shop with Weighted Late Work Criterion

Erwin Pesch, FB 5 - Institute of Information Systems, University of Siegen, Hoelderlinstr. 3, 57068, Siegen, Germany, pesch@fb5.uni-siegen.de, *Jacek Blazewicz, Malgorzata Sterna, Frank Werner*

We analyze different solution procedures for the two-machine flow shop problem with a common due date and weighted late work criterion, which is binary NP-hard. In computational experiments we compare the practical efficiency of a dynamic programming approach, an enumerative method and a heuristic list scheduling procedure.

■ TC-12

Tuesday, 1:30-3:00pm

Tapa Ballroom III

Dynamic Transit Networks

Cluster: Transportation

Invited session

Chair: *Hong K. Lo*, Civil Engineering, Hong Kong University of Science and Technology, Hong Kong, Hong Kong, cehklo@ust.hk

1 - A Bi-level Programming Model For Determining The Optimal Hub-and-spoke Bus Network

Yu-chiun Chiou, Feng Chia University, Taichung, Taiwan, ycchiou@fcu.edu.tw, *Lawrence W. Lan*

This paper proposes a bi-level programming model for determining the optimal hub-and-spoke of inter-city bus network. The upper-level problem is formulated for determining the network relationship between routes, while the lower-level problem aims to solve the optimal location, routing, and scheduling. A case study on 60 routes is conducted.

2 - Implementation of stochastic assignment in dynamic schedule-based transit networks

C.o. Tong, Civil Engineering, The University of Hong Kong, Pokfulam Road, Pokfulam, Hong Kong, Hong Kong, cotong@hku.hk, *S.c. Wong, Sylvia Fung*

This paper investigates different methods for the implementation of stochastic assignment in dynamic schedule-based transit networks. The model considers heterogeneity in passengers' preferences for different components of travel time rather than heterogeneity in passengers' perception of these components. Several methods for implementation of stochastic assignment will be developed.

3 - A probit-type reliability-based transit assignment model

Yang Liu, The Hong Kong Polytechnic University, The Hong Kong Polytechnic University Hung Hom Kowloon Hong Kong, 852, Hong Kong, Hong Kong, 03902295r@polyu.edu.hk, *William Lam*

This paper proposes a new probit-type reliability-based transit assignment model, in which passengers' route choices are based on the minimal expected travel time disutility with taking account the effect of transit service reliability. In the proposed model, the transit line frequencies are elastic and subject to congestion at transit stations and on roads (if applicable) together with and the capacity constraint of the transit vehicle.

■ TC-13

Tuesday, 1:30-3:00pm

Sea Pearl I

Reliability and Maintenance

Cluster: Quality, Statistics and Reliability

Invited session

Chair: *Aparna Gupta*, Decision Sciences & Engineering Systems, Rensselaer Polytechnic Institute, Troy, NY, United States, guptaa@rpi.edu

Chair: *Reinaldo Souza*, Departamento de Engenharia Elétrica, Pontifícia Universidade Católica do Rio de Janeiro, Rua Marquês de São Vicente, 24020-140, Rio de Janeiro, RJ, reinaldo@ele.puc-rio.br

1 - Strategically optimum maintenance of sensor-enabled multi-component systems using continuous-time jump deterioration models

Aparna Gupta, Decision Sciences & Engineering Systems, Rensselaer Polytechnic Institute, Troy, NY, United States, guptaa@rpi.edu, *Chaipat Lawsirirat*

Today sensor technology supports condition-based maintenance to more efficiently deliver Long-Term Service Agreements offered by manufacturers (such as GE, UTC). We address the strategic maintenance problem from the manufacturers perspective. The goal is to find strategically optimal maintenance action for multi-component systems deteriorating continuously with jumps by using continuous-time simulation.

2 - Revised Residual Approach for Machine Diagnosis

Kazuhiro Takeyasu, College of Economics, Osaka Prefecture University, 1-1 Gakuenchou, 599-8531, Sakai, Osaka, Japan, takeyasu@eco.osakafu-u.ac.jp, *Yasuo Ishii*

For the detection of failure, residual based approach has been introduced which makes whiteness test of residual parts of Kalman Filter. Simplified calculation method of Kalman Filter is newly proposed. 1st order and 2nd order approximation of normal equation are calculated and proved to be practical for calculation time and accuracy.

3 - Using data envelopment analysis to set quality targets to Brazilian electricity utilities

Reinaldo Souza, Departamento de Engenharia Elétrica, Pontifícia Universidade Católica do Rio de Janeiro, Rua Marquês de São Vicente, 24020-140, Rio de Janeiro, RJ, reinaldo@ele.puc-rio.br, *José Francisco Pessanha*, *Luiz da Costa Laurencel*

In Brazil the price cap model controls the electricity tariff. This approach can reduce the investments in services quality as it incentive the cost cutting, therefore an additional regulation is needed. This paper presents an approach that combine two DEA models to set quality targets for the Brazilian electricity utilities.

■ TC-14

Tuesday, 1:30-3:00pm
Sea Pearl II

Emerging Technology in the Classroom

Cluster: Computational Software Development
Invited session

Chair: *Jeff Arthur*, Statistics, Oregon State University, 44 Kidder, 97331-4606, Corvallis, Oregon, United States, arthur@science.oregonstate.edu

Chair: *Jeffrey Camm*, Qaom, University of Cincinnati, Mail Location 0130, 45221, Cincinnati, Ohio, United States, Jeff.Camm@uc.edu

1 - Incorporating Active Learning into PowerPoint Lectures through Classroom Games

James Cochran, Department of Marketing and Analysis, Louisiana Tech University, PO Box 10318, 71272, Ruston, LA, United States, jcochran@cab.latech.edu

We demonstrate how to incorporate active learning into PowerPoint lectures/class discussions through use of television show-based classroom games. The Monty Hall problem from 'Let's Make a Deal', David Letterman's 'Trump or Monkey', Regis Philbin's 'Who Wants to be a Millionaire', and Alex Trebeck's 'Jeopardy' are all featured and demonstrated.

2 - Bringing Relevance to an Undergraduate Course in Engineering Statistics

Jeff Arthur, Statistics, Oregon State University, 44 Kidder, 97331-4606, Corvallis, Oregon, United States, arthur@science.oregonstate.edu, *Aimee Taylor*

We describe our work on a set of instructional modules under development that are aimed at making the material in an undergraduate engineering statistics course more meaningful to the students. Experiences with trial runs in the classroom, as well as student reactions, will also be discussed.

3 - On the Use of Integer Programming versus Evolutionary Solver in Spreadsheet Optimization

Jeffrey Camm, Qaom, University of Cincinnati, Mail Location 0130, 45221, Cincinnati, Ohio, United States, Jeff.Camm@uc.edu, *Kenneth Baker*

We discuss some experimental results comparing the integer programming approach to the evolutionary solver approach for achieving optimality in spreadsheet models of a number of well-known problem types. We also report some results on student performance with these two different approaches.

■ TC-15

Tuesday, 1:30-3:00pm
Sea Pearl III

Network Design and Routing under Uncertainty

Cluster: Routing
Invited session

Chair: *Alper Atamturk*, Ieor, University of California-Berkeley, 4141 Etcheverry Hall, 94720-1777, Berkeley, CA, United States, atamturk@ieor.berkeley.edu

1 - Robust network capacity expansion

Fernando Ordonez, Industrial and Systems Engineering, University of Southern California, 3715 McClintock Ave, Ger 240, 90089, Los Angeles, CA, United States, fordon@usc.edu

We consider capacity expansion for networks under demand and cost uncertainty. We show that robust capacity expansion is tractable under reasonable assumptions for transportation networks. Computational results show the robust solution reduces the worst-case cost by 20% while increasing 5% from the optimal value of a representative deterministic solution.

2 - New Models for the Delay Management Problem

Martine Labbé, Département d'Informatique, Université Libre de Bruxelles, Cp 210/01, Boulevard du Triomphe, 1050, Brussels, Belgium, mlabbe@ulb.ac.be, *Luigi De Giovanni*, *Geraldine Heilporn*

The Delay Management Problem concerns the management of potentially lost vehicle connections in a public transportation network affected by unpredictable vehicle delays, with the objective of minimizing the total passenger delay at destination. Compact Mixed Integer Linear Programming models are presented and different Integer Programming solution approaches are proposed.

3 - Two-Stage Robust Network Flow and Design for Demand Uncertainty

Alper Atamturk, Ieor, University of California-Berkeley, 4141 Etcheverry Hall, 94720-1777, Berkeley, CA, United States, atamturk@ieor.berkeley.edu, *Muhong Zhang*

We give an explicit characterization of the first-stage decisions, prove NP-hardness of the corresponding separation problem and discuss polynomial special cases. Using a "budget for uncertainty" we give an upper bound on the probability of infeasibility of a robust solution for a random demand.

■ TC-16

Tuesday, 1:30-3:00pm
Sea Pearl IV

Stochastic Dynamic Programming

Cluster: Dynamic Programming
Invited session
Chair: *Thomas Archibald*, School of Management, University of Edinburgh, United Kingdom, T.Archibald@ed.ac.uk

1 - The dynamic routing of impatient customers to heterogeneous service stations

Kevin Glazebrook, School of Management, University of Edinburgh, William Robertson Building, 50, George Square, Eh8 9jy, Edinburgh, United Kingdom, kevin.glazebrook@ed.ac.uk, *Chris Kirkbride*, *Jamal Ouenniche*

We propose a general Markovian model for the routing of impatient customers for service provided by a collection of heterogeneous stations. Queue length information is available to inform routing decisions. A simple index heuristic is developed and comes close to maximising the rate of rewards earned from service completions.

2 - Approximate dynamic programming for routing in multi-skill call centers

A. Pot, Wiskunde, Vrije Universiteit, Boelelaan 1081a, 1081hv, Amsterdam, sapot@few.vu.nl, *Ger Koole*

From a mathematical view the call routing is complex. Exact techniques for policy improvement suffer from the curse of dimensionality. This presentation treats our exploration of approximate dynamic programming. We try to get insight in the structure of the value function and we will focus on the ADP method itself.

3 - On the monotonicity of optimal expected processing time under random tool life

Bernard Lamond, Operations & Decision Systems, Universite Laval, Pavillon Palasis-Prince, G1k 7p4, Quebec, Quebec, Canada, bernard.lamond@fsa.ulaval.ca, *Manbir Sodhi*

We examine the monotonicity of optimal expected processing time for a machine-tool with variable cutting speed, a finite tool magazine and random tool life, as a function of magazine capacity. We interpolate the integer capacity with a continuous parameter of the first renewal distribution in a delayed renewal process.

4 - Optimising transshipment policies in multi-location inventory systems

Thomas Archibald, School of Management, University of Edinburgh, United Kingdom, T.Archibald@ed.ac.uk, *Kevin Glazebrook*, *Dan Black*

We propose a stochastic dynamic programming model for the control of transshipments in multi-location inventory systems and develop approximate solution methods using decomposition and other dimensionality reduction techniques. The new methods are compared with the static stock pooling policies that are often used in practice.

■ TC-17

Tuesday, 1:30-3:00pm
Sea Pearl V

Multiobjective Combinatorial Optimization

Cluster: Multi-Criteria Decision Analysis
Invited session
Chair: *Matthias Ehrgott*, Engineering Science, University of Auckland, Private Bag 92019, 1001, Auckland, New Zealand, m.ehrgott@auckland.ac.nz

1 - Multiobjective Optimization in Resource Management for Military Training

George Konstantinow, The ISERA Group, LLC, 135 East Ortega Street, 93101, Santa Barbara, CA, george.konstantinow@iseragroup.com, *Lina Garcia*

Resources - instructors, facilities, and equipment - for military training are typically allocated independently according to the specific training paradigms they support (classroom, simulation, online distributed learning, etc.). We present multiobjective optimization methods for training resource identification and allocation and demonstrate how these are applied in current military training programs.

2 - Multiple Criteria Districting Problems,Models, Algorithms, and Applications: The Public Transportation Paris Region Pricing System

José Figueira, School of Economics, University of Coimbra, Av. Dias da Silva, 165, Coimbra, Portugal, figueira@fe.uc.pt, *Vincent Mousseau*, *Bernard Roy*, *Fernando Pereira*

This paper deals with the problem of a multicriteria partitioning of a territory into zones. We propose a new method to approximate the efficient frontier based on an evolutionary algorithm with local search. The algorithms were applied to a real-world problem of the Paris region public transportation.

3 - Multicriteria Models for Unit Crewing in Airline Crew Scheduling

Matthias Ehrgott, Engineering Science, University of Auckland, Private Bag 92019, 1001, Auckland, New Zealand, m.ehrgott@auckland.ac.nz, *David Ryan*, *Bassy Tam*

The aim of unit crewing is to have crew of different ranks operate the same sequence of flights as much as possible. We present several multicriteria models that model the tradeoff between crew cost and unit crewing. We show that unit crewing is beneficial for the robustness of pairing solutions.

■ TC-18

Tuesday, 1:30-3:00pm
Sea Pearl VI

OR for Process Industries II

Cluster: OR for Process Industries
Invited session

Chair: *Goutam Dutta*, Production and Quantitative Methods Area, Indian Institute of Management, Wing 3, PMQ Area, Vastrapur, I.I.M, Ahmedabad, 380015, Ahmedabad, Gujarat, India, goutam@iimahd.ernet.in

1 - A Case on Supply Chain Planning in a Process Industry in India

Ravichandran Narasimhan, Production & Quantitative Methods Area, Indian Institute of Management, Ahmedabad, Vastrapur, Ahmedabad, 380 015, Ahmedabad, Gujarat, India, nravi@iimahd.ernet.in

We present the details of a case pertaining to issues in supply chain planning in the context of process industry. More specifically, the case provides an opportunity to plan for raw material purchase, material handling and facilities planning. The scope of such models and their usage would be highlighted.

2 - Competitive Capacity Planning and Product Allocation for Commodity Products

Uday Karmarkar, UCLA Anderson School, 110 Westwood Plaza, Box 951481, 90095, Los Angeles, CA, ukarmark@hotmail.com, *Kumar Rajaram*

Short term capacity constraints often apply in industries where production capacity changes are difficult due to high fixed costs and long implementation times . We formulate the deterministic competitive multi-product capacity planning problem to study product mix decisions, including competition for limited supplies of raw materials.

3 - Reinventing a Large Process Plant

Arabinda Tripathy, Indian Institute of Management, Ahmedabad, Indian Institute of Management, Ahmedabad, 380015, Gujarat, India, tripathy@iimahd.ernet.in

A hundred year old process plant have been facing severe global competitive pressures. The company with successful implementation of various improvement initiatives becomes the global least cost manufacturer of its products. The process of reinvention is explained in the framework of Soft OR.

4 - A Survey of OR/MS Application in Process Industries

Goutam Dutta, Production and Quantitative Methods Area, Indian Institute of Management, Wing 3, PMQ Area, Vastrapur, I.I.M, Ahmedabad, 380015, Ahmedabad, Gujarat, India, goutam@iimahd.ernet.in

We survey about 40 papers from the published literature (IAOR) in various process industries (non-steel) namely Aluminium, Pharmaceuticals , Cement and Copper Industry. The classification is done based on methodologies. The survey shows that very few work has been done in mathematical programming based integrated planning model.

■ TC-19

Tuesday, 1:30-3:00pm
Nautilus I

AHP06: Miscellaneous Applications I

Cluster: Analytic Hierarchy / Network Process
Invited session

Chair: *Rafikul Islam*, Department of Business Administration, International Islamic University Malaysia, Jalan Gombak, 53100, Kuala Lumpur, Malaysia, rislam@iiu.edu.my

Chair: *William Wedley*, Faculty of Business Administration, Simon Fraser University, 8888 University Drive, V5a 1s6, Burnaby, British Columbia, Canada, wedley@sfu.ca

1 - Application AHP to the selection of road equipments, one examination in the Japan Highway Public Corporation

Tetsuji Uemura, Piblic Management Innovation Consulting Department, Nomura Research Institute, 14F Marunouchi-Kitaguchi Bldg., 1-6-5 Marunouchi, 1000005, Chiyoda, Tokyo, t-uemura@nri.co.jp, *Koji Yamamoto*, *Eizo Kinoshita*

In the JH Tohoku branch, in order to establish road equipments, for example the road lightning system, we used absolute-AHPIn the field where we chose, there was much traffic accident. After AHP analysis, we actually establish one kind of equipment and after that, traffic accident has decreased extremely.

2 - A three-staged fussy AHP method in traffic innovations prioritization

Kevin P. Hwang, Transportation and Communication Management Science, National Cheng-Kung University, 1, University Boulevard, Tainan, Taiwan, 70101, Tainan, Taiwan, hwangis@mail.ncku.edu.tw

A three-staged fussy multi-criteria objective method including fuzzy Delphi, fuzzy AHP, and value matrix was employed to reveal factors and weights to implement innovative traffic devices. It reveals the factors follows the order of 1.effectiveness, 2.cost/financial resource, 3.location and environment, 4.product capability, 5.possible political concerns, and lastly, 6.administrative endeavor.

3 - MBNQA Criteria in Education: Assigning Weights from Malaysian Perspective and Proposition of an Alternative Evaluation Scheme

Rafikul Islam, Department of Business Administration, International Islamic University Malaysia, Jalan Gombak, 53100, Kuala Lumpur, Malaysia, rislam@iiu.edu.my

The present paper uses analytic hierarchy process (AHP) to reassign weights to the Malcolm Baldrige National Quality Award criteria in Education from Malaysian perspective. The paper also proposes an alternative evaluation scheme based upon absolute measurement procedure of AHP.

4 - Fuzzy Stock Selection using Fuzzy Analytic Hierarchy Process

Fatma Tiryaki, Faculty of Art and Sciences, Department of mathematics, Yildiz Technical University, Davutpasa Kampusu -ISTANBUL, Turkey, 34, Istanbul, Turkey, ftiryaki@yildiz.edu.tr, *Beyza Ahlatcioglu*

A lot of research work has been conducted on financial problems; one of the hot research topics is the use of fuzzy set theory to solve them

when imprecise information is represented in fuzzy terms. This paper shows how fuzzy AHP methods can be used for stock selection.

■ TC-20

Tuesday, 1:30-3:00pm
Nautilus II

Risk Analysis

Cluster: Decision Analysis
Invited session

Chair: *John Butler*, Ohio State University, 2100 Neil Ave, 43215, Columbus, Ohio, United States, butler.267@osu.edu

1 - Anticipating and Weathering Storms in Property and Casualty Insurance: Applying Probabilistic Risk Analysis Methods to a Business Context.

Lea Deleris, Management Science and Engineering, Stanford University, Terman Engineering Center, Room 346, 94305, Stanford, CA, ldeleris@stanford.edu, *Elisabeth Pate-Cornell*

The objective of this research is to provide managers in the property and casualty insurance industry with a framework to identify the risks that they face and take action to reduce their exposure if deemed necessary. We make use of risk analysis techniques such as influence diagrams and probabilistic modeling.

2 - Matching Exploration Mission Capability Needs with Candidate Technology Solutions

Charles Weisbin, Strategic Systems Technology Program Office, Jet Propulsion Laboratory, 4800 Oak Grove Drive, Ms 179-224, 91011, Pasadena, California, United States, Charles.R.Weisbin@jpl.nasa.gov

This paper presents the START methodology (STrategic Assessment of Risk and Technology) [http://start1.jpl.nasa.gov] and provides an initial evaluation of the selection of technology investments by NASA which would maximize exploration return, subject to available resources and acceptable risk, to help realize the Presidential Space Exploration Vision.

3 - Integrated Risk Assessment

Diane Williams, *CPA*, Acquisition Management Department, Defense Acquisition University - South, 6767 Madison Pike, Bldg #7, 35806, Huntsville, AL, United States, Diane.williams@dau.mil, *JOhn Adams*

Integrating technical and schedule risk assessments together with cost estimating models is a significant management challenge. The Army's THAAD program ($1.5B) used the ACEIT model and adjusted specific cost estimating relationships, thus calibrating the hardware / software estimates according to known risks, providing more accurate budgets, cost/benefit, and affordability assessments.

■ TC-21

Tuesday, 1:30-3:00pm
Lehua Suite

Computational Probability

Cluster: Applied Probability
Invited session

Chair: *Mohan Chaudhry*, Royal Military College of Canada, Kingston, ON, Canada, chaudhry-ml@rmc.ca

1 - A Heuristic Approach to Discrete Time Queues with Vacations

Sung Jin Kim, Industrial Engineering, Kaist, stochastic model lab of industrial engineering KAIST GusongDong YusungGu, 305-701, Daejon, Korea, Republic Of, kimsj0529@hotmail.com, *Nam Ki Kim*

We consider discrete-time GeoX/G/1 queues with single and multiple vacations, both under N-policy. We suggest a heuristic approach to derive their mean queue-waiting times. The heuristic approach is mainly based on an arriving customer's viewpoint.

2 - Analysis of the Geo/G/1 queue with Disasters (Geo/G/1/DST)

Xeungwon Yi, Industrial Engineering, KAIST(Korea Advanced Institute of Science and Technology), Department of Industrial Engineering, Korea Advanced Institute of Science and Technology, Yousong, Daejeon 305-701, Korea, 305-701, Daejeonshi, omaosi@kaist.ac.kr, *Kyung Chae*

In this paper, we consider Geo/G/1 queues governed by a stochastic clearing mechanism, called "disaster", which removes all workload in the system whenever it occurs to the system. The clearing mechanism of disasters can be applied to computer systems in the presence of a virus as a clearing operation of all stored messages present in the system. We present the system size distribution.

3 - A simple numerical solution to get queue-length distributions of the discrete-time queues: GI/G/1 and GI/D/c

Nam Ki Kim, Industrial Engineering, Chonnam National University, 300 Yongbong-dong Buk-gu, 500-757, Gwangju, Korea, Republic Of, freedom@chonnam.ac.kr, *Mohan Chaudhry*

Based on a discrete-time version of the distributional Little's law, we present a simple computational procedure to obtain queue-length distributions of the discrete-time queues GI/G/1 and GI/D/c from their respective waiting-time distributions that are available by various existing methods. Sample numerical examples are demonstrated at the end.

■ TC-22

Tuesday, 1:30-3:00pm

Kahili I

DEA05: Applications in DEA I

Cluster: Data Envelopment Analysis and Performance Management

Invited session

Chair: *Georg Westermann*, Wirtschaftswissenschaften, Hochschule Harz, Friedrichstr. 57-59, D-38855 Wernigerode, 38855, Wernigerode, gwestermann@hs-harz.de

1 - Thailand's Provincial Hospitals' Performance Assessment: Incorporating Stochastic Demand for Hospital Care into Deterministic DEA

Thamana Lekprichakul, Economics, University of Hawaii at Manoa, 1474 St. Louis Drive, 96816, Honolulu, HI, thamana@hawaii.edu

This paper gauges cost efficiency of Thailand's provincial hospitals. It addresses a common flaw in past hospital efficiency studies by showing how stochastic demand for hospital care can be incorporated into a typical deterministic DEA framework. It also demonstrates that using Tobit estimator in post-DEA analysis is flawed.

2 - Benchmarking the Performance of Philippine Corporations

Emilyn Cabanda, Graduate School, University of Santo Tomas, UST Graduate School, Espana, Manila Philippines, 1008, Manila, dr_cabanda@yahoo.com, *Candy Chiu*

This paper investigates the performance of top 300 corporations in the Philippines from 1998-2002. The use of DEA output-orientated model extends our robust analysis across 24 several industries, with unbalanced sample size. Reported new findings indicate that high productivity growth is due to high efficiency score of the majority corporations.

3 - DEA as a Tool in Benchmarking Studies - The Case of Students' Canteens

Georg Westermann, Wirtschaftswissenschaften, Hochschule Harz, Friedrichstr. 57-59, D-38855 Wernigerode, 38855, Wernigerode, gwestermann@hs-harz.de

Benchmarking is a complex process enabling organisations to learn from best practises. Successful benchmarking simultaneously takes into account variations in product/customer/production structures as well as efficiency differentials. Applying data of about 150 students' canteens this paper demonstrates the possibilities of DEA to serve as a comprehensive tool in that process.

■ TC-23

Tuesday, 1:30-3:00pm

Kahili II

General Health Care

Cluster: Health Care

Invited session

Chair: *Atsuko Ikegami*, Faculty of Science and Technology, Seikei University, 3-3-1 Kichijoji-kitamachi, Musashino-shi, 180-8633, Tokyo, Japan, atsuko@st.seikei.ac.jp

1 - Modelling dynamic prioritisation, finite capacity, and feedback in waiting lists

Wayne Thompson, Engineering Systems Department, Cranfield University, Royal Military College of Science, Shrivenham, Sn6 8la, Swindon, United Kingdom, w.a.thompson@cranfield.ac.uk

Separate processes describing patients' epidemiology and service provision are combined in a discrete event simulation framework using cloned entities. Service rationing is imposed by limiting the number of patients in a prioritised queue. Multilevel, statistical models of patients' waiting times are fitted. Insight is gained using ideas of queuing networks.

2 - Using clinical pathways and genetic algorithm for hospital scheduling

Cornelia Teich, Am Schafweg 24 c, 08496, Neumark, Germany, tobias.teich@fh-zwickau.de, *Thomas Giese*, *Marko Härtig*, *Frank Trommler*

The papers objective is the concept of a system for time and resource planning in hospitals based on clinical pathways. A genetic algorithm is used to optimize the usage rate of the resources. Therefore a genetic representation will be introduced coping with converging and diverging workflows including uncertainties.

3 - Applied performance measurement: A case study using DEA and other Frontier Production Function - related indexes

Adolf Stepan, Inst. of. Management Science, Univ. of Technology Vienna, Theresianumgasse 27, A-1040 Wien, A-1040, Wien, stepan@imw.tuwien.ac.at, *Margit Sommersguter-Reichmann*

DEA and other frontier production function related indices are used for assessing hospital performance. Data from public sector hospitals were analysed over time and sensitivity analyses examine the robustness of the results. Using the Malmquist productivity index we check whether observed changes are due to improved efficiency or technology changes.

4 - A model for home help staff scheduling

Atsuko Ikegami, Faculty of Science and Technology, Seikei University, 3-3-1 Kichijoji-kitamachi, Musashino-shi, 180-8633, Tokyo, Japan, atsuko@st.seikei.ac.jp

Home help organizations provide services at respective users' homes at a time that is convenient for the user.　It is difficult to assign helpers with time window constraints to these services adequately due to many types of constraints．We discuss a mathematical model for this scheduling problem.

■ TC-24

Tuesday, 1:30-3:00pm

Hibiscus I

Finance III

Cluster: Finance

Contributed session

Chair: *Atsuo Suzuki*, Mathematical Sciences, Nanzan University, 27, Seirei-cho, 489-0863, Seto-shi, Aichi-ken, Japan, d04mm001@msie.nanzan-u.ac.jp

1 - Negotiation modeling in Project Financing

Tadashi Uratani, Industrial and System Engineerig, Hosei University, Kajinocho 3-7-2, Koganei, 184-8584, Tokyo, uratani@k.hosei.ac.jp, *Masanori Ozawa, Takashi Kobayashi, Kunihiro Wakayama*

Project Financing is financing technology for large scale project. The project is undertaken by sponsors, lenders and the government. Sponsors manage to maximize the profit of equity investment lenders control the risk. The government promotes the project by tax and equity participation. We propose a negotiation model for corporation.

2 - Currency hedging for a multi-national firm

Markku Kallio, Business Technology, Helsinki School of Economics, Pl 1210, 00101, Helsinki, kallio@hkkk.fi

A multi-stage stochastic optimization model is developed aiding the CFO of a global company in currency hedging. The approach employs a VEqC model for the exchange rates and conventional currency instruments for hedging. Alternative objectives and hedging policy constraints are used to illustrate the performance of hedging strategies.

3 - On the Valuation and Optimal Boundaries of Convertible Bonds with Call Notice Periods

Kyoko Yagi, Mathematical Sciences, Nanzan University, 27 Seire-cho, 489-0863, Seto-shi, Aichi-ken, Japan, d04mm003@msie.nanzan-u.ac.jp, *Katsushige Sawaki*

This paper presents a valuation model of convertible bonds with call notice periods in a setting of optimal stopping problem. We explore the analytical properties of optimal conversion and call notice boundaries by the investor and the issuer, respectively. The value of convertible bonds and optimal critical prices are examined numerically.

4 - A Rational Pricing Model of Warrant in Corporate Alliance

Koichi Miyazaki, Systems Engineerings, The University of Electro-Communications, 1-5-1 Chofugaoka, 182-8585, Chofu, Tokyo, miyazaki@se.uec.ac.jp, *Satoshi Nomura*

We propose a rational design of warrant in corporate alliance that satisfies arbitrage-free conditions among three players such as a bond holder or an equity holder of the warrant issuing company and the warrant buying company. An algorism for the computation and several numerical examples are also provided.

5 - The Pricing of Perpetual Game Options and their Optimal Boundaries

Atsuo Suzuki, Mathematical Sciences, Nanzan University, 27, Seirei-cho, 489-0863, Seto-shi, Aichi-ken, Japan, d04mm001@msie.nanzan-u.ac.jp, *Katsushige Sawaki*

In this paper, we discuss the pricing of perpetual game options when the stock pays dividends continuously at a positive rate. Moreover, we investigate about the optimal boundaries of the seller and the buyer. Also some numerical results are presented to demonstrate analytical properties of the price functions.

■ TC-25

Tuesday, 1:30-3:00pm
Hibiscus II

Network Flows

Cluster: Military Applications
Invited session

Chair: *Kevin Wood*, Operations Research Department, Naval Postgraduate School, Monterey Naval Postgraduate, 93943, Monterey, Ca, kwood@nps.navy.mil

1 - A Network Design Problem with Continuous Enemy Interdiction

Churlzu Lim, Systems and Industrial Engineering, The University of Arizona, 85721, Tucson, AZ, United States, clim@email.arizona.edu, *Cole Smith, Fransisca Sudargho*

We consider a network design problem to maximize flow revenue minus arc construction costs. Additionally, an enemy will (rationally) destroy arcs before the flow revenues are realized. This leads to a nonlinear integer programming formulation, which we solve using a novel concave optimization methodology.

2 - The US Army Uses A Network Optimization Model to Designate Career-Fields for Officers

Alexandra Newman, Division of Economics and Business, Colorado School of Mines, 1500 Illinois Street, 80401, Golden, CO, United States, newman@mines.edu, *Dan Shrimpton*

We developed a network-optimization model, the career-field designation model, that quickly assigns officers into specialized roles. The model maximizes a combination of officer skills and preference while assigning the required number of officers to each role. The US Army uses this system to designate about 1,500 officers each year.

3 - Dynamic Escape Routes for Naval Ships

Francisco J Perez Villalonga, Operations Research Department, Naval Postgraduate School, Monterey, California, United States, fperezvi@nps.edu, *Javier Salmerón*

Warship escape routes are typically planned during the ship's design phase. Static signaling systems placed onboard may mislead the egress procedure under certain circumstances. This work proposes dynamic evacuation routes, which consider the warship condition and damage location. Results for a frigate are presented and compared to existing escape plans.

Tuesday, 3:30-5:00pm

■ TD-01

Tuesday, 3:30-5:00pm
Honolulu I

OR Applications in Forestry - Logistics

Cluster: Renewable and Natural Resources
Invited session

Chair: *Mikael Rönnqvist*, Department of Finance and Management Science, Norwegian School of Economics and Business Administration, No-5045, Bergen, Norway, mikael.ronnqvist@nhh.no

1 - Economic Impacts Of Increased Forest Conservation In Europe: A Forest Sector Model Analysis

Maarit Kallio, Vantaa Research Center, Finnish Forest Research Institute, Unioninkatu 40 A, 00170, Helsinki, maarit.kallio@metla.fi, *Alexander Moiseyev*, *Birger Solberg*

The magnitude of economic impacts of increased forest biodiversity conservation in the EU on the forest sector was investigated with a forest sector model, EFI-GTM. The aggregate impacts in the EU appeared relatively low, because international trade counterbalances regional shortages. EU forest biodiversity conservation may decrease biodiversity in Russia.

2 - Agent-Based Supply Chain Planning in the Forest Products Industry

Sophie D'Amours, Génie mécanique, Consortium FOR@C, Université Laval, Pavillon Pouliot, G1k7p4, Québec, Québec, Sophie.Damours@forac.ulaval.ca, *Jean-Marc Frayret*

This presentation introduces a software architecture that combines agent and OR technologies to enable the development of specific planning support tools for naturally distributed problems, while creating integrated decision support systems for handling supply chain planning problem. A specific application in the forest supply chain is presented.

3 - OR tools to support storm damaged areas in Sweden

Mikael Rönnqvist, Department of Finance and Management Science, Norwegian School of Economics and Business Administration, No-5045, Bergen, Norway, mikael.ronnqvist@nhh.no

The storm that hit Southern Sweden in January 2005 resulted in that approximately 75 million cubic metres were wind thrown or damaged (one year's cutting). An entire new transportation and storage structure must be planned and put in operation. We discuss tools and experiences from this work.

■ TD-02

Tuesday, 3:30-5:00pm
Honolulu II

Scheduling in Practice

Cluster: Scheduling and Timetabling
Invited session

Chair: *Chang Sup Sung*, Industrial Engineering, Korea Institute of Science & Technology, 373-1 Kusong-dong, Yusong-Ku, 305-701, Daejon, cssung@kaist.ac.kr

1 - Due-date based algorithm for order-lot pegging in a semiconductor wafer fabrication facility

June Young Bang, Industrial Engineering, Kaist, IE department KAIST, 373-1 GuseongDong YuseongGu, 305-701, Daejeon, juneyb@kaist.ac.kr, *Kwee Yeon An*, *Yeong Dae Kim*

This paper focuses on order-lot pegging algorithms for due date based measures in semiconductor wafer fabrication. Four Strategies of pegging are suggested and Algorithms are presented and evaluated for each strategy. Due-date based order-lot pegging algorithms assign each lot to the orders in the way of minimizing its tardiness.

2 - Scheduling a Large Reentrant Hybrid Flow Line for Multi-Chip Module Assembly

Sangjin Lee, Industrial Engineering, Kaist, SIMLab I.E. Dept KAIST, 373-1 Gusung-dong Yusung-gu, 305-701, Deajon, sangjin.lee@kaist.ac.kr, *Lee Tae-Eog*

We present a scheduling problem for a large hybrid flow line for assembling multi-chip memory modules. It has reentrant job flows, assembly operations, and setups. We propose a job-oriented scheduling strategy for improving the on-time delivery performance without sacrificing keeping the machine utilization and throughput performances significantly.

3 - Applications of Genetic Algorithms to the Group Technology Economic Lot Scheduling

Heechul Bae, Industrial & Systems Engineering, National University of Singapore, Faculty of Engineering, 10 Kent Ridge Crescent, 119260, Singapore, hessed@pusan.ac.kr, *Ilkyeong Moon*

The concept of group technology has been successfully applied to many production systems. We apply group technology principles to the economic lot scheduling problem. We develop a heuristic algorithm and a hybrid genetic algorithm for the GT-ELSP. Numerical experiments show that the developed algorithms outperform the existing heuristics.

4 - A Production Scheduling Problem with dynamic delivery cost

Chang Sup Sung, Industrial Engineering, Korea Institute of Science & Technology, 373-1 Kusong-dong, Yusong-Ku, 305-701, Daejon, cssung@kaist.ac.kr, *Ik Sun Lee*

This paper considers a scheduling problem for coordination between production sequencing and finished job delivery to a customer. The objective is to minimize sum of the associated delivery costs and scheduling costs. The proposed problem is proved to be NP-hard. A polynomial algorithm is derived in a special case.

5 - Scheduling of Transporters and Blocks in Shipbuilding

Woon-Seek Lee, Systems Management & Engineering, Pukyong National University, Busan 608-739, Korea, Kor, Busan, iewslee@pknu.ac.kr, *Cheol-Min Joo*

This paper considers a transporter scheduling problem under a static transportation environment in shipbuilding. A heuristic algorithm is proposed to minimize the weighted sum of empty transporter travel times, delay times, and tardy times. Also, the performance of the proposed algorithm is evaluated.

■ TD-03

Tuesday, 3:30-5:00pm
Honolulu III

Stochastic Programming IV

Cluster: Stochastic Programming
Invited session

Chair: *Gautam Mitra*, School of Information Systems, Computing and Mathematics, Carisma, Brunel University, Uxbridge, Ub8 3ph, United Kingdom, gautam.mitra@brunel.ac.uk

1 - State-Space Partitioning Methods for Pricing High-Dimensional American-Style Options

Xing Jin, Mathematics, National University of Singapore, 2 Science Drive 2, 117543, Singapore, Singapore, matjx@nus.edu.sg

In this paper, a bundling method based on quasi-Monte Carlo sequences is proposed to price high-dimensional American-style options. By using low-discrepancy points, this approach partitions the state space and forms bundles. A convergence proof of the algorithm is provided with a variety of examples with up to 15 dimensions.

2 - Methods for Risk and Fund Management

Nicos Christofides, Centre for Quantitative Finance, Imperial College, Exhibition Rd, London, Sw7 2az, London, United Kingdom, n.christofides@imperial.ac.uk

We describe the modelling of asset dynamics. Independent components and neural networks introduce non-linear dependence representing fat-tailed return distributions. An arbitrage-free state-space transition graph represents the dynamics. Risk-management and fund-management problems are solved using dynamic programming and state-space mapping. We give real applications for hedge funds.

3 - Empirical Studies on Internationally Diversified Investment Using Stock-Bond Integrated Portfolio Model

Shusuke Komuro, Industrial and System Engineering, Chuo University, 61013,Chuo University,1-13-27, 112-8551, Kasuga, Bunkyo-ku, Tokyo, Japan, shusuke@shibusawa-co.jp, *Hiroshi Konno*

This paper presents the result of simulation on the effect of internationaly diversified investment using a stock-bond integrated portfolio model using 46 countries' stocks and 20 countries' bonds. The result indicates that this model usually outperform the traditional asset allocation model.

4 - Optimal Asset Allocation in a Dynamic Downside-Risk Framework: An Exact Solution for Complete Market

Xun Li, Department of Mathematics, The National University of Singapore, 2 Science Drive 2, 117543, Singapore, matlx@nus.edu.sg, *Zhenyu Wu*

This article presents, in closed form, an analytical solution to the optimal asset allocation problem in a dynamic downside-risk framework. This study provides economic insights of the properties of the downside risk measure. It sheds light on both academic and practical implications of the model to fields of risk management.

■ TD-04

Tuesday, 3:30-5:00pm
Iolani I

Mathematical Programming

Cluster: Mathematical Programming
Contributed session

Chair: *Pieter du Plessis*, 23 Rosini Street, van der Hoff park, 2531, Potchefstroom, Gauteng, rkwpmdp@puknet.puk.ac.za

1 - Solving a class of constrained variational inequalities with oracle description

Wei Xu, Civil Engineering, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong, Hong Kong, xuwei@ust.hk, *Hai Yang*, *Bingsheng He*, *Meng Qiang*

We consider a class of constrained variational inequalities with oracle description. For given dual variable, the relaxed problem will be solved by an oracle (or a black box). The task of solving the original problem is reduced to find the optimal Lagrangian multipliers. Some iterative prediction-correction methods are proposed.

2 - Multiple Criteria Linear Regression

Subhash Narula, of Management, Virginia Commonwealth University, 1015 Floyd Avenue,, Box 844000, 23284-4000, Richmond, Virginia, United States, snarula@vcu.edu, *John Wellington*

Sometimes choice of a criterion is unclear from statistical or other considerations. Under such circumstances, it may be more appropriate to use multiple criteria rather than a single criterion to estimate the parameters in a multiple linear regression model. We illustrate this with an example and outline possible solution procedures.

3 - Rough Set Approach To Urban Waste Management

Benedetto Matarazzo, Department of Economics and Quantitative Methods, Faculty of Economics - University of Catania, Corso Italia, 55, 95129, Catania, Italy, matarazz@unict.it, *Agata Matarazzo*, *Maria Teresa Clasadonte*, *Salvatore Greco*

We apply rough set approach to multiple criteria decision relative to urban waste management in West Sicily. Our approach permits to take into account economic, environmental and techinical criteria expressed by quantitative and qualitative data. The results are presented in terms of "if...,then..." decision rules, easily understandable by decision makers.

4 - Stopped semi-Markov decision processes with multiple constraints: the non-discounted case

Masayuki Horiguchi, Dept. of Information Environment Engineering, School of Information Environment, Tokyo Denki University, 2-1200 Muzai Gakuendai, Inzai, 270-1382, Chiba, Japan, horiguchi@sie.dendai.ac.jp

The optimization problem for a non-discounted case of stopped SMDPs with finite states, actions and multiple constraints is considered. The cost and terminal reward structures in stopped SMDPs are transformed into those in stopped MDPs, by which the original optimization problem are solved through the corresponding Mathematical Programming formulation.

5 - Using mathematical programming to simultaneously discard data points, select regressors and make transformation decisions in regression models

Pieter du Plessis, 23 Rosini Street, van der Hoff park, 2531, Potchefstroom, Gauteng, rkwpmdp@puknet.puk.ac.za, *Hennie Kruger, Giel Hattingh*

The paper aims at contributions to regression modelling where suspicious data, regressor selection and transformation selection are factors to be considered. Models based on mathematical programming techniques are discussed that consider data elimination, regressor selection and transformation selection simultaneously. Empirical results are presented

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■ **TD-05**

Tuesday, 3:30-5:00pm

Iolani II

New Approaches to Pricing and Revenue Management

Cluster: Dynamic Pricing & Revenue management

Invited session

Chair: *Georgia Perakis*, Sloan School of Management, Mit, Room E53-359, 50 Memorial Drive, 2139, Cambridge, MA, United States, georgiap@mit.edu

1 - An Analysis of the Re-Solving Issue in Network Revenue Management

Nicola Secomandi, Tepper School of Business, Carnegie Mellon University, 5000 Forbes Avenue, 15213, Pittsburgh, PA, United States, ns7@andrew.cmu.edu

The talk develops a theory of re-solving for math-programming-based network-revenue-management heuristics. It reveals the cause of the unexpected re-solving behavior of an LP-based booking-limit heuristic in an example of Cooper, where including information about the realized demand during the booking period in the LP hurts the heuristic's revenue generating ability.

2 - An Evolutionary Game-Theoretic Model of Revenue Management in a Dynamic Network Environment

Terry Friesz, Industrial and Manufacturing Engineering, Pennsylvania State University, State College, Pennsylvania, United States, tfriez@psu.edu, *Reetabrata Mookherjee, Matthew Rigdon*

We articulate a dynamic model of revenue optimization where a set of abstract service providers are involved in oligopolistic network competition. The price setting mechanism of the firms is a learning process resembling the replicator dynamics in evolutionary games. The resulting differential game takes the form of differential variational inequality.

3 - A Learning Approach to Dynamic Pricing under Competition

Soulaymane Kachani, Industrial Engineering & Operations Research, Columbia University, S.W. Mudd Building Room 334, 500 W. 120th St, 10027, New York, NY, kachani@ieor.columbia.edu, *Georgia Perakis, Carine Simon*

We present an optimization approach that addresses joint pricing and demand learning in oligopolistic markets. The parameters of the demand function are dynamic and learnt over time. We show how the

problem reduces to a sequence of mathematical programs with equilibrium constraints (MPECs), study its properties and discuss insights.

■ **TD-06**

Tuesday, 3:30-5:00pm

Iolani III

Network Design IV

Cluster: Telecommunications and Network Design

Contributed session

Chair: *Eleni Hadjiconstantinou*, Tanaka Business School, Imperial College London, London, United Kingdom, e.hconstantinou@imperial.ac.uk

1 - An Algorithm for the Maximum Profit Rooted-tree Problem

Takashi Kobayashi, Hosei university, Tokyo, Japan, t.kobaya@k.hosei.ac.jp, *Toshiko Fukuma*

We present an algorithm for obtaining the not-necessarily-spanning rooted-tree that maximizes the profit in a graph with node-incomes and branch-costs. It consists of node-merging procedure and iterations of getting the maximum-weighted routes.

2 - Dynamic Programming Approach for the Optimal Stars-Clustering-Tree Problem

Michal Stern, Tel-Aviv-Jaffa Academic College, 18 Rehavat-Ilan st., 54056, Givat-Shmuel, Israel, stern@mta.ac.il, *Ephraim Korach*

We present a polynomial dynamic programming algorithm for solving: Given a complete graph G=(V,E) with a weight on every edge and a collection of subsets of V, find a minimum weight spanning tree T such that all subsets in the collection induce stars in T with disjoint centers.

3 - Applying Path Counting Methods for Evaluating Edge and Node Deletion Connectivity Functions for the Network-structured System

Kazuhiro Kobayashi, Tokyo Institute of Technology, 2-12-1-w8-29, Oh-Okayama, 152-8552, Meguro, Tokyo, Japan, kazuhir2@is.titech.ac.jp, *Tatsuo Oyama, Hozumi Morohoshi*

We apply path counting methods to evaluate edge and node deletion connectivity function for the network-structured system. We show the stable connectivity functions for many different types of graphs and some actual lifeline networks. Some theoretical results are also given for special types of graphs.

4 - A branch and cut procedure for the two-edge connected network design problem

Eleni Hadjiconstantinou, Tanaka Business School, Imperial College London, London, United Kingdom, e.hconstantinou@imperial.ac.uk, *Efstratios Rappos*

Given an undirected graph, the problem is to design the minimum-cost two-edge connected network that satisfies flow constraints. The cost function consists of a fixed and a linear component. We present a solution methodology which involves a branch-and-cut algorithm based on a mixed-integer programming formulation of this problem.

■ TD-08

Tuesday, 3:30-5:00pm
Iolani VI

Supply Chain Optimization

Cluster: Supply Chain Management

Invited session

Chair: *Edwin Romeijn*, 303 Weil Hall, University of Florida, 32611, Gainesville, FL, United States, romeijn@ise.ufl.edu

1 - Planning Models for Setting Capacity and Demand Levels in a Production System

Joseph Geunes, Industrial and Systems Engineering, University of Florida, 303 Weil Hall, 32611-2083, Gainesville, FL, United States, geunes@ise.ufl.edu, *Yasemin Merzifonluoglu*

We consider the problem of concurrently determining optimal planned demand, capacity, production, and inventory levels. Assuming various degrees of flexibility, including the ability to determine the delivery timing of demands, these models can serve to benchmark current operations and can drive decisions on optimal demand and capacity planning.

2 - Bundling Retail Products: Models and Analysis

Kumar Rajaram, UCLA Anderson School, Los Angeles, CA, United States, krajaram@anderson.ucla.edu, *Kevin Mccardle*, *Christopher Tang*

We consider the impact of bundling products on retail merchandising. We consider two broad classes of retail products: basic and fashion. For these product classes, we develop models to calculate the optimal bundle prices, order quantities, and profits under bundling. We use this analysis to establish conditions and insights under which bundling is profitable. Our analysis confirms that bundling profitability depends on individual product demands, bundling costs, and the nature of the relationship between the demands of the products to be bundled.

3 - Inventory Allocation Policies for Multiple Customers with Different Service Levels

David Simchi-Levi, Mit, United States, dslevi@MIT.EDU, *Victor Martinez de Albeniz*

We consider a firm serving N different retailers each of which generates random demand. Service is performed from a common pile of inventory and service level guaranteed by the firm may vary from retailer to retailer. The problem faced by the company is to fulfill its customers' requests with the least possible cost. Thus, the objective is to minimize inventory, while satisfying the service level constraints.

■ TD-09

Tuesday, 3:30-5:00pm
Iolani VII

Heuristic and Metaheuristic Algorithms for Combinatorial Optimization III

Cluster: Metaheuristics

Invited session

Chair: *Mutsunori Yagiura*, Applied mathematics and physics, Kyoto university, Yoshida Honmachi Sakyo-ku, Kyoto, 606-8501, Kyoto, Japan, yagiura@amp.i.kyoto-u.ac.jp

Chair: *Koji Nonobe*, Applied Mathematics and Physics, Kyoto University, 606-8501, Kyoto, Japan, nonobe@amp.i.kyoto-u.ac.jp

1 - Cooperative Approach for the Satisfiability Problem

Michel Vasquez, Lgi2p, Ecole des Mines d'Alès, Parc scientifique Georges Besse, 30035 Cedex 1, Nîmes, France, Michel.Vasquez@ema.fr, *Djamal Habet*

We present a cooperation model between complete and incomplete algorithms to solve SAT problem. The involved algorithms are an exhaustive search; Satz and a local search; Walksat and its variants. An important feature of this hybridization is the exploitation, during the local search, of the variable dependencies (implications and equivalencies).

2 - An Effective Heuristic for the Maximum Weight Trace Formulation of the Multiple Sequence Alignment Problem

Akihiro Une, Department of Information and Computer Engineering, Okayama University of Science, 1-1 Ridai-cho, Okayama, 7000005, Okayama, Japan, une@ice.ous.ac.jp, *Akihiro Hamamoto, Kengo Katayama, Hiroyuki Narihisa*

Finding a high-quality multiple sequence alignment (MSA) is one of the most important problems in computational molecular biology. It is well-known that the MSA problem can be reformulated as the problem of finding the maximum weight trace in an alignment graph. We present a local-improvement heuristic for the reformulated problem.

3 - Search Space Analysis of the Maximum Clique Problem

Nobuo Ueno, Department of Information and Computer Engineering, Okayama University of Science, 1-1 Ridai-cho, Okayama, 7000005, Okayama, Japan, ueno@k2x.ice.ous.ac.jp, *Akihiro Hamamoto, Kengo Katayama, Hiroyuki Narihisa*

The performance of metaheuristics depends on the shape of the underlying search space, because a task of metaheuristics is to guide the search toward regions which contain high-quality solutions from current ones. We analyze the search space for the maximum clique problem, and show that it is very pessimistic for standard metaheuristics.

4 - Vertex Selection Rules of Local Search for the Maximum Weighted Clique Problem

Akihiro Hamamoto, Department of Information and Computer Engineering, Okayama University of Science, 1-1 Ridai-cho, Okayama, 700005, Okayama, Japan, a-hamamoto@ice.ous.ac.jp, *Kengo Katayama, Masashi Sadamatsu, Hiroyuki Narihisa, Nobuo Funabiki*

In heuristic methods for the maximum weight clique problem, the vertex selection rules are important because the vertex weights in a given graph should be taken into account in heuristic searches, not only vertex degrees as in the unweighted case. We provide several rules for local improvement heuristic, and show the comparison results.

■ TD-11

Tuesday, 3:30-5:00pm
Tapa Ballroom II

Advances in Network Design

Cluster: Combinatorial Optimization
Invited session

Chair: *Stefan Voss*, Wirtschaftsinformatik/Information Systems, University of Hamburg, Von-Melle-Park 5, 20146, Hamburg, Hamburg, Germany, stefan.voss@uni-hamburg.de

1 - Tolerances versus Costs in Branch and Bound Algorithms

Marcel Turkensteen, Econometrics and OR, University of Groningen, 9700 Av, Groningen, Netherlands, m.turkensteen@eco.rug.nl, *Boris Goldengorin, Gerard Sierksma, Diptesh Ghosh*

We introduce a new type of Branch and Bound algorithms where the branching rules and the lower bounds are based on tolerances. These tolerance-based algorithms are applied to the Asymmetric Traveling Salesman Problem. It appears that these algorithms outperform the commonly used cost-based algorithms for many instances.

2 - Partitioning Strategies to solve the Tree Knapsack Problem and the Extended Tree Knapsack problem

David van der Merwe, Computer Science, North-West University, Potchefstroom, 2522, Potchefstroom, North-west, South Africa, rkwdjvdm@puk.ac.za, *Giel Hattingh*

Tree knapsack problems and related extended models are important for local access telecommunication network (LATN) design. Shaw (Telecommunication Systems 7(1997)) and other authors discuss these problems. This paper proposes a new partitioning strategy and reports on empirical work and comparative performance findings.

3 - Optimal Cabling of the LOFAR Radio Telescope

Lolke Schakel, Landleven 5, 9700 Av, Groningen, Netherlands, l.p.schakel@eco.rug.nl, *Gerard Sierksma*

LOFAR is a revolutionary, large-scale radio telescope consisting of 76 sensor stations to be located in the Netherlands. All sensor stations have to be linked up with expensive fiberglass cables. The complexity of the Steiner problem is due to the fact that cheaper already existing fibers can be used.

4 - Use tabu search to solve the hierarchical network for time-definite express common carriers design problem

Sheu-hua Chen, Distribution Manegement, National Chinyi Institute of Technology, Taipin, Taichung, Taiwan, ROC, 411, Taichung, Taiwan, Taiwan, shchen@ncit.edu.tw

This research addressed the time-constrained hierarchical hub-and-spoke network design problem which determining the fleet size and schedules for the primary and secondary routes to minimize the total operating cost while satisfying the desired level of service. This scenario is described by a route-space directed network .

■ TD-12

Tuesday, 3:30-5:00pm
Tapa Ballroom III

Planning Models in Freight Transportation

Cluster: Transportation
Invited session

Chair: *Hugo Simao*, Dept of Operations Research and Financial Engineering, Princeton University, Equad E-316, 08544, Princeton, New Jersey, United States, hpsimao@princeton.edu

1 - An Auctioning System for Solving Vehicle Routing Problems

Sam Thangiah, Artificial Intelligence and Robotics Lab., Slippery Rock University, Computer Science Department, 002 Maltby Center, 16057, Slippery Rock, PA, sam.thangiah@sru.edu, *Michael McNamara, Ola Laleye*

Heuristics for complex vehicle routing and scheduling problems are usually solved using a layered approach. We introduce a distributed system for solving routing and scheduling problems. The implementation of the system to solve Vehicle Routing Problem with Time Windows and Time Windows with Multiple-Depots will be detailed.

2 - Economies of scope in shipper operations using integer programming

Hugo Yoshizaki, Production Engineering, University of Sao Paulo, Rua Corinto 739 Apt 74A, Butanta, 05586-060, Sao Paulo, SP, Brazil, hugo@usp.br

Truckload operations are characterized by economies of scope (load balance) rather than economies of scale. Using mixed integer linear programming, we developed optimization-based evaluations of two truckload cases from a shipper standpoint: dedicated or privately owned fleet operations, and inbound freight, contracted by the shipper (FOB) or the supplier (CIF).

3 - Using an Optimizing Simulator to Solve Large Transportation Networks

Jeff Day, Engineering & Research, Schneider National, 3101 S. Packerland Drive, 54313, Green Bay, WI, dayj@schneider.com, *Hugo Simao, Warren Powell*

We use an optimizing simulator, based on informational decomposition and approximate dynamic programming, to perform tactical and strategic studies on large transportation networks. Data aggregation is used to further reduce the size of the problem and engineering costs and pattern matching are combined to guide the optimization.

4 - Using Distributed Computing to Accelerate the Optimizing Simulator Solution

Hugo Simao, Dept of Operations Research and Financial Engineering, Princeton University, Equad E-316, 08544, Princeton, New Jersey, United States, hpsimao@princeton.edu, *Warren Powell, Jeff Day*

Within the context of using a decomposition and dynamic programming based optimizing simulator to perform tactical and strategic studies on a large truckload network, we explore the decomposition aspect of the approach by distributing the solution of the sub-problems among several processors, using inter-process communication to flow information among them.

■ TD-14

Tuesday, 3:30-5:00pm

Sea Pearl II

Recent Developments in COIN-OR

Cluster: Computational Software Development

Invited session

Chair: *Jeff Linderoth*, Industrial and Systems Engineering, Lehigh University, 200 W Packer Ave, 18015, Bethlehem, PA, United States, jtl3@lehigh.edu

1 - CoinMP: Simple C-API Windows DLL implementation of CLP, CBC, and CGL

Bjarni Kristjansson, Maximal Software, Inc., 2111 Wilson Boulevard, 22201, Arlington, Virginia, United States, bjarni@maximalsoftware.com

The COIN Open Source Initiative has become very popular in the recent years. To make life easier for users that simply want to solve models and not compile C++ applications, we have developed standard C-API Windows DLL CoinMP.DLL that implements most of the functionality of CLP, CBC, and CGL.

2 - How to Publish Your Code on COIN-OR

Robin Lougee-Heimer, Mathematical Sciences, IBM Research, T.J. Watson Research Center, 1101 Kitchawan Road, 10598, Yorktown Heights, NY, United States, robinlh@us.ibm.com

We review the processes and decisions involved in contributing to a COIN-OR project or "publishing" your own open-source code, data, and models in the COIN-OR repository. Common misconceptions regarding licenses, code ownership, and open-source will be discussed and your questions discussed.

3 - Experiences with NLPAPI

Jeff Linderoth, Industrial and Systems Engineering, Lehigh University, 200 W Packer Ave, 18015, Bethlehem, PA, United States, jtl3@lehigh.edu

NLPAPI is provides a way to create Nonlinear Programs, solve them, and access their solution information. In this talk, we will give some examples of using NLPAPI in the context of building solvers for non-convex quadratc programming and mixed integer nonlinear programming.

■ TD-15

Tuesday, 3:30-5:00pm

Sea Pearl III

Stocastic Models: Applications to Computer Science

Cluster: Computer Science

Contributed session

Chair: *Toshiyuki Kawanishi*, Information Science, Kanagawa University, 2946 Tsuchiya, 259-1205, Hiratsuka-shi, Kanagawa-Ken, Japan, toshi@kl.info.kanagawa-u.ac.jp

1 - Arrival Rate Approximation by Nonnegative Cubic Splines

Farid Alizadeh, Msis & Rutcor, Rutgers University, 640 Bartholomew Rd, 08854, Piscataway, NJ, United States, alizadeh@rutcor.rutgers.edu, *Jonathan Eckstein*, *Nilay Noyan*, *Gabor Rudolf*

We describe an optimization method to approximate the arrival rate ofnon-homogeneous Poisson process based on observed arrival data. We estimate the arrival function by cubic splines using the maximum likelihood principle. A critical feature of the model is that the splines are constrained to be everywhere nonnegative. We formulate this constraint using a characterization of nonnegative polynomials by positive semidefinite matrices. Results from e-mail arrivals will be presented.

2 - A Note on Expected Staying Time Related to Paging

Jun Kiniwa, Applied Economics, University of Hyogo, 8-2-1 Gakuen nishi-machi, 651-2197, Kobe, Hyogo, Japan, kiniwa@econ.u-hyogo.ac.jp, *Kensaku Kikuta*, *Toshio Hamada*

The expected staying time is the expected time interval during which an item stays in the fast memory. Using Markov chain theory, we show that there is a relationship between the expected staying time and a hit ratio. As a result, the superiority of LRU over FIFO is verified.

3 - Performance Evaluation Models with Two-Layer Queueing Networks

Toshiyuki Kawanishi, Information Science, Kanagawa University, 2946 Tsuchiya, 259-1205, Hiratsuka-shi, Kanagawa-Ken, Japan, toshi@kl.info.kanagawa-u.ac.jp, *Issei Kino*

In this paper, two-layer queueing network models are proposed to analyze performance of system with hierarchy structure. For the non-product form two-layer networks, we propose an approximate technique based on the flow-equivalent technique. Numerical examples are shown with both approximate and exact solution.

4 - A Genetic Algorithm Method for Optimization Model of Transmission Network

Septoratno Siregar, Petroleum Engineering, Institut Teknologi Bandung, Jalan Ganesha 10, 40132, Bandung, West Java, Indonesia, ss@tm.itb.ac.id, *Kuntjoro Adji Sidarto*, *Pudjo Sukarno*, *Edy Soewono*, *Ivanky Saputra*, *Muhammad Zukhri*, *Nanci Rohani*

We study an optimization problem for oil transmission pipeline and utilize genetic algorithm method which avoids the initial guess to find the optimal solution. The objective function model consists of minimizing investment and operation costs in which the parameter being optimized is the diameter. The model has been validated.

■ TD-16

Tuesday, 3:30-5:00pm

Sea Pearl IV

Greedy Algorithms and Approximate DP

Cluster: Dynamic Programming

Invited session

Chair: *Art Lew*, ICS Dept, University of Hawaii, Post 317, 96822, Honolulu, Hawaii, United States, artlew@hawaii.edu

Chair: *Thomas Archibald*, School of Management, University of Edinburgh, United Kingdom, T.Archibald@ed.ac.uk

1 - Dynamic Programming and Greedy Algorithms

Art Lew, ICS Dept, University of Hawaii, Post 317, 96822, Honolulu, Hawaii, United States, artlew@hawaii.edu

Greedy algorithms and dynamic programming are commonly regarded as separate paradigms for algorithm design. We discuss how greedy algorithms can be formulated as special cases of dynamic programming algorithms.

2 - Towards a Precise Model for Greedy and Dynamic Programming

Allan Borodin, Computer Science, University of Toronto, 10 Kings College Rd, M5s3g4, Toronto, Ontario, bor@cs.toronto.edu

In any Design and Analysis of Algorithms course, we invariably discuss "algorithmic paradigms" such as greedy and dynamic programming.

We can intuitively describe such algorithms but rarely do the standard texts attempt precise models, say as applied to combinatorial approximation. We propose some precise models for such paradigms.

3 - Solving a Dynamic, Stochastic, Multiknapsack Problem with Approximate Dynamic Programming

Joseph Hartman, Industrial and Systems Engineering, Lehigh University, Mohler Lab, 200 W. Packer Ave., 18015, Bethlehem, PA, United States, jch6@lehigh.edu

We present a dynamic programming approach for the dynamic, stochastic multiknapack problem which is can be used to accept or reject orders in a constrained capacity manufacturing environment. Approximation techniques are developed to solve larger instances and mitigate end-of-horizon effects. We also extend the model to include capacity decisions.

■ TD-17

Tuesday, 3:30-5:00pm
Sea Pearl V

Multicriteria Location Problems

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *Antonio Manuel Rodríguez-Chía*, Estadística e Investigación Operativa, Universidad de Cadiz, Facultad de Ciencias. Pol. Río San Pedro., 11510, Puerto Real, Cádiz, Spain, antonio.rodriguezchia@uca.es

1 - A new software tool to solve multicriteria facility location problems on networks

Marcos Colebrook, Depto. de Estadistica, Investigacion Operativa y Computacion, Universidad de La Laguna, Facultad de Matematicas, av. Astrofisico F. Sanchez s/n, 38271, La Laguna, Santa Cruz de Tenerife, Spain, mcolesan@ull.es, *Sergio Alonso*, *Joaquín Sicilia*

We present a new software application that compiles several algorithms to solve desirable and undesirable facility location problems on multicriteria networks. By means of a graphical interface, the program allows modeling and editing the input data, as well as displaying the optimal solution on the network.

2 - The Pareto Set For The Doubly Weighted Center-Median Path Problem

Justo Puerto, Universidad de Sevilla, Sevilla, Spain, puerto@us.es, *Arie Tamir*, *Antonio Manuel Rodríguez-Chía*, *Dionisio Perez*

In this paper we consider the location of a path-shaped facility P on a tree network. We use a biobjective model to represent the total transportation cost: the maximum center-weighted distance, and the sum of the median-weighted distances from P to the nodes tree.

3 - MCDM Location Problems

Antonio Manuel Rodríguez-Chía, Estadística e Investigación Operativa, Universidad de Cadiz, Facultad de Ciencias. Pol. Río San Pedro., 11510, Puerto Real, Cádiz, Spain, antonio.rodriguezchia@uca.es, *Justo Puerto*, *Stefan Nickel*

In this paper, we provide a broad overview of the most representative multicriteria location problems as well as of the most relevant achievements in this field, indicating the relationship between them whenever possible. We consider a large number of references which have been classified in three sections depending on the type of decision space where the analyzed models are stated. Therefore, we distinguish between continuous, network, and discrete multicriteria location problems.

■ TD-18

Tuesday, 3:30-5:00pm
Sea Pearl VI

Industry Applications

Cluster: Industry Applications
Contributed session

Chair: *Mei-Chen Lo*, Institute of Management of Technology, Chiao Tung University, 1001, University Road, 300, Hsinchu, Taiwan, mjlo.mt90g@nctu.edu.tw

1 - Using Integer Programming for Studying of Match Factories Performance with regard to raw material, The Case of Iran

Majid Azizi, Wood and Paper Department, Faculty of Natural Resources,University of Tehran, Daneshkadeh St., Faculty of Natural Resources, Department of Wood and Paper, 31585-4314, Karaj, Tehran, Iran, Islamic Republic Of, mazizi@ut.ac.ir

The aim of this research is studying of match factories performance with regard to raw material limitation in Iran. By using of integer programming the cities that their production have economic feasibility are determined. Production of the units and wood raw material were used as objective function and limitation equation respectively.

2 - Analysis of the consumers' expectation for the food traceability system

Gen Suda, 209-18 kujira, Gose-shi, Nara-ken, 639-2312, Japan, octagon_net@hotmail.com, *Yasuo Ishii*, *Kazuhiro Takeyasu*, *Sojiro Koshimura*, *Takashi Matsushita*

Food traceability is now an urgent issue for securing food safety. Internet connected mobile phones are most prevailing in Japan and among advanced countries. New traceability system with the mobile internet access is under construction in our group. This analysis is based on the questionnaires done to consumers and farmers.

3 - Applied MCDM Approach for Measuring Information Quality

Mei-Chen Lo, Institute of Management of Technology, Chiao Tung University, 1001, University Road, 300, Hsinchu, Taiwan, mjlo.mt90g@nctu.edu.tw, *Fang-Mei Tseng*, *Gwo-Hshiung Tzeng*

Automation in both materials transporting and information collecting for operation feedback and effective IQ are the key areas. This paper proposes an AHP method to set weights of IQ dimensions and uses TOPSIS to assess IQ relative performance of different IC companies to indicate effective resource allocation for IQ improvement.

4 - An Analysis on Type of Sequencing Machines at Korean Postal Market

Seung-Jin Wang, Postal Technology Research Center, Electronics and Telecommunications Research Institute, Daejon, Korea, Republic Of, sjgnaw@etri.re.kr, *Seong-Joon Lee*

The purpose of this paper is an attempt to establish and evaluate the criteria and the methods for determination of type of the delivery sequence sorting machines at Korean postal service. We arrange the details of valuation items under each criterion and show the results of comparative analysis using them.

■ TD-19

Tuesday, 3:30-5:00pm
Nautilus I

AHP07: Miscellaneous Applications II

Cluster: Analytic Hierarchy / Network Process
Invited session

Chair: *Diederik J.D. Wijnmalen*, Systems & Support for Decisions & Operations, TNO Organisation for Applied Scientific Research, P.O. Box 96864, 2509 Jg, The Hague, Netherlands, wijnmalen@fel.tno.nl

1 - Fuzzy C-means Clustering To Explore The Strategy Combination Of Fuel Cell Industry In Taiwan

Hua-Kai Chiou, Department of Statistics, National Defense University, P.O. Box 90046-15 Chunghe, Taipei 235, Taiwan, 235, Taipei, Taiwan, hkchiou@ebtnet.net, *Gwo-Hshiung Tzeng*, *Benjamin J.C. Yuan*, *Chien-Pin Wang*

This research focus on the optimal development strategy combination of fuel cell industry in Taiwan, we introduce fuzzy C-means clustering to determine the optimal combination of considered strategies for industry development. Four clusters be extracted for enhancing the industrial promotion and improving national competitiveness.

2 - Ordinal Fuzzy Measure and Its Application in Analytical Hierarchy Process with Choquet Integral

Yuh-Wen Chen, Institute of IE and MOT, Da-Yeh University, 112 Shan-Jeau Rd., Da-Tsuen,, Chang-Hwa 51505, Taiwan., 51505, Chang-Hwa, Taiwan, profchen@mail.dyu.edu.tw, *Moussa Larbani*

Sugeno's proportionality of fuzzy density is the popular way to resolve fuzzy density, but this arbitrary assumption between any two fuzzy densities is not easy for beginners. We propose an alternatively ordinal idea inspired from the multi-objective game theory for resolving these densities.

3 - Selection Method with AHP for Packaged Software in Consideration of Uncertain Factors

Takao Ohya, System Engineering Research Laboratory, Central Research Institute of Electric Power Industry, 2-11-1 Iwado Kita, 201-8511, Komae-shi, Tokyo, Japan, ohya@criepi.denken.or.jp

Method for selection of packaged software alternatives is proposed. In this method, various effects and costs covering a life cycle are evaluated with AHP in consideration of uncertain factors, such as use frequency. Pairwise comparison method of AHP is also used for factor scaling needed for consideration of uncertain factors.

4 - Supplier selection and planning model using AHP

Heung Suk Hwang, Department of Business Administration, Kainan University, Kainan University, Department of Business Administration, No.1 Kainan Rd., Lu-jhu, Taoyuan, 338, Taiwan (R.O.C.), 338, Taoyuan, Taiwan, hshwang@mail.knu.edu.tw, *Chun-Ling Chuang*, *Meng-Jong Goan*

This paper is concerned with supplier selection model using a multi-criteria decision making problem. There are three contributions on this paper. First, propose a MCDA model for the quantitative measure of supplier. Second, integrate the review results of individual analyses and third, develope a computer program for this model.

5 - To establish the criterion in the evaluation of the performance for KM project

Gwo-Hshiung Tzeng, Institute of Management of Technology, National Chiao Tung University, 1001,Ta-Hsueh Rd., 300, Hsinchu, Taiwan, ghtzeng@cc.nctu.edu.tw, *Chin-Yi Chen*

Organizations are usually according to their own constitution and adapting themselves to the external environment.This research based on the key success factors of the KM project and applies to the Analysis Hierarchy Process to calculate the importance of each criterion to establish an authentic evaluation model.

■ TD-20

Tuesday, 3:30-5:00pm
Nautilus II

Decision Analysis

Cluster: Decision Analysis
Invited session

Chair: *John Butler*, Ohio State University, 2100 Neil Ave, 43215, Columbus, Ohio, United States, butler.267@osu.edu

Chair: *Steven Greidinger*, School of Public Policy, University of Maryland, College Park, Van Munching Hall, 20742-1821, College Park, MD, steve_greidinger@hotmail.com

1 - Quantifying How a Study's Value of Information Falls If Its Recommendations Will Not Always Followed

Steven Greidinger, School of Public Policy, University of Maryland, College Park, Van Munching Hall, 20742-1821, College Park, MD, steve_greidinger@hotmail.com

Studies with substantial value may not be fully utilized by decision-makers for personal or political reasons. The results may not be well-communicated, or authority may be distributed among many individuals. If information is not used, it becomes less valuable even if it is

accurate. This talk will discuss how to incorporate the chance that a study will not be used into a Value of Information calculation.

2 - The Analytical Process Used to Develop Military Utility-Based Architectures for a governmental Integrated Planning Process

John Tindle, Northrop Grumman Information Technology - TASC, 1795 Jet Wing Drive, Suite 200, 80916, Colorado Springs, CO, United States, john.tindle@ngc.com

To support a large governmental budget build, a new ground-breaking analytical process to develop military utility-based architectures was created. This resulted in the development and integration of several analytical tools which produced architectures that were feasible, provided the greatest "bang-for-buck", and maximized military utility.

3 - Using Decision Analysis for BRAC 2005

William Tarantino, Total Army Basing Study, US Army, Arlington, United States, William.Tarantino@us.army.mil, *Lee Ewing*, *Gregory Parnell*, *John Harris*

Army installations provide facilities and maneuver space to organize, train and equip the United States Army. Four previous Base Closure and Realignment Commission (BRAC) rounds in 1988, 1991, 1993, and 1995, resulted in 97 major domestic base closures, 55 major base realignments, and 235 minor installations being either closed or realigned. We describe decision analysis methods the Army used to support BRAC 2005 installation and stationing decision-making.

■ TD-21

Tuesday, 3:30-5:00pm
Lehua Suite

Queueing Theory: Some Recent Developments

Cluster: Applied Probability
Invited session
Chair: *U. Narayan Bhat*, Southern Methodist University, P.O.Box 750332, 75275-0332, Dallas, TX, United States, nbhat@mail.smu.edu

1 - Analysis of a Multiserver Multipriority Queueing System

Sidney Hantler, Stochastic Analysis, IBM TJ Watson Research Center, PO Box 704, 3n-d06, 10598, Yorktown Heights, NY, United States, hantler@us.ibm.com, *B A Taylor*, *H R Gail*

We determine the equilibrium queue length distribution for queueing systems with several heterogeneous servers and several priority classes of customers. The classes may have different service time distributions, and the service discipline can be quite general, including, for example, both preemption and nonpreemption. The equilibrium conditions for the corresponding Markov chain give rise to an equation whose coefficients are matrices and whose solutions are vector valued holomorphic functions of several complex variables. Simpler systems, such as the single server system and the multiple server system with identically distributed service requirements, were analyzed by Cobham, Cohen, etc.

2 - Cone Schedules in Queueing Networks with Applications to Communication Systems

Kevin Ross, Information Systems and Technology Management, University of California Santa Cruz, 1156 High St, SOE3, 95064, Santa Cruz, CA, United States, kross@soe.ucsc.edu, *Nicholas Bambos*

We present recent results in scheduling over networks of queues with forwarding and feedback. Our geometric interpretation of stability leads to a class of projective cone scheduling algorithms which achieve maximal throughput. This analysis generalizes several results in queueing theory and communication systems, allowing very general arrival traces and service configurations.

3 - Predicting and Managing Waits in Emergency Rooms

Sriram Dasu, University of Southern California, Los Angeles, CA, United States, dasu@marshall.usc.edu

We model waiting times in emergency rooms. Service process can be modeled as re-entrant queues, and the arrival process is a time varying Poisson process. We examine option of allowing offline waits. We explore whether it is possible to guarantee a time window in which the returning patient is seen.

4 - Batch Queues with Choice of Arrivals: Equilibrium Analysis and Experimental Study

Rami Zwick, Dept. of Marketing, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, China, mkzwick@ust.hk, *William E. Stein*, *Amnon Rapoport*, *Darryl Seal*, *Hongtao Zhang*

We study a batch queueing game with and without balking where the players decide if and when to join the queue. Equilibrium solutions are constructed and tested experimentally. With repeated iterations of the stage game, all experimental conditions result in aggregate, but not individual, behavior approaching mixed-strategy equilibrium play.

■ TD-22

Tuesday, 3:30-5:00pm
Kahili I

DEA06: Applications in DEA II

Cluster: Data Envelopment Analysis and Performance Management
Invited session
Chair: *Ranjeet Kaur Khaira*, Australia, Australia, Australia, Ranjeet.Khaira@BusEco.monash.edu.au

1 - Applications of Data Envelopment Analysis in Manufacturing

Mauricio Cabrera-Rios, Programa de Posgrado en Ingeniería de Sistemas, Universidad Autónoma de Nuevo León, Pedro de Alba S/N, Edificion de Posgrado, 66450, Sn. Nicolas de los Garza, Nuevo León, Mexico, mcabrera@uanl.mx, *Carlos Castro*, *José Castro*

Data Envelopment Analysis can be effectively used to solve multiple criteria optimization problems in manufacturing. Its combined use with several different modelling and simulation techniques can render a methodology readily available for application in the industry. In this talk, a series of case studies are presented to encourage further application.

2 - Outsourcing Decision Of Strategic It Activities: Obtaining Competitive Action Potential (cap) By Filling An Efficiency Gap Vis-À-vis Competition

Jahyun Goo, Information Technology & Operations Management, Florida Atlantic University, 777 Glades Rd, 33431, Boca Raton, FL, United States, jgoo@fau.edu

This paper proposes that firms engage in outsourcing of their strategic IT activities based partly on the relative efficiency (with respect to their competitors) of their key IT input resources and factors, in addition to other drivers including their imitative response following industry trends in this regard.

3 - A Data Envelopment Analysis Application of Merger & Acquisition for Biomedical Businesses in Taiwan

Chia-Nan Wang, Information and Electronic Commerce, Kainan University, No. 1 Kainan Rd., Luzhu, 338, Taoyuan County, Taiwan, cn.wang@newfancy.com, *Chia-Te Lai*, *Chih-Hong Wang*

Traditional merger & acquisition (M&A) evaluations focusing on finance indices are not appropriate for operation efficiency of high-tech businesses. We proposed a data envelopment analysis (DEA) method for selecting the M&A candidates. Several Taiwan biomedical companies are analyzed and the results are sound after verifying with some biomedical managers.

■ TD-23

Tuesday, 3:30-5:00pm
Kahili II

Health Care / Medical Applications

Cluster: Health Care
Contributed session
Chair: *Haruna Ryo*, Information and Physical Science, 2-1 Yamadaoka,Suita,Osaka,Japan, 5650871, Suita, Osaka, ryoharuna@ist.osaka-u.ac.jp

1 - Critical Success Factors in Implementing EHR to Family Medicine Clinics

Kennedy Ganti, Department of Family Medicine, UMDNJ-Robert Wood Johnson Medical School, 1403 Plymouth Rd., 08902, North Brunswick, New Jersey, United States, ken_ganti@yahoo.com

Hospitals and clinics have been using various IT solutions to improve operations resulting in better patient care. Implementations of Electronic Health Records have grown in U.S. healthcare institutions becoming a clinical necessity. Topics include: Implementation and experience from two associated clinics from the physicians' perspective.

2 - Calibrating of Individual Health Evolution Model for Long-term Healthcare Financing Decisions

Aparna Gupta, Decision Sciences & Engineering Systems, Rensselaer Polytechnic Institute, Troy, NY, United States, guptaa@rpi.edu, *Zhisheng Li*

Quantifying uncertainties in the evolution of an individuals' health is essential for the planning of long-term healthcare financing. After constructing a comprehensive health indicator index and a health risk factor system, this paper calibrates a stochastic health evolution model using the National Health Interview Survey data.

3 - Modelling health care interventions

Keith Cooper, School of Management, University of Southampton, So17 1bj, Southampton, Hampshire, United Kingdom, kc@soton.ac.uk, *Sally Brailsford*, *Lyn Thomas*, *Ruth Davies*

Economic evaluations often use decision tree, Markov or discrete events simulation models to evaluate health care interventions. Using empirical examples for coronary heart disease, the strengths and weaknesses of the techniques are explored and guidelines for the optimal choice of modelling technique are developed.

4 - Extraction method of structure relation based on clustering for medical diagnosis

Haruna Ryo, Information and Physical Science, 2-1 Yamadaoka,Suita,Osaka,Japan, 5650871, Suita, Osaka, ryoharuna@ist.osaka-u.ac.jp, *Hiroaki Ishii*

In medical diagnosis, it is necessary to judge synthetically many sick groups based on huge database using computer. We extract rules about medical treatment methods based on database of patients suffering from diabetes mellitus using fuzzy clustering combined with rink analysis.

■ TD-24

Tuesday, 3:30-5:00pm
Hibiscus I

Risk Analysis and Management

Cluster: Risk Analysis and Management
Contributed session
Chair: *Xin Liu*, Rm 310, Graduate House, University of Hong Kong, Hong Kong, 000000, Hong Kong, China, liuxin@hkusua.hku.hk

1 - When The Risk-free Portfolio Exists In The Mean-variance Analysis

Yoshio Hayashi, School of Business Administration, Kinki University, Kowakae 3-4-1, 5778502, Higashi Osaka, Osaka, Japan, yokohaya@m8.dion.ne.jp

Nontrivial necessary and sufficient conditions that the risk-free portfolio exists under a certain condition in the mean-variance analysis are obtained. The results are applied to the case that the number of assets is three. The three-asset case is also approached directly by minimizing a single-variable quadratic function, leading conformable results.

2 - Statistical data analyses on railway accidents in Japan

Masashi Miwa, Track Management, Railway Technical Research Institute, 2-8-38 Hikari-cho Kokubunji-shi Tokyo Japan, 185-8540, Kokubunji, Tokyo, Japan, miwa@rtri.or.jp, *Brian Canlas Gozun*, *Tatsuo Oyama*

We deal with statistical data on Japanese railway accidents occurring in the last 30 years including frequency, types, causes and results (injuries and deaths). Probabilistic mathematical models are used to explain transitional phenomena. The effectiveness of several countermeasures used by railway companies to prevent railway accidents is quantitatively measured.

3 - Risk Management and Investment Planning in Deregulated Power Markets

Lindsay Anderson, Civil and Environmental Engineering, University of Western Ontario, 1151 Richmond St., N6a5b9, London, Ontario, landerson@eng.uwo.ca

In any market, a model of the underlying process is required to make risk management or investment decisions. For deregulated electricity markets, this underlying process is challenging. We will describe a 'hybrid' system model that captures the spot price process. Some interesting conclusions and applications will also be discussed.

4 - Value Appropriation and the Organization of Innovation

Marc Sachon, Operations Management, IESE Business School, Univ. of Navarra, Av. Pearson 21, 08034, Barcelona, Spain, msachon@iese.edu, *Bruno Cassiman, Alejandro Lago*

We present a simple and tractable model to identify optimal budgeting strategies for development efforts in a multiple period decision problem with different probabilities of development success for internal and external projects in the presence of knowledge diffusion.

5 - Risk aversion at capacity-constrained lot-sizing problem

Xin Liu, Rm 310, Graduate House, University of Hong Kong, Hong Kong, 000000, Hong Kong, China, liuxin@hkusua.hku.hk

This paper introduces extensions incorporating risk aversion in models of capacitated lot-sizing problem. A decision model is built. The choice concerns the quantity to be ordered to face a random demand, an expected cost to be minimized. Aa heuristic was also developed for solving large scale instances.

■ TD-25

Tuesday, 3:30-5:00pm

Hibiscus II

Logistics Applications I

Cluster: Military Applications

Invited session

Chair: *Edward Pohl*, Industrial Engineering, University of Arkansas, 4177 Bell Engineering Center, 72701, Fayetteville, Ar, epohl@engr.uark.edu

1 - Oil analysis of marine diesel engines: CBM optimization

Andrew Jardine, University of Toronto, Toronto, Ontario, Canada, jardine@mie.utoronto.ca

A spectroscopic oil analysis program (SOAP)is used to monitor the health of diesel engines on two fleets of frigates. Result of the optimization of health monitoring decisions for the fleets will be presented. The approach take is to build a proportional hazards model (PHM) that is use to estimate the hazard rate of an engine at the time of inspection. Ecomomic or availability consideration are then considered to identify the optimal maintenance decision subsequent to inspection.

2 - A Reliability Model for Contingency Construction Operations

Marlin Thomas, Industrial Engineering, Purdue University, 315 N. Grant Street, 47907-2023, West Lafayette, IN, muthomas@ecn.purdue.edu

We consider a contingency with a prescribed mission requiring a construction project of n days of duration. Mission reliability is assessed based on reliability interference of load measured in days required, and the capacity taken as the availability of allotted resources. Construction network reliability is used in making critical allocation decisions.

3 - Information Uncertainty in a Sense and Respond Logistics Architecture

Edward Pohl, Industrial Engineering, University of Arkansas, 4177 Bell Engineering Center, 72701, Fayetteville, Ar, epohl@engr.uark.edu, *Patrick Driscoll, Joel Nachlas*

In this presentation the authors will develop the concept of "information reliability". The focus of the talk will be on the effect of uncertainty in a "sense and respond" networked logistics architecture. Preliminary modeling paradigms will be presented.

Thursday, 9:00-10:30am

■ RA-02

Thursday, 9:00-10:30am
Honolulu II

Scheduling and Production Planning

Cluster: Scheduling and Timetabling
Invited session

Chair: *Marc Posner*, Industrial, Wedling & Systems Engineering, Ohio State University, 1971 Neil Ave., 43210, Columbus, Ohio, United States, posner.1@osu.edu

1 - A New Algorithm for the m-Machine Problem

Mauricio Solar, Computer Engineering Department, University of Santiago de Chile, Av. Ecuador 3659, 1, Santiago, msolar@usach.cl, *Carlos Gomez*

The m-machine problem is considered : given m machines and n tasks, assign the n jobs minimizing the makespant. In the online version, every time a job reaches the system, it must be assigned immediately to one of the m machines. A new algorithm is introduced that performs better.

2 - LT Heuristics for Production Planning Problem with Sequence Dependent Setups on Two Machines

Zrinka Lukac, Department of Mathematics, Faculty of Economics, Kennedyev trg 6, 10000, Zagreb, Croatia, zlukac@efzg.hr, *Kristina Soric*, *Visnja Vojvodic Rosenzweig*

We model the problem as a bilevel mixed 0-1 integer programming problem. The object of the leader is to assign the items to the machines, while the object of the follower is to minimize the costs of the machine. We develop a heuristics based on tabu search and Lagrangean relaxation.

3 - Allocation of Jobs and Resources to Work Centers

Marc Posner, Industrial, Wedling & Systems Engineering, Ohio State University, 1971 Neil Ave., 43210, Columbus, Ohio, United States, posner.1@osu.edu, *Hui-Chih Hung*

For our problem, servers are partitioned into parallel work centers. Each job type has a distinct Poisson arrival rate and WIP weight, and is assigned to a single center. The goal is to minimize the total WIP cost. Bounds on heuristics are developed for both identical and non-identical server problems.

■ RA-03

Thursday, 9:00-10:30am
Honolulu III

Stochastic Modeling in Finance

Cluster: Management Information Systems
Invited session

Chair: *Rita D'Ecclesia*, Teoria Economica e Metodi Quantitativi per le Scelte politiche, Università di Roma, Piazza Aldo Moro 5, 00185, Roma, Italy, Italy, rita.decclesia@uniroma1.it

1 - Long Swings in the US-Dollar: a Stochastic Control Approach.

Rosella Castellano, Dief, University of Macerata, Via Crescimbeni, 20, 62100, Macerata, castellano@unimc.it, *Rita D'Ecclesia*

Since 1973 currency market has been dominated by US-Dollar cycles, the so called long swings. The aim of this paper is to use a stochastic control method to describe the US-Dollar dynamic and to provide a validation of the model.

2 - CDS and Equity a changing relationship according to credit rating

Rita D'Ecclesia, Teoria Economica e Metodi Quantitativi per le Scelte politiche, Università di Roma, Piazza Aldo Moro 5, 00185, Roma, Italy, Italy, rita.decclesia@uniroma1.it

Credit derivatives have been experiencing a large success in financial markets. The aim of this paper is first, to examine the relationship between cds spreads and equities for various European and US companies; second, to investigate whether this relationship changes accordingly to various credit ratings.

3 - Productivity and costs for firms in presence of technology renewal processes

Roy Cerqueti, Faculty Of Economics, Department Of Mathematics For Economic, Financial And Insurance Decisions, University Of Rome La Sapienza, Via Del Castro Laurenziano, 9, 00161, Rome, roy.cerqueti@uniroma1.it, *Giulia Rotundo*

Competitive small as well as big firms must adequate their technology in order to survive on the market. The role of technology in firms is continuously growing. Even for small firms. We examine the role of innovation technology through its impact on the distribution of firms, productivity, costs of renewal.

■ RA-04

Thursday, 9:00-10:30am
Iolani I

Optimization Techniques I

Cluster: Optimization Techniques
Contributed session

Chair: *Vladimir Tsurkov*, Complex Systems, Dorodnicyn Computer Centre of Russian Academy of Sciences, 40 Vavilov str, 119991, Moscow, tsurkov@ccas.ru

1 - On Well Solvable Cases of the Quadratic Assignment Problem with Monotone and Bimonotone Matrices

Valery Gordon, United Institute of Informatics Problems, Surganov str. 6, 220012, Minsk, Belarus, gordon@newman.bas-net.by, *Vitali Demidenko*, *Gerd Finke*

Conditions imposed on the matrices of the quadratic assignment problem are derived such that optimum is attained on a given permutation. These conditions describe four new sets of matrices and enlarge the well solvable special cases of the problem. The work is supported in part by Projects INTAS-03-51-5501 and ISTC-B-986.

2 - Experiments With A Branch And Cut Algorithm For Concave Separable Functions And Integer Variables.

Idalia Flores, Sistemas, UNAM Facultad de Ingeniería, Plazuela de los Reyes 45-B301 Los Reyes Coyoacán, 4330, Mexico, Mexico, idalia@servidor.unam.mx

An algorithm is developed for minimizing a concave separable function over a convex polyhedron, with the additional constraint of integer variables. The algorithm uses a cutting plane procedure to identify the global minimum extreme point of the convex polyhedron, if it is not found, branch and bound procedure is used.

3 - Minimax under integral constraints

Vladimir Tsurkov, Complex Systems, Dorodnicyn Computer Centre of Russian Academy of Sciences, 40 Vavilov str, 119991, Moscow, tsurkov@ccas.ru

We consider a set of non-negative functions of two independent variables on a rectangle. Their integrals with respect to either variables are equal to values of the given functions. Algorithms of finding minimax are developed for different classes of functions. Applications of this problem to mechanics, geometry, tomography are presented.

■ RA-05

Thursday, 9:00-10:30am
Iolani II

Recent Advances in Dynamic Pricing

Cluster: Dynamic Pricing & Revenue management
Invited session

Chair: *Aurelie Thiele*, Industrial and Systems Engineering, Lehigh University, 200 West Packer Ave Room 329, 18015, Bethlehem, PA, United States, aurelie.thiele@lehigh.edu

1 - A Dynamic Pricing and Inventory Management Fluid model under Competition for a Multi-Product Capacitated System

Elodie Adida, Operations Research Center, Massachusetts Institute of Technology, MIT Room E40-130, 77 Massachusetts Ave, 02139, Cambridge, MA, United States, eadida@mit.edu, *Georgia Perakis*

We present a dynamic pricing and inventory control fluid model under competition for a multi-product capacitated system. We formulate the problem as a coupled-constrained non-zero sum differential game. We use quasi-variational inequalities to show the existence of a Nash equilibrium and we introduce a relaxation algorithm to find the equilibrium.

2 - A strategic consumer response to dynamically priced products

Yuri Levin, School of Business, Queen's University, Goodes Hall, K7l 3n6, Kingston, Ontario, Canada, ylevin@business.queensu.ca, *Jeffrey McGill*, *Mikhail Nediak*

We study the consumer response to dynamically priced products under the assumption that a consumer is a rational decision-maker (a strategic consumer). Then, we consider a "game" of strategic consumers against the monopolist company which dynamically prices the products. We formulate the model as a stochastic dynamic game, and obtain the equilibrium solution.

3 - Robust Dynamic Pricing

Aurelie Thiele, Industrial and Systems Engineering, Lehigh University, 200 West Packer Ave Room 329, 18015, Bethlehem, PA, United States, aurelie.thiele@lehigh.edu

We present a robust optimization approach to the problem of dynamically pricing multiple products subject to random demand and capacitated resources. We model the demands as uncertain parameters belonging to uncertainty sets rather than random variables with probability distributions. We study the impact of uncertainty on the resource levels and optimal prices.

■ RA-06

Thursday, 9:00-10:30am
Iolani III

Telecommunications I

Cluster: Telecommunications and Network Design
Contributed session

Chair: *Soo Tae Kwon*, Information Systems, Jeonju University, 1200 Hyoja-Dong Wansan-Gu Jeonju, Jeonbuk Korea, 560-759, Jeonju, Jeonbuk, kstfms@jj.ac.kr

1 - Optimized MPLS Traffic Engineering with QoS

Richard Barr, Engineering Management, Info, and Systems, Southern Methodist University, PO Box 750123, 75275, Dallas, TX, United States, barr@engr.smu.edu, *Saib Jarrar*

MPLS is an evolving switching technology designed to overcome deficiencies in IP networks. This research presents MPLS traffic-engineering optimization models and explores network-design and service-pricing tradeoffs when quality-of-service classes are implemented. Computational experiments yield practical guidelines for deploying MPLS-based networks to optimize resource utilization and maximize revenues.

2 - On a Resource Allocation Model for Internet Protocol (IP) Networks With Modular Facility Sizes

Hanan Luss, Telcordia Technologies, 444 Hoes Lane, Room 1D-254, 08854, Piscataway, New Jersey, United States, hluss@telcordia.com

Consider a problem where multiple demands are served by multiple facilities. The demand and facility sizes are all power-of-two integers. We find the minimum-cost set of facilities that can serve all the demands. The model can be applied to allocating blocks of addresses in IP networks.

3 - On the Optimal Allocation of Cells in a Wireless Communication Network

Soo Tae Kwon, Information Systems, Jeonju University, 1200 Hyoja-Dong Wansan-Gu Jeonju, Jeonbuk Korea, 560-759, Jeonju, Jeonbuk, kstfms@jj.ac.kr, *So Young Chung*

This paper considers a cell allocation problem in a Wireless Communication Network with limited capacity of Base Switching Center(BSC) and Mobile Switching Center(MSC), and the aim is assigning cells to BSC and MSC for supporting an efficient handoff and reducing the cabling cost.

■ RA-07

Thursday, 9:00-10:30am
Iolani V

Transportation

Cluster: Transportation

Contributed session

Chair: *Hai Yang*, Civil Engineering, The Hong Kong University of Science and Technology, Hong Kong, China, cehyang@ust.hk

1 - Urban Public Transport System Design. Metodology, And Application.

J.Enrique Fernández, Transportation Engineering, Universidad Católica de Chile, Vicuña Mackenna 4860,, Campus San Joaquin UC, 6904411, Santiago, Chile, jef@ing.puc.cl

In this paper we present a methodology for solving the Public Transport Network Design Problem (PTNDP) and describe its application in the context of the Design Study developed in order to propose a new structure for the transit system of the city of Santiago, Chile.

2 - Forecasting Metro Manila Transportation Systems Using Synthesized Data

Brian Canlas Gozun, National Graduate Institute for Policy Studies, 7-22-1 Roppongi, Minato-ku, 106-8677, Tokyo, Japan, bcgozun@gmail.com, *Tatsuo Oyama*

This research uses synthesized data (through data fusion) to update the household travel survey data in Metro Manila which was last done in 1996. Stochastic microsimulation and activity-based, time-use models will be used to forecast transportation systems. The results not only reduce survey costs but also creates flexible transportation databases.

3 - Reformulating and solving a class of transportation network optimization problems with user equilibrium constraints

Hai Yang, Civil Engineering, The Hong Kong University of Science and Technology, Hong Kong, China, cehyang@ust.hk, *Meng Qiang*, *Guoshan Liu*

We address a generalized bilevel transportation network optimization problem that can be modeled by a mathematical program with equilibrium constraints (MPEC). Based on a continuously differentiable gap function of the variational inequalities (VI) for the generalized user equilibrium traffic assignment problem, the MPEC model is reformulated .

■ RA-08

Thursday, 9:00-10:30am
Iolani VI

Sustainable Supply Chains

Cluster: Supply Chain Management

Invited session

Chair: *Luk Van Wassenhove*, Technology and Operations Management Area, Insead, Boulevard de Constance, 77305, Fontainebleau cedex, France, luk.van-wassenhove@insead.edu

1 - Location of Activity Cells in Reverse Logistics

Marija Bogataj, Faculty of Economics‚KMOR & Faculty of Maritime studies and Transport, University of Ljubljabna,

Kardeljeva ploscad 17, Si 1000, Ljubljana, Slovenia, marija.bogataj@guest.arnes.si, *Ludvik Bogataj*

To control the flows in a supply chain the analysis of decisions in frequency domain is presented. The answer to the question of optimal locations of activity cells in reverse logistics is given when the network is presented analogous to fundamental MRP equations in frequency domain.

2 - Safety and Traceability in Sustainable Supply Chains

Jo van Nunen, Department Decision and Information Sciences, RSM Erasmus University, Burgemeester Oudlaan 50, 3062 Pa, Rotterdam, Netherlands, jnunen@rsm.nl, *Rob Zuidwijk*, *Albert Veenstra*

There are several drivers for the creation of safe, secure and traceable supply chains. Walmart had pure economic drivers when they asked their main suppliers to use RFID chips. In agricultural supply chains the food safety law enforces traceability. However, the different perspectives can be used simultaneously.

3 - The WEEE Directive and Sustainability

Luk Van Wassenhove, Technology and Operations Management Area, Insead, Boulevard de Constance, 77305, Fontainebleau cedex, France, luk.van-wassenhove@insead.edu

The WEEE Directive in Europe will quickly have a huge impact on other regions and on global business. This paper discusses the directive, the key issues in its implementation, the major problems as perceived by companies from different sectors and the emerging legislation in other regions. It concludes with interesting problems to which our discipline can contribute.

■ RA-09

Thursday, 9:00-10:30am
Iolani VII

Metaheuristics I

Cluster: Metaheuristics

Invited session

Chair: *J E Beasley*, Department of Mathematical Sciences, Brunel University, Ub8 3ph, Uxbridge, United Kingdom, john.beasley@brunel.ac.uk

1 - A Hybrid Approach for Minimum Concave Cost Network Flow Problems

Dalila Martins Fontes, Faculdade de Economia and LIACC, Universidade do Porto, Rua Dr. Roberto Frias, 4200-464, Porto, Portugal, fontes@fep.up.pt, *José Fernando Gonçalves*

This paper presents a hybrid approach combining a genetic algorithm with a local search for the single-source uncapacitated minimum cost network flow problem with general concave costs. These problems are known to be NP-Hard and therefore, exact methods to solve them in their full generality are only able to address small size instances. Computational experiments were performed using randomly generated problems and the results obtained are compared to optimal solutions obtained by dynamic programming and to upper bounds obtained by local search for larger problem instances. The results reported show that the hybrid methodology improves upon previous approaches.

2 - A genetic algorithm for the cover printing problem

Teghem Jacques, Service de Mathématique et recherche opérationnelle, Faculté Polytechnique de Mons, Rue de Houdain, 9, 7000, Mons, Belgium, Jacques.Teghem@fpms.ac.be, *Samya Elouad*

The cover printing problem consists on finding an assignment of book covers to offset plates for print, minimizing both the number of used plates and the total number of printed copies under the satisfaction of different book titles' requirement. Genetic approaches are proposed combining with a LP solver. Extensive numerical experiments are presented.

3 - A Hybrid Genetic Algorithm For The Problem Of Configuring A Hub-and-spoke Network For A LtI Trucking Company In Brazil

Claudio B. Cunha, Dept. of Transportation Engineering, Escola Politecnica - University of Sao Paulo, Av. Prof. Almeida Prado, Trav. 2, n° 83 - Cidade Universitária, 05508-900, Sao Paulo, SP, Brazil, cbcunha@usp.br, *Marcos Roberto Silva*

A hybrid GA is proposed to the problem of configuring hub-and-spoke networks for trucking companies that operate LTL services in Brazil. The proposed formulation allows variable scale-reduction factors for the transportation costs according to the amount of freight between hubs. Computational results and a practical application are also presented.

4 - Movie Shoot Scheduling

Martin Zachariasen, Department of Computer Science, University of Copenhagen, Universitetsparken 1, Dk-2100, Copenhagen, Denmark, martinz@diku.dk, *Mads Buus Jensen*

The movie shoot scheduling problem is the problem of assigning scenes from a screenplay to shooting days. The main objective is to minimize the number of days used for shooting a film, subject to various soft and hard constraints. Exact and heuristic methods have been tested on real-world instances.

■ RA-10

Thursday, 9:00-10:30am
Tapa Ballroom I

Using Cyberinfrastructure for Computational OR

Cluster: Tutorials
Invited session

Chair: *Robin Lougee-Heimer*, Mathematical Sciences, IBM Research, T.J. Watson Research Center, 1101 Kitchawan Road, 10598, Yorktown Heights, NY, United States, robinlh@us.ibm.com

1 - Using Cyberinfrastructure for Computational Operations Research

Jeff Linderoth, Industrial and Systems Engineering, Lehigh University, 200 W Packer Ave, 18015, Bethlehem, PA, United States, jtl3@lehigh.edu

Cyberinfrastructure describes the melding of tools and capabilities —hardware, middleware, software applications, algorithms, and networking— that are now transforming research and education. In this talk, I will give a survey of cyberinfrastructure tools available for operations research professionals, with an emphasis on optimization

tools. The talk will conclude with two case studies demonstrating the successful application of cyberinfrastructure in solving large-scale instances of optimization problems.

■ RA-11

Thursday, 9:00-10:30am
Tapa Ballroom II

Routing under Uncertain Information

Cluster: Combinatorial Optimization
Invited session

Chair: *Luca Maria Gambardella*, Idsia, Galleria 2, 6928, Manno-Lugano, Switzerland, Switzerland, luca@idsia.ch

Chair: *Roberto Montemanni*, Università della Svizzera Italiana, Istituto Dalle Molle di Studi sull'Intelligenza artificiale (IDSIA), Ch-6928, Manno-Lugano, Canton Ticino, Switzerland, roberto@idsia.ch

1 - Robust shortest path problems with constrained interval data

Roberto Montemanni, Università della Svizzera Italiana, Istituto Dalle Molle di Studi sull'Intelligenza artificiale (IDSIA), Ch-6928, Manno-Lugano, Canton Ticino, Switzerland, roberto@idsia.ch, *Luca Maria Gambardella*

Many real problems can be modelled as robust shortest path problems on digraphs with interval costs, where intervals represent uncertainty.

Here we propose an extended model where arc costs are constrained to assume realistic configurations only, i.e. we aim to cut off some unrealistic configurations otherwise allowed by interval data.

2 - The shortest path problem with interval data

Pawel Zielinski, Institute of Mathematics, Wroclaw University of Technology, Wybrzeze Wyspianskiego 27, 50-370, Wroclaw, Poland, pziel@im.pwr.wroc.pl, *Adam Kasperski*

We consider the shortest path problem in a network with interval arc lengths. For such uncertainty representation, we adopt the min-max regret criterion. We present some complexity results and 2-approximation algorithm for the studied problem. We also show a pseudopolynomial algorithm for the problem in series-parallel networks.

3 - Structural Properties of an Optimal Reoptimization Policy and the Extended Restocking Approach for the Vehicle Routing Problem with Stochastic Demands

Nicola Secomandi, Tepper School of Business, Carnegie Mellon University, 5000 Forbes Avenue, 15213, Pittsburgh, PA, United States, ns7@andrew.cmu.edu

The talk presents properties of a finite-horizon Markov decision process formulation of the single VRP with stochastic demands with reoptimization and a novel solution approach (extended restocking) based on this formulation. A simple extended-restocking heuristic, generates policies with quality comparable to that of a rollout policy, a state-of-the-art reoptimization heuristic.

■ RA-12

Thursday, 9:00-10:30am
Tapa Ballroom III

Collaborative Operations Planning in Transportation and SCM

Cluster: Transportation
Invited session

Chair: *Giselher Pankratz*, Dept. of Information Systems, FernUniversität - University of Hagen, Profilstrasse 8, 58084, Hagen, Germany, giselher.pankratz@fernuni-hagen.de

1 - Challenges and opportunities with inter-organizational collaboration in supply chain management

Kjetil Fagerholt, Pipelife Norway, Syltbakken, 6650, Surnadal, Norway, kjetil.fagerholt@pipelife.no, *Marielle Christiansen*

We present supply chain optimization models applied within the Norwegian plastic pipe industry. Challenges and opportunities with inter-organizational collaboration in the supply chain are discussed. Even though model results indicate significant potential improvements, there is still a way to go to fully implement the ideas of supply chain management.

2 - Collaborative resource planning in multiple supply chains

Jörg Homberger, Computer Science, University of Cooperative Education, Weilimdorferst. 84, 70469, Stuttgart, Germany, homberger@ba-stuttgart.de

A multi-project model is presented for resource planning in a company which is integrated in multiple supply chains. Project agents coordinate the use of resources via an electronic blackboard which generates candidate solutions. The agents make their preferences in a collaborative way using the Vickrey Groves mechanism.

3 - Multi agent systems for collaborative operational transportation planning

Giselher Pankratz, Dept. of Information Systems, FernUniversität - University of Hagen, Profilstrasse 8, 58084, Hagen, Germany, giselher.pankratz@fernuni-hagen.de

In recent years, a number of projects have been initiated which are concerned with the development and evaluation of multi agent systems for collaborative operational transportation planning. This contribution gives a systematic survey of current research in this field, leading to a discussion of several open problems and research questions.

■ RA-13

Thursday, 9:00-10:30am
Sea Pearl I

Maintenance Modelling I

Cluster: Quality, Statistics and Reliability
Invited session

Chair: *Wenbin Wang*, School of AEMS, University of Salford, Centre for OR and Applied Statistics, M5 4wt, Salford, United Kingdom, w.wang@salford.ac.uk

1 - Minimizing the combined cost of inventory and maintenance

Gary Hogg, Industrial Engineering, Az State University, 502 Goldwater Center (ms5906), 85287-5906, Tempe, AZ, ghogg@asu.edu

Presents method for minimizing inventory/maintenance costs. Processing and maintenance times are used with a non-linear cost function characterizing cost for stochastic failures. Arrival times are assumed known; the decision variables are job and preventive maintenance schedules. A designed experiment compares the method with the stochastic model of Co and Araar.

2 - Probabilistic Dynamic Programming in Maintenance Operations

Ronald Aaron Po, Department of Industrial Engineering and Operations Research, University of the Philippines Diliman, 165 F Cordillera Street, Sta. Mesa Heights, 1114, Quezon City, rupo@up.edu.ph

Probabilistic dynamic programming was used to formulate a preventive maintenance plan. Probability of failure distributions and costs of maintaining and purchasing equipment are inputs to the model. Pilot analysis on a fleet of a car rental company resulted in a very thorough maintenance plan with significant cost savings.

3 - Comparing the Proportional Hazards Model (PHM) and a Stochastic Filtering Approach for Estimation and Control of Maintenance Activities Using Vibration Information

Matthew Carr, Accounting, Economics and Management Science, University of Salford, 11 Marlborough Avenue, Whalley Range, M16 Oaj, Manchester, matthew_carr@hotmail.com

The ability to predict the expected time remaining before a component fails is crucial when scheduling maintenance activities. Using stochastically related vibration information from the irregular monitoring of components in a laboratory fatigue experiment, we have conducted a simple comparison between two established techniques; stochastic filtering and proportional hazards modelling.

■ RA-14

Thursday, 9:00-10:30am
Sea Pearl II

Optimization Modeling Languages and Services I

Cluster: Computational Software Development
Invited session

Chair: *Kipp Martin*, Gsb, University of Chicago, 5807 South Woodlawn, 60637, Chicago, Illinois, kipp.martin@gsb.uchicago.edu

1 - Optimization Services – A Unified and Standard Framework for Optimization Over the Internet

Jun Ma, Iems, Northwestern University, Tech Institute, C231, 60208, Evanston, IL, United States, maj@northwestern.edu, *Robert Fourer*, *Kipp Martin*

We present a standard architecture under our concept of "Optimization Services" as unified framework for next generation optimization systems. Through standardization of optimization representation, communication, discovery and registration, the framework provides an open

computational infrastructure for all modeling system components including modeling languages, optimization servers, clients, interfaces, analyzers, solvers and simulations.

2 - OSiL: An Instance Language and API for Optimization

Kipp Martin, Gsb, University of Chicago, 5807 South Woodlawn, 60637, Chicago, Illinois, kipp.martin@gsb.uchicago.edu, *Robert Fourer, Jun Ma*

We present OSiL (Optimization Services Instance Language), an XML Schema for representing optimization instances including general nonlinear programming, quadratic programming, user-defined functions, and optimization via simulation. In addition, we provide open-source Java libraries that simplify the exchange of problem-instance and solution information between modeling systems and solvers.

3 - Extensions to an Optimization Services Instance Language

Robert Fourer, Industrial Engineering and Management Sciences, Northwestern University, 2145 Sheridan Road, 60208-3119, Evanston, IL, United States, 4er@iems.northwestern.edu, *Jun Ma, Kipp Martin*

Optimization problems of interest today go beyond the traditional linear, integer, quadratic, and smooth nonlinear types. A language for problem instances must be extended accordingly. This presentation describes prospective extensions to OSiL, our proposed language standard, in such areas as combinatorial optimization and constraint programming, stochastic programming, and semidefinite and cone programming.

■ RA-15

Thursday, 9:00-10:30am
Sea Pearl III

Decision Support for Location Problems in Urban Development

Cluster: Practice of OR
Invited session

Chair: *Christiane Tammer*, Mathematics and Computer Science, Martin-Luther-University Halle-Wittenberg, Theodor-Lieser-Str. 5, D-06120, Halle, Germany, tammer@mathematik.uni-halle.de

1 - A Multicriteria Approach for Location-Routing Problems

Christiane Tammer, Mathematics and Computer Science, Martin-Luther-University Halle-Wittenberg, Theodor-Lieser-Str. 5, D-06120, Halle, Germany, tammer@mathematik.uni-halle.de

The problem combines two types of decisions that arise in urban development and strategic planning, namently the location of facilities and design of routes. We consider a location-routing problem with time-windows and propose multicriteria approach for solving as a two-stage model.

2 - A Multicriteria Approach for Corporate Decisions. The case of Location-Routing Problems

Renate Patz, Research and Sciencetransfer, University of Applied Sciences Merseburg, Geusaer Strasse, D-06217,

Merseburg, Sachsen-Anhalt, Germany, renate.patz@ltg.fh-merseburg.de, *Annette Henn*

We consider a multicriteria approach to study different types of decision problems with competing alternatives resulting from the different demands of urban development. Process of modelling starts from the idea of involving stakeholder-interests. Finally we propose multicriteria approach for solving a location-routing problem with time-windows as a two-stage model.

3 - Decision Support for Sustainable Planning

Ronny Weinkauf, SCC Software GmbH, Fritz-Haber-Str. 9, 06217, Merseburg, ronny.weinkauf@scc-web.de

The present planning situation is often characterized by conflicting interests and strong competitions between regions. Our intention is to give the planners decision support on the base of an software application with optimization methods. The system supports the sustainable planning process as a learning process.

■ RA-17

Thursday, 9:00-10:30am
Sea Pearl V

Problem structuring for MCDA

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *Valerie Belton*, Dept. Management Science, University of Strathclyde, 40 George Street, G1 1qe, Glasgow, United Kingdom, val.belton@strath.ac.uk

1 - Concordant outranking with multiple criteria of ordinal significance

Raymond Bisdorff, Applied Mathematics Unit, University of Luxembourg, 162a, avenue de la Faiencerie, L-1511, Luxembourg, Luxembourg, raymond.bisdorff@uni.lu

In this communication we address the problem of aggregating outranking statements from multiple preference criteria of ordinal significance. The concept of ordinal concordance of a global outranking situation is defined and an operational test for its presence is developped.

2 - On the concept of decision aiding process.

Alexis Tsoukiàs, Lamsade - Cnrs, Université Paris Dauphine, 75775 Paris Cedex 16, France, tsoukias@lamsade.dauphine.fr

The paper presents the concept of decision aiding process. Its aim is to analyse the type of activities occurring between a "client" and an "analyst" both engaged in a decision process. The decision aiding process is analysed both under a cognitive point of view and an operational point of view.

3 - Mapping multicriteria problems

Valerie Belton, Dept. Management Science, University of Strathclyde, 40 George Street, G1 1qe, Glasgow, United Kingdom, val.belton@strath.ac.uk

The potential for problem structuring methods, eg cognitive/causal mapping, to complement the use of MCDA, has long been recognised. But to what extent has this been realised? A number of case studies will be introduced to illustrate the practical possibilities, highlight the consequent benefits and inform consideration of the question

■ RA-20

Thursday, 9:00-10:30am
Nautilus II

Group Decision Making and Negotiation

Cluster: Group Decision Making and Negotiation
Contributed session

Chair: *Markus Hostmann*, Eawag, P. O. Box 611, 8600, Dübendorf, Switzerland, markus.hostmann@eawag.ch

1 - Generation Of Indicators Of Relative Efficiency Applying Data Envelopment Analysis, For The Function Of Extension In The National University Of Colombia

Gloria Rodriguez Lozano, Faculty of Economic Sciences, National University of Colombia, Carrera 19 # 82-42 Apto. 701, Bogotá, Bogotá, girodriguezl@unal.edu.co, *Francisco Arcelus*

This paper assessed through performance indicators the way as is carrying out the Function of Extension in the National University of Colombia, analyzed it from two perspectives: Not Remunerated and Remunerated Extension. This study was carried out using DEA, this tool allow to compare the management of all faculties.

2 - Developing measures of effectiveness for cross-cultural activities

Steven Bailey, Business, Troy University, 92 Seabreeze Circle, 32413, Panama City Beach, FL, United States, scottbailey70@sent.com

A process for developing measures of effectiveness in situations that span cultural and language boundaries. This process leads to rapid acceptance of the measures, better understanding of the requirements of the activities, greater commitment to the success of the activities, and a high degree of tolerance among the participants.

3 - Status of MCDA methods in environmental management projects

Markus Hostmann, Eawag, P. O. Box 611, 8600, Dübendorf, Switzerland, markus.hostmann@eawag.ch

This study analyzes the strength of MCDA methods for environmental planning projects. The MAVT method was applied to a river rehabilitation project and stakeholders' responses to the results were evaluated. The main strength was the methods' ability to support the learning process of stakeholders and to facilitate consensus solutions.

■ RA-21

Thursday, 9:00-10:30am
Lehua Suite

Applied Probability and OR Models I

Cluster: Applied Probability
Invited session

Chair: *Hsing Paul Luh*, Dept. of Mathematical Sciences, National Chengchi University, Taipei, Taiwan, slu@nccu.edu.tw

1 - The Study of Impartiality on Medical Resources under National Health Insurance in Taiwan.

Zhi-Jun Chen, Graduate School of Management, Ming Chuan University, No.250, Sec. 5, Jhongshan N. Rd., Shihlin District, Taipei City 111, Taiwan (R.O.C.), 11103, Taipei, Xinzhu, Taiwan, ivy.cute916@msa.hinet.net, *Wen-Hsiang Wu*, *Chin-Tsai Lin*, *Chie-Bein Chen*

The expense of NHI is not fair in Taiwan. We will measure the equality in five phases including accessibility equality,need equality,health equality,choices group equality and medical expenses equality, and construct the effect of impartiality through DEA. We hope can make the medical resource to be fair in the future.

2 - Selecting An Feasible Hierarchy Structure of AHP in Grey System

Chen Chie-Bein, Institute of International Business, National Dong Hwa University, Institute of International Business, National Dong Hwa University, Hualien, R.O.C., 974, Hualien, Taiwan, cbchen@mail.ndhu.edu.tw, *Lin Chin-Tsai*, *Chan Chia-Ho*

The purpose of this paper is to develop a novel procedure that selects an feasible hierarchy structure in grey system, when weight is grey numbers of AHP. The procedure is as follows: first, the decision style of the decision-maker determines the whitening value of the grey number. Second, using the grey generating operation transforms each hierarchy structure into a sequence. Third, calculate grey relational grades. Lastly, ranking, after ranking can be obtained the optimal hierarchy. The results can be used to select an feasible hierarchy when we have multiple hierarchical structure schema and weight is grey numbers of AHP.

3 - DEA Future Analysis in Grey System: An Application of the GM(1,1IT,r)

Lin Chin-Tsai, Department of Business Administration, Yuanpei University of Science and Technology, President office, Yuanpei University of Science and Technology,No.306, Yuanpei St., Hsin Chu 300,Taiwan., 886, Hsin Chu, Taiwan, ctlin@mail.yust.edu.tw, *Hwang Shiuh-Nan*, *Chan Chia-Ho*

This paper combines DEA, gery linear programming and GM(1,1IT,r) model in order to expand a novel model of DEA. Results in the study can be applying with measuring performance in the future.

4 - Data Envelopment Analysis-Discriminant Analysis by Mixed Integer Programming Applies for Stocks Selection

Chuang Wang-Ching, Business Administration, Kang Ning Junior College of Medical Care and Management, 137,Lane75,Sec.3,Kang-Ning Rd. Nei-Hu,Taipei,Taiwan,R.O.C., 2F., No.47, Alley 95, Lane 113, Donghu Rd., Neihu District, Taipei City 114, Taiwan (R.O.C.), 11488, Taipei, Taiwan, Taiwan, dchuang.erica@msa.hinet.net, *Hwang Shiuh-Nan*, *Lin Chin-Tsai*

This paper exploits tools which are the additive model and mixed integer programming (MIP) approaches of data envelopment analysis-discriminant analysis (DEA-DA) for predicting stocks returns in order to gain something helpful for stocks selection. The research confirms that the latter has more significant discriminant power than the former.

■ RA-22

Thursday, 9:00-10:30am

Kahili I

DEA07: Applications in DEA III

Cluster: Data Envelopment Analysis and Performance Management

Invited session

Chair: *Wade Cook*, Schulich School of Business, York University, Management Science, Room S337M, 4700 Keele Street, M3j 1p3, Toronto, Ontario, Canada, wcook@schulich.yorku.ca

1 - European Nitrate Pollution Regulation and Farms' Performance.

Isabelle Piot-Lepetit, Economie, Inra, 4 allée Adolphe Bobierre, CS 61103, 35011, Rennes cedex, France, Isabelle.Piot@rennes.inra.fr, *Monique LeMoing*

This paper analyzes the impact of the Nitrate Directive on farms' performance. First, we develop a model that explicitly integrate the individual constraint on manure spreading. The individual threshold is introduced as a productive right. The DEA framework allows for modelling exchange of productive rights among producers.

2 - Efficinecy measurement of rice farms in Kangwon Province using Data Envelopment Analysis(DEA) in Korea

Jong Moo Kim, School of Economics, Sung Kyun Kwan University, 3-53 Myungryun-dong, Jongro-Ku, 110-745, Seoul, Korea, Republic Of, jongmoo2003@yahoo.co.kr

The purpose of thispaper isto analyse the cost efficiency of rice farms in Kaangwon Province. The distribution of 75 bookpkeeping rice farms in Kangwon Province in 2003 showed a very low score of physical efficiency using the input-oriented constant return toscale model. Only 20 rice farms fell in the 01-10 range.

3 - Commercial performance in the motion pictures industry: a DEA approach

Wade Cook, Schulich School of Business, York University, Management Science, Room S337M, 4700 Keele Street, M3j 1p3, Toronto, Ontario, Canada, wcook@schulich.yorku.ca, *Moez Hababou*

In this paper, we propose the use of the Data Envelopment Analysis methodology to measure the relative performance of released motion pictures. By analyzing a sample of 339 movies produced between 1998 and 2002 we investigate those factors that are key to the commercial success of a movie.

■ RA-24

Thursday, 9:00-10:30am

Hibiscus I

Business Applications I

Cluster: Business Applications

Contributed session

Chair: *Brian Dangerfield*, Centre for OR & Applied Statistics, University of Salford, Maxwell Building, The Crescent, M5 4wt, Salford, United Kingdom, b.c.dangerfield@salford.ac.uk

1 - Capacity Adjustment through Distribution Improvement in Imperfect Competition

Arief Suharko, IPMI Business School, Jl. Rawajati Timur I No. 1, Kalibata, 12750, Jakarta Selatan, Indonesia, suharko@indosat.net.id

In this paper, we construct a model to assist a medium-sized player to survive in a large player's domination. Specifically, in the case of bottled tea industry in Indonesia, the model links the manufacturing capacity adjustment with the returned cycle time of the empty bottles in the distribution system.

2 - Meta-heuristic approach for the analysis of a queue system with multiple and different servers

Miguel Gomez-Sanchez, Statistics and Actuarial Sciences, Universidad De Las Americas Puebla, Sta. Catarina Martir, Cholula, Puebla, Mexico, 72820, San Andrés Cholula, Puebla, Mexico, migueln@udlap.mx

This paper presents the analysis of a queuing system where a sub set of servers can be selected from an available group. Each time a sub-set is required, the performance of the system changes, but based on an evolutionary algorithm the total cost (waiting plus servers costs) may be reduced.

3 - A System Dynamics Model for Planning Economic Development in Sarawak

Brian Dangerfield, Centre for OR & Applied Statistics, University of Salford, Maxwell Building, The Crescent, M5 4wt, Salford, United Kingdom, b.c.dangerfield@salford.ac.uk

Research is ongoing to construct a model to aid the planning of economic development in Sarawak, E. Malaysia. Little formal economic modelling had taken place previously and the suggestion to develop an SD model involved considerable prior explanation and persuasion. The current status of the work is described.

■ RA-25

Thursday, 9:00-10:30am

Hibiscus II

Logistics Applications II / Analysis of SoS

Cluster: Military Applications

Invited session

Chair: *Caroline Smith*, Math & Stat, James Madison University, Msc 7803, 22807, Harrisonburg, va, smithc@math.jmu.edu

Chair: *Hoa Generazio*, 8401 Fenwood Drive, 22152, Springfield, Virginia, hoa.generazio@us.army.mil

1 - Characteristics of System of Systems

Hoa Generazio, 8401 Fenwood Drive, 22152, Springfield, Virginia, hoa.generazio@us.army.mil

The body of knowledge on SoS is in its infancy - there is not a commonly accepted definition of SoS. Paper provides an overview of SoS via current definitions, examples from various fields; offer additional characteristics for a more comprehensive and generalized definition; highlight some issues and some preliminary insights.

2 - Maritime Domain Protection Systems of Systems

David Olwell, Systems Engineering, Naval Postgraduate School, 777 Dyer Road, Bu 113, 93943, Monterey, CA, dholwell@nps.edu

Students and faculty at NPS designed a system of systems for securing maritime domain protection in the Western Pacific. This paper summarizes the analysis of alternatives for this integrated campus research paper, and presents the preferred design.

3 - Monitoring and Evaluation of Logistics Performance

John English, Industrial Engineering, University of Arkansas, 4207 Bell Engineering, 72701, Fayetteville, Arkansas, jre@uark.edu

Frameworks of performance measurements for logistics systems are often a collection of "successful and useful" data points which evolve over time. In this effort, we have compiled a comprehensive set of strategically suitable PMs organized in four groups: financial, quality, cycle time and resource.

4 - Using Mathematically Modeling to Examine Munitions Pre-Positioning Strategies

Raymond Hill, Biomedical, Industrial & Human Factors, Wright State University, 207 Russ Eng. Center, 3640 Col Glenn Hwy, 45435, Dayton, OH, ray.hill@wright.edu

The Air Force uses pre-positioning to deploy forces rapidly. We define and develop a mathematical model to define a pre-positioning strategy. The resulting Pre-Po model is a mixed integer program tested against a realistically stressing planning scenario. Analytical results and insights are presented along with avenues for further work.

5 - Missions and Means Framework Application

Paul Tanenbaum, Survivability/Lethality Analysis Directorate, U.S. Army Research Laboratory, Attn: Amsrd-arl-sl-b, 21005, Aberdeen Proving Ground, Maryland, United States, paul.tanenbaum@us.army.mil, *Britt Bray, Jack Sheehan*

The Missions and Means Framework is a conceptual structure for specifying military missions and evaluating the utility of solutions for fulfilling them. It captures causal links between military operations and the resources they require, enhancing collaboration between their respective communities. We present our recent work demonstrating its feasibility and applicability.

Thursday, 11:00am-12:30pm

■ RB-01

Thursday, 11:00am-12:30pm
Honolulu I

OR in Nature Conservation

Cluster: Renewable and Natural Resources
Invited session
Chair: *Darek Nalle*, College of Natural Resources, University of Idaho, 83844, Moscow, ID, United States, nalle@uidaho.edu
Chair: *Hayri Onal*, University of Illinois, United States, h-onal@uiuc.edu

1 - Finding the Efficient Frontier for Biological and Economic Value in Land Use Management

Jeff Arthur, Statistics, Oregon State University, 44 Kidder, 97331-4606, Corvallis, Oregon, United States, arthur@science.oregonstate.edu, *Jeffrey Camm, Robert Haight, Erik Nelson, Stephen Polasky, Paul Fackler*

We use a biological model to predict the probability that species will persist given the pattern of habitat, and a separate economic model that uses land characteristics to predict the value of economic activity. The models are used together to develop a biological/economic efficient frontier.

2 - Connectivity in the design of protected area networks on a species by species basis

Leonor S.Pinto, Matematica, Instituto Superior de Economia e Gestao, Rua do Quelhas, 6, 1200-781, Lisboa, Portugal, lspinto@iseg.utl.pt, *J. Orestes Cerdeira, Kevin Gaston*

In the design of protected area networks connectivity has been addressed using a graph to describe the adjacency relationship between sites. This is not ideal in situations where different species require levels of adjacency quite dissimilar. We propose a model to treat connectivity on a species by species basis.

3 - Towards a theory of optimization for conservation

Darek Nalle, College of Natural Resources, University of Idaho, 83844, Moscow, ID, United States, nalle@uidaho.edu

Various optimization modeling frameworks for conservation have recently evolved. This work summaries general classes of models, explores consequences from implementing different classes of solutions, and attempts to build an economic theory for the use of optimization in conservation.

4 - Conserving biodiversity hotspots: how can we optimally allocate conservation resources?

Michael Bode, Department of Mathematics, University of Queensland, St Lucia, 4072, Brisbane, Queensland, Australia, mbode@maths.uq.edu.au, *Hugh Possingham*

The world's ecosystems are coming under increasing threat from development. International nature conservation agencies are planning to allocate resources between and within regions. We formulate this dynamic resource allocation problem using optimal control theory for three hotspots in the Asia-Pacific region, and discover the best land acquisition strategy.

5 - Designing an efficient network of nature preserves with economic, ecological and social considerations

Hayri Onal, University of Illinois, United States, h-onal@uiuc.edu, *Pornchanok Yanprechaset*

Existing studies incorporate economic and ecological considerations in reserve design. Nature preserves provide recreation benefits to urban residents. Therefore, site accessibility and urban population size to reserves are important determinants of site selection. We present an IP approach and an empirical application with Illinois data.

■ **RB-03**

Thursday, 11:00am-12:30pm
Honolulu III

Stochastic Models I

Cluster: Stochastic Programming
Contributed session

Chair: *Kazuhiro Takeyasu*, College of Economics, Osaka Prefecture University, 1-1 Gakuenchou, 599-8531, Sakai, Osaka, Japan, takeyasu@eco.osakafu-u.ac.jp

1 - Stochastic Network Interdiction with Different Perception

Feng Pan, D-4, Los Alamos National Laboratory, Los Alamos National Laboratory, 87545, Los Alamos, NM, United States, fpan@lanl.gov, *David Morton*

We introduce a stochastic network interdiction model to minimize the maximum-reliability path in which interdictor and evader have different perceptions of network parameters. Examples are presented to show different interdiction strategies for different perceptions. We develop valid inequalities to reduce the computation time and show the results.

2 - A heuristic to solve a hierarchical stochastic scheduling problem on a single machine to minimize maximum expected tardiness.

David Alcaide, Estadística, Investigación Operativa y Computación, Universidad de La Laguna, Avenida Astrofisico Francisco Sanchez s/n, La Laguna. Tenerife, Spain, dalcaide@ull.es, *Andrés Rodríguez-González, Joaquín Sicilia*

A stochastic scheduling problem on a single machine is considered. Job processing times are random variables. There are precedence relations among jobs. Each job must to be performed between its release and due dates. A heuristic is proposed to find, among suitable sequences, solutions where maximum expected tardiness is minimized.

3 - System Parameter Distance for Machine Diagnosis

Yasuo Ishii, Economics, Osaka Prefecture University, 1-1 Gakuenchou, Sakai, Osaka-fu 599-8531,Japan, 599-8531, Sakai, Japan, ishii-yasuo01@hankyu-group.jp, *Kazuhiro Takeyasu*

Under the assumption of impact vibration, simplified calculation method for autocorrelation function is introduced. Applying them to AR model, failure detection can be achieved by calculating parameter distance in a simple way. It is also derived that the variance of forecasting error means the Mahalanobis' generalized distance.

■ **RB-04**

Thursday, 11:00am-12:30pm
Iolani I

Optimization Techniques II

Cluster: Optimization Techniques
Contributed session

Chair: *David Wolpert*, NASA Ames Research Center, Moffett Field, CA, United States, dhw@email.arc.nasa.gov

1 - Algorithms for Identification of Nonlinear Differential Equations for Complex Dynamic Systems based on Experimental Data

Siegfried Voessner, Engineering- and Business Informatics, Graz University of Technology, Kopernikusgasse 24, A-8010, Graz, Austria, voessner@tugraz.at, *Thomas Buchsbaum*

We show a new algorithmic approach for identifying the differential equations of motion of complex dynamic systems (like aircrafts) based on their trajectories and control parameters. The two-stage method combines Evolutionary Optimization and Local Search with special feasibility preservation techniques. We demonstrate its advantages and compare it to conventional techniques.

2 - Optimal Design Patterns in One-Dimensional Elastic Media with a Low Number of Layers

Ani Velo, Mathematics and Computer Science, University of San Diego, 5998 Alcala Park, University of San Diego, 92110, San Diego, CA, United States, avelo@sandiego.edu, *George A. Gazonas*

The main focus of this work is to understand the role of one-dimensional multi-layered elastic media in controlling the stress wave amplitude. We extend our previous optimality results for two-layers to multi-layered media, describing analytically classes of optimal designs which provide the smallest stress amplitude throughout the structure at all times.

3 - Optimization using fully coupled probability distributions

David Wolpert, NASA Ames Research Center, Moffett Field, CA, United States, dhw@email.arc.nasa.gov, *Charles Strauss*

A powerful new class of optimization techniques searches over probability distributions of the independent variable rather than directly on the value of that variable. Heretofore these techniques have needed to restrict the search to a low-dimensional subspace of all distributions. Here we show how to avoid such restrictions.

■ **RB-05**

Thursday, 11:00am-12:30pm
Iolani II

Dynamic Pricing in Supply Chain Systems

Cluster: Dynamic Pricing & Revenue management
Invited session

Chair: *Tim Huh*, Columbia University, New York, NY, United States, th2113@columbia.edu

1 - The Impact of Manufacturer Rebates on Supply Chain Profits

Xin Chen, Department of Mechanical and Industrial Engineering, University of Illinois Urbana-Champaign, 224 Mechanical Engineering Bldg, MC-244, 1206 West Green Street, 61801, Urbana, IL, xinchen@uiuc.edu, *Chung-Lun Li*, *David Simchi-Levi*

We consider a two-stage supply chain with a manufacturer and a retailer, where a single seasonal product is facing uncertain and price-sensitive demand. We characterize the impact of a manufacturer rebate on the expected profits of both the manufacturer and the retailer.

2 - Optimal Group Buying Policies under Demand Substitution

Hongsuk Yang, David Eccles School of Business, The University of Utah, Salt Lake City, Utah, United States, hongsuk.yang@business.utah.edu, *Hojung Shin*

We consider two competing retailers, willing to form a coalition to take advantage of quantity discounts offered from the manufacturer. A retailer makes a tradeoff between two choices: to join the coalition for a lower cost, or not to join and purchase high-cost customized products with lower substitutability.

3 - Dynamic Pricing and Forecasting with Serial Correlation in Demand

Xiaowei Xu, Dept. IE/MS, Northwestern University, 2145 Sheridan Road, Room C223, Tech Bldg., 60208, Evanston, IL, xuxiaowe@northwestern.edu, *Wallace Hopp*

This paper examines how to coordinate demand forecast with dynamic pricing. We find that separating demand forecasting from dynamic pricing results in systematic overpricing and a supermartingale price trend, but the resulting revenue loss is slight. In contrast, we observe that ignoring demand correlation can cause serious revenue loss.

4 - A Unifying Assumption for the Optimality of (s,S) Replenishment Policies for Inventory Systems

Tim Huh, Columbia University, New York, NY, United States, th2113@columbia.edu, *Ganesh Janakiraman*

We study optimal inventory policies in discrete-time systems with stationary stochastic demand. For a single-stage system with fixed ordering costs and multiple sales levers (such as pricing, advertising, etc.), we extend the optimality of (s,S)-type policies to more general settings than previously known. We identify a set of sufficient conditions for the optimality of (s,S) Replenishment Policies. Our proof is novel, more direct and easier to understand than earlier ones.

■ RB-06

Thursday, 11:00am-12:30pm
Iolani III

Telecommunications II

Cluster: Telecommunications and Network Design
Contributed session

Chair: *Wei Feng*, Engineering Physics, Electronics and Mechanics, Nagoya Institute of Technology, Graduate School of Engineering, Nagare College, 464-8555, Nagoya, fen@system.nitech.ac.jp

1 - Linear Programming Application For Efficient Telecommunication Networks Provisioning

Walter Gassenferth, Administration, Faculdades IBMEC, Av. Rio Branco, 108, Centro, 20040-001, Rio de Janeiro, RJ, Brazil, wgassen@terra.com.br, *Maria Augusta Machado*

This paper presents a practical proposition for the application of Linear Programming quantitative method to assist planning and control of telecommunication circuits provisioning activities. Based upon data provided by a Brazilian telecom company, the LP method was employed to determine the optimum mix of production for a set of products.

2 - Using Neural Networks to Classify Internet Users based on the Hourly Traffic Utilization

Rui Valadas, Institute of Telecommunications, University of Aveiro, Campus Universitario, 3810, Aveiro, Portugal, rv@det.ua.pt, *António Nogueira*, *M. Rosário de Oliveira*, *Paulo Salvador*, *António Pacheco*

We consider using Neural Networks to classify Internet users based on their hourly traffic utilization. The methodology resorts to a predefined set of clusters used to train the neural network. The classification of Internet users finds application in several traffic engineering tasks and in the selection of suitable billing plans.

3 - Performance Analysis of Wireless Mobile Networks with Queueing Priority and Guard Channels

Wei Feng, Engineering Physics, Electronics and Mechanics, Nagoya Institute of Technology, Graduate School of Engineering, Nagare College, 464-8555, Nagoya, fen@system.nitech.ac.jp, *Masashi Kowada*

In this paper we analyze the performance of wireless mobile networks by a finite buffer queueing model with nonpreemptive queueing priority and guard servres. We present the explicit representation of the stationary distributions of the number of customers and waiting times and obtained the blocking probabilities for different classes.

■ RB-07

Thursday, 11:00am-12:30pm
Iolani V

Port Terminal Operations

Cluster: Transportation
Invited session

Chair: *Jiyin Liu*, Business School, Loughborough University, Loughborough, Leicestershire, Le11 3tu, United Kingdom, j.y.liu@lboro.ac.uk
Chair: *Stefan Voss*, Wirtschaftsinformatik/Information Systems, University of Hamburg, Von-Melle-Park 5, 20146, Hamburg, Hamburg, Germany, stefan.voss@uni-hamburg.de

1 - Operations research methods for container terminal logistics - a survey

Stefan Voss, Wirtschaftsinformatik/Information Systems, University of Hamburg, Von-Melle-Park 5, 20146, Hamburg, Hamburg, Germany, stefan.voss@uni-hamburg.de, *Dirk Steenken*, *Robert Stahlbock*

Containers have achieved undoubted importance in international sea freight transportation. Increasing containerization has led to remarkable competition among seaport container terminals. Terminal operations need appropriate optimization methods and effective and efficient

use of information technology. We present a survey of operations research methods for the main logistic processes in terminals.

2 - A Lagrangian heuristic for dynamically scheduling ships to berth

Lixin Tang, The Logistics Institute, Northeastern University, Shenyang, China, 110004, Shenyang, China, qhjytlx@mail.neu.edu.cn, *Shaohua Li, Jiyin Liu*

This paper studies the problem of dynamically scheduling ships to berth at the raw material dock in an iron and steel plant. We propose a mathematical model and consider Lagrangian relaxation algorithm for its solution. Computational results show that the algorithm can obtain a good solution in reasonable time.

3 - Quay crane scheduling at container terminals to minimize the maximum relative tardiness of vessel departures

Jiyin Liu, Business School, Loughborough University, Loughborough, Leicestershire, Le11 3tu, United Kingdom, j.y.liu@lboro.ac.uk, *Yat-wah Wan, Lei Wang*

We schedule quay cranes in a container terminal to minimize the maximum relative tardiness for vessels with different ready times. The problem is formulated as a mixed integer linear programming model and solved by a heuristic decomposition approach. The computational experiments show that the proposed approach is effective and efficient.

■ RB-08

Thursday, 11:00am-12:30pm
Iolani VI

Strategic Airlift Transportation Issues in Supply Chain Management

Cluster: Supply Chain Management

Invited session

Chair: *Robert Brigantic*, Dept. of Operational Sciences, Air Force Institute of Technology, 2950 Hobson Way, 45433, Wright-Patterson AFB, OH, United States, robert.brigantic@afit.edu

Chair: *Alan Johnson*, Dept. of Operational Sciences, Air Force Institute of Technology, Wright-Patterson AFB, Ohio, United States, alan.johson@afit.edu

1 - Assessment of Selected Air Mobility Planning Factors

Alan Johnson, Dept of Operational Sciences, Air Force Institute of Technology, 2950 Hobson Way, Bldg 41, 45433-7765, Wright-Patterson AFB, OH, United States, alan.johnson@afit.edu

Air mobility analysts use published planning factors such as aircraft range and payload to determine strategic airlift closure timelines for logistics support. However, evidence suggests that those planning factors are obsolete. We identify issues that might have contributed to a significant difference between recent mission data and the planning factors.

2 - An Effective Management Strategy for Effective Passive RFID Implementation

William Cunningham, Operational Sciences, Air Force Institute of Technology, Afit/ens, 2950 Hobson Way,

45433-7765, Wright-Patterson AFB, OH, United States, william.cunningham@afit.edu, *David Koch, Fisch John*

Over ten years after the lessons of the first gulf war had been absorbed and the Global Transportation Network was initiated, DoD continues to struggle with tactical in-transit visibility. DoD has mandated that the supply chain apply a new and revolutionary technology, passive RFID, to solve this problem. However, many issues central to implementation remain unresolved. First, a comprehensive management strategy, including a redesign of business practices, must be developed. This research provides a framework for that strategy and offers recommendations for top management actions to ensure passive RFID delivers on its promise of revolutionary improvements in the supply chain.

3 - Maximum Cargo Throughput in Intertheater Airlift

Robert Brigantic, Dept. of Operational Sciences, Air Force Institute of Technology, 2950 Hobson Way, 45433, Wright-Patterson AFB, OH, United States, robert.brigantic@afit.edu, *Jeanette Voigt*

As the United States pulls back forces from overseas, intertheater airlift takes a larger role in military contingencies, making it important to know the capability of the airlift fleet. Using standard formulas, this session will examine factors affecting cargo throughput and the maximum cargo delivery capability each day.

4 - Strategic Airlift En Route Analysis and Considerations

Robert Brigantic, Dept. of Operational Sciences, Air Force Institute of Technology, 2950 Hobson Way, 45433, Wright-Patterson AFB, OH, United States, robert.brigantic@afit.edu, *Michael Sere*

Operation Enduring Freedom, Operation Iraqi Freedom, and other post September 11th, 2001 mobility deployment requirements have clearly demonstrated the need to adopt a more global en route capability to support America's strategic airlift aircraft. The focus of this research is to examine concepts to meet this need and addresses important aspects that should be considered in devising new en route strategies and establishing new en route airfields.

■ RB-09

Thursday, 11:00am-12:30pm
Iolani VII

Methods and Applications

Cluster: Metaheuristics

Invited session

Chair: *Laura Cruz*, División de Estudios de Posgrado e Investigación, Instituto Tecnologico de Ciudad Madero, Ave. 1o de mayo y Sor Juana I. de la Cruz, Colonia Los Mangos, 89440, Madero, Tamaulipas, Mexico, lauracruzreyes@yahoo.com

Chair: *Joaquín Ortega*, Ciencias Computacionales, Cntro Nacional de Investigación y Desarrollo Tecnológico, Interior Internado Palmira S/N, Col. Palmira, 62490, Cuernavaca, Morelos, jperez@cenidet.edu.mx

1 - ILP and Heuristic Approaches for a new VRP variant

Laura Cruz, División de Estudios de Posgrado e Investigación, Instituto Tecnologico de Ciudad Madero, Ave. 1o de mayo y Sor Juana I. de la Cruz, Colonia Los Mangos, 89440, Madero, Tamaulipas, Mexico, lauracruzreyes@yahoo.com, *Apolinar*

Ramírez, Nelson Rangel, Norma Edith Garcia Avalos, Juan Arturo Herrera Ortiz

We propose the analysis of a new variant of VRP problem through ILP model and an Ants Colony System Algorithm. This approach includes the CVRP, VRPTW, SDVRP, VRPM, MDVRP, FSMVRP and a new one which deals with the number of vehicles can be received at the same time by customers.

2 - Alternative Strategies to explore the SNNB Algorithm Performance

Vanesa Landero, Centro de Postgrado e Investigación, Instituto Tecnológico de Ciudad Madero, Av. Primero de Mayo, Col Los Mangos, 89000, Madero, Tamaulipas, landerov76@yahoo.com.mx, *Joaquín Ortega, Rodolfo Pazos, Laura Cruz, Cesar Guerra Salcedo*

In this paper we modified the SNNB algorithm, utilizing other distance measures, instances organization, instances space search and model selection; where all of them were combined and the objective is to explore the SNNB classification accuracy. The best strategy E17 won 15 and only lost 3 cases against SNNB classifier.

3 - Self-Tuning of the Tabu Search Parameters: an Application to Distributed Data Bases

Joaquín Ortega, Ciencias Computacionales, Cntro Nacional de Investigación y Desarrollo Tecnológico, Interior Internado Palmira S/N, Col. Palmira, 62490, Cuernavaca, Morelos, jperez@cenidet.edu.mx, *Rodolfo Pazos, Juan Javier Gonzalez Barbosa, Vanesa Landero, Ernesto Ferat*

The Tabu Search algorithm performance depends on the values of its control parameters. In this paper, we present some strategies to automate the control parameters of the Tabu Search algorithm. For validating our approach, a set of randomly generated instances of the distributed data base design problem was used.

■ RB-10

Thursday, 11:00am-12:30pm
Tapa Ballroom I

The Generation Of Experimental Data For Scheduling And Other Optimization Problems

Cluster: Tutorials
Invited session

Chair: *Jacek Blazewicz*, Instytut Informatyki, Politechnika Poznanska, ul.Piotrowo 3a, 60-965, Poznan, jblazewicz@cs.put.poznan.pl

1 - The Generation Of Experimental Data For Scheduling And Other Optimization Problems

Marc Posner, Industrial, Wedling & Systems Engineering, Ohio State University, 1971 Neil Ave., 43210, Columbus, Ohio, United States, posner.1@osu.edu, *Nicholas Hall*

We demonstrate that widely used data generation schemes introduce biases into computational results. Moreover, they do not represent how data arises in practice. We describe principles that are important for data generation. Specific proposals are provided for generating data for many types of scheduling problems. Using these principles, we develop a methodology for preselecting solution approaches using problem data. These strategies are demonstrated by comparing two

optimization methods for the 0-1 Knapsack Problem. The choice of a particular method is based the characteristics of the input data. This methodology shows that existing solution procedures can be used more effectively.

■ RB-11

Thursday, 11:00am-12:30pm
Tapa Ballroom II

Lagrangean Relaxation and Related Topics

Cluster: Combinatorial Optimization
Invited session

Chair: *Monique Guignard*, Opim, University of Pennsylvania, 5th floor, JMHH, 3730 Walnut Street, 191046340, Philadelphia, PA, United States, guignard@wharton.upenn.edu

1 - Stabilization in Column Generation

Jacques Desrosiers, Management Science, HEC Montreal, 3000, Côte-Sainte-Catherine, H3t 2a7, Montreal, Quebec, jacques.desrosiers@hec.ca, *Antonio Frangioni, Hatem Ben Amor*

The standard column generation algorithm suffers from instability issues that limit its efficiency. Building on the theory developed for non-differentiable optimization, we propose a class of stabilized column generation algorithms which avoid the instability by using a stabilizing term in the dual; this amounts to considering a generalized augmented Lagrangian of the primal master problem. Since the theory allows for a great degree of flexibility in the choice of this term, we use simple piecewise-linear functions. The effectiveness of this approach is demonstrated by computational experiments on large-scale multi-depot vehicle scheduling problems and simultaneous vehicle and crew scheduling problems.

2 - Revisiting Lagrange relaxation for processing large-scale mixed integer programming problems

Chandra Poojari, School of Information systems, Computing and Mathematics, Centre for the Analysis of Risk and Optimisation Modelling Applications, Brunel University,Uxbridge, Ub8 3ph, London, United Kingdom, Chandra.Poojari@brunel.ac.uk, *Gautam Mitra, Christos Siamitros*

We present a Lagrangean relaxation based generic solver for processing MIP problems. We use a constraint classification scheme to identify the complicating constraints, sub-gradient optimisation to update the multipliers, and a greedy algorithm to find the feasible solutions. Performance and the effect of the alternative control settings are investigated.

3 - Implementing a Lagrangean relaxation in GAMS on a GRID machine, with application to lot sizing.

Monique Guignard, Opim, University of Pennsylvania, 5th floor, JMHH, 3730 Walnut Street, 191046340, Philadelphia, PA, United States, guignard@wharton.upenn.edu, *Alex Meeraus, Antoine Sauré, Alex Ornatsky*

We will describe the design of a system in GAMS for solving a Lagrangean relaxation dual on a GRID computer using a bundle method. We apply this system to multi-item lotsizing problems with setup times.

4 - Stochastic optimization and Lagrangean relaxation

Andrés Weintraub, University of Chile, Santiago, Chile, aweintra@dii.uchile.cl, *Antonio Alonso Ayuso, Laureano Fernando Escudero, Monique Guignard, Patricio Hernández, Martin Quinteros*

We review possible uses of Lagrangean relaxation in stochastic optimization. We concentrate on Branch-and-Fix and Fix-and-Relax coordination methodologies and describe several practical applications.

■ **RB-12**

Thursday, 11:00am-12:30pm
Tapa Ballroom III

U.S. Postal Services' Transportation Network

Cluster: Transportation
Invited session

Chair: *Pranab Shah*, Network Operations Development, U.S. Postal Service, 475 L'Enfant Plaza, SW., Rm#6800, 20260, Washington, D.C., pranab.m.shah@usps.gov

1 - Transforming the U.S. Postal Services' Transportation Network

Pranab Shah, Network Operations Development, U.S. Postal Service, 475 L'Enfant Plaza, SW., Rm#6800, 20260, Washington, D.C., pranab.m.shah@usps.gov

The U.S. Postal Service (USPS) manages a multi-billion dollar transportation budget, and moves 40 percent of the world's mail volume. To remain competitive, USPS has undertaken an ambitious initiative to re-design its logistic network. In this talk, we describe the challenge of transforming one of the world's largest logistic networks.

2 - Decision Support for Logistics Planning and Scheduling at USPS

Pranab Shah, Network Operations Development, U.S. Postal Service, 475 L'Enfant Plaza, SW., Rm#6800, 20260, Washington, D.C., pranab.m.shah@usps.gov

In this talk, we describe a framework of projects, tools, and processes being put into place to transform USPS' transportation and logistics network. The size and complexity of the network operations present formidable challenges and opportunities to the operations research community.

3 - TOPS: The USPS' Transportation Optimization, Planning, and Scheduling System

Robin Lougee-Heimer, Mathematical Sciences, IBM Research, T.J. Watson Research Center, 1101 Kitchawan Road, 10598, Yorktown Heights, NY, United States, robinlh@us.ibm.com, *Vernon Austel, Francisco Barahona, Feng Cheng, Joao Goncalves, Hua Ni, Pranab Shah, John Tomlin, Matthew Weidman*

The Transportation Optimization, Planning, and Scheduling (TOPS) System is a set of processes and tools designed to optimize the USPS' logistic network by scheduling transportation and routing mail to meet service requirements at minimized cost. In this talk we describe the core optimization planning engine in the TOPS system.

■ **RB-13**

Thursday, 11:00am-12:30pm
Sea Pearl I

Maintenance Modeling II

Cluster: Quality, Statistics and Reliability
Invited session

Chair: *Wenbin Wang*, School of AEMS, University of Salford, Centre for OR and Applied Statistics, M5 4wt, Salford, United Kingdom, w.wang@salford.ac.uk

1 - Scheduling preventive maintenance of oil pumps using generalized proportional intensities models

David F. Percy, Centre for Operational Research and Applied Statistics, University of Salford, M5 4wt, Greater Manchester, United Kingdom, d.f.percy@salford.ac.uk

Percy and Alkali recently introduced generalized proportional intensities models for complex repairable systems. We discuss their properties and variants, including the choice of baseline intensities, scaling factors and predictor variables. We apply them to data from the petroleum industry before introducing subjective priors and decision theory for scheduling preventive maintenance.

2 - A two stage prognosis model in condition based maintenance

Wenbin Wang, School of AEMS, University of Salford, Centre for OR and Applied Statistics, M5 4wt, Salford, United Kingdom, w.wang@salford.ac.uk

The life of a monitored item may be classified into two stages, namely a normal working stage up to a point where a random defect is initiated and a defective stage from this point to a failure. This paper reports on a model to predict the defect initiation point of a monitored item and the time to failure given available condition monitoring information. Stochastic filtering and hidden Markov models are used to construct the model and some associated modelling development is discussed.

3 - Optimal preventive-maintenance policy for leased products under some threshold values

Ruey Huei Yeh, Department of Industrial Management, National Taiwan University of Science and Technology, 43 Keelung Road, Section 4,, 106, Taipei, Afghanistan, rhyeh@mail.ntust.edu.tw

This paper develops a maintenance model for a leased product. Within a lease period, failures are rectified by minimal repairs and may incur a penalty. Preventive-maintenance is performed when it reaches a threshold value to reduce possible product failures. The objective is to minimize the expected total maintenance cost.

■ **RB-14**

Thursday, 11:00am-12:30pm
Sea Pearl II

Optimization Modeling Languages and Services II

Cluster: Computational Software Development
Invited session

Chair: *Robert Fourer*, Industrial Engineering and Management
Sciences, Northwestern University, 2145 Sheridan Road,
60208-3119, Evanston, IL, United States,
4er@iems.northwestern.edu

Chair: *Bjarni Kristjansson*, Maximal Software, Inc., 2111 Wilson
Boulevard, 22201, Arlington, Virginia, United States,
bjarni@maximalsoftware.com

1 - Life beyond the optimization model: linking processing with modeling

Irvin Lustig, ILOG Direct, Ilog, 25 Sylvan Way, 07078, Short
Hills, NJ, United States, ilustig@ilog.com

Outside the classroom, an optimization model is just a small part of
an optimization application. Even in simple applications, data needs to
be preprocessed, and the solution needs to be summarized into a useful
form. The latest version of OPL links the OPL modeling language with
full-fledged scripting language.

2 - Optimization Services Instance Language (OSiL), Solvers, and Modeling Languages

Kipp Martin, Gsb, University of Chicago, 5807 South
Woodlawn, 60637, Chicago, Illinois,
kipp.martin@gsb.uchicago.edu, *Robert Fourer*, *Jun Ma*

OSiL (Optimization Services Instance Language), is an XML vocabu-
lary for representing very general nonlinear optimization instances.
In this talk we describe how to pass optimization instances in OSiL to
solvers. We illustrate with LINDO and several NEOS solvers. We also
discuss how to create OSiL problem instances.

3 - Optimization via Simulation under the Optimization Services Framework

Jun Ma, Iems, Northwestern University, Tech Institute, C231,
60208, Evanston, IL, United States, maj@northwestern.edu,
Robert Fourer, *Kipp Martin*

Optimization Services (OS) is a standard and universal framework for
optimization over distributed systems. We show how OS provides the
infrastructure for performing optimization via simulation, where opti-
mization and simulation can be located anywhere over the Internet, and
how the process can be parallelized. Performance and other issues are
addressed.

4 - OptML: A new XML standard for representing Optimization Model Instances

Bjarni Kristjansson, Maximal Software, Inc., 2111 Wilson
Boulevard, 22201, Arlington, Virginia, United States,
bjarni@maximalsoftware.com

With optimization projects, there is often need to store model instances,
e.g., for building model libraries, providing technical support, and op-
timization services over the Internet. With OptML, we propose a new
portable, non-solver specific standard, based on XML, which supports
multiple problem types, linear, mixed-integer, quadratic, nonlinear, and
stochastic.

■ **RB-15**

Thursday, 11:00am-12:30pm
Sea Pearl III

Decision Technologies for Agricultural and Food Business

Cluster: Decision Technologies for Agricultural and
Food Business
Invited session

Chair: *Paul Preckel*, Agricultural Economics, Purdue University,
403 State Street, 47907, West Lafayette, in, United States,
preckel@purdue.edu

Chair: *Philip Jones*, Tippie College of Business, Univ. of Iowa,
Management Sciences Dept., 52242, Iowa City, IA,
philip-c-jones@uiowa.edu

1 - Modelling the capacity of the South African fresh fruit export supply chain

Frank Ortmann, Applied Mathematics, University of
Stellenbosch, Private Bag X1, Matieland, 7602, Stellenbosch,
Western Cape, South Africa, ortmann@dip.sun.ac.za, *Esbeth
van Dyk*, *Jan van Vuuren*

A multi-commodity maximum-flow approach is used to determine the
current and medium term future projected capacity of and bottlenecks
in the South African fresh fruit export supply chain infrastructure (com-
prising pack houses, cold stores, road and rail transportation links, port
terminals and sea freight) on a national level.

2 - Aggregate Planning for a Large Food Manufacturer with High Seasonal Demand

Marco Aurélio de Mesquita, Engenharia de Produção, Escola
Politécnica, USP, Av. Prof. Almeida Prado, trav.2, n.128,
Cidade Universitária, 05508-900, São Paulo, SP, Brazil,
marco.mesquita@poli.usp.br, *Flávia Midori Takey*

In order to support the inventory management in a Brazilian food com-
pany, an aggregate production planning model have been developed.
The model determines the monthly production and the resources re-
quirements to accomplish productions plans. A significant reduction of
inventory levels of both raw materials and final products was achieved.

3 - Vertically Aligned vs. Open Market Coordination: Dominance or Co-Existence?

Allan Gray, Agricultural Economics, Purdue University, 403
W. State St., 47907-2056, West Lafayette, IN,
gray@purdue.edu, *Paul Preckel*

Will a vertically aligned system become the exclusive coordination sys-
tem in the U.S. pork industry? The results of the analysis indicate
that the packer will source hogs from aligned and independent live hog
markets to balance the cost of higher quality aligned hogs against the
variability in premium product demand.

4 - The Use of Mean-Variance, Semivariance and Direct Expected Utility Maximizing Models in Agriculture

Calum Turvey, Agricultural, Food and Resource Economics,
Rutgers University, 55 Dudley Road, 08901, New Brunswick,
NJ, turvey@aesop.rutgers.edu

Agricultural economists have embraced the use of mathematical mod-
elling for solving problems of constrained agricultural production and

farm portfolio choice under conditions of risk. This paper compares commonly used portfolio models applied to agriculture including the mean-variance model, single index model, semivariance modelling and direct expected utility maximization.

■ RB-16

Thursday, 11:00am-12:30pm
Sea Pearl IV

Games and Inventory Models

Cluster: Game Theory
Invited session

Chair: *Ana Meca*, Operations Research Center, Universidad Miguel Hernández, Avda. Universidad s/n, Edificio Torretamarit, 03202, Elche, Alicante, Spain, ana.meca@umh.es

Chair: *Francisco R. Fernandez*, Facultad de Matematicas, Universidad de Sevilla, Sevilla, Sevilla, Spain, fernande@us.es

1 - Generalized inventory cost games

Ana Meca, Operations Research Center, Universidad Miguel Hernández, Avda. Universidad s/n, Edificio Torretamarit, 03202, Elche, Alicante, Spain, ana.meca@umh.es, *Andrés Toledo*

We introduce a new class of inventory games that arise from inventory problems with temporary discounts. It turns out generalized inventory cost games extend the classes of inventory cost games and inventory games with temporary discount. We focus on studying the character concave or convex of generalized inventory cost games.

2 - On the core and the Owen point of production-inventory games

Justo Puerto, Universidad de Sevilla, Sevilla, Spain, puerto@us.es, *Ana Meca, Luis Antonio Guardiola Alcala*

Production-inventory games were introduced in Guardiola et al. (2004) as a new class of totally balanced combinatorial optimization games. The Owen point was proposed as a specifically appealing core-allocation. In this paper we analyze the structure of the core and propose an axiomatic characterization of the Owen point.

3 - Cooperation and profit allocation in distribution chains

Ana Meca, Operations Research Center, Universidad Miguel Hernández, Avda. Universidad s/n, Edificio Torretamarit, 03202, Elche, Alicante, Spain, ana.meca@umh.es, *Luis Antonio Guardiola Alcala, Judith Timmer*

In this work we introduce a new class of cooperative games arising from distribution chain models. For this class of games, we obtain a characterization for balancedness. In addition, the core structure of theses games is determined. To complete the paper, several examples are analyzed.

4 - A Set-covering Game Model for the Pricing Strategy of Rush Orders

Chin-I Chiang, Marketing and Distribution Management, Hsuan Chuang University, 48, Hsuan Chuang Rd.,, 300, Hsinchu, cichiang@hcu.edu.tw

This paper proposes a set-covering game model, a cooperative game model with which the cost of each coalition is determined by solving

a revised set-covering problem, to deal with the problem of pricing strategies of rush orders.

5 - Multicriteria Operations Research Games

Francisco R. Fernandez, Facultad de Matematicas, Universidad de Sevilla, Sevilla, Sevilla, Spain, fernande@us.es, *Justo Puerto*

In this paper we introduce the class of multicriteria operations research games. These games are associated with cooperative situations that arise from multiobjective programming problems. We present core solution concepts and describe in detail the multiobjective linear production and multicriteria minimum cost spanning tree games.

■ RB-17

Thursday, 11:00am-12:30pm
Sea Pearl V

Multi-Criteria Decision Analysis Under Uncertainty

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *Jian-Bo Yang*, Manchester Business School, The University of Manchester, PO Box 88, Booth Street East, The University of Manchester, M60 1qd, Manchester, England, United Kingdom, jian-bo.yang@manchester.ac.uk

1 - Multiple Criteria Decision Analysis Using Interval Beliefs and Numerical Data

Jian-Bo Yang, Manchester Business School, The University of Manchester, PO Box 88, Booth Street East, The University of Manchester, M60 1qd, Manchester, England, United Kingdom, jian-bo.yang@manchester.ac.uk, *Ying-Ming Wang, Dong-Ling Xu*

An investigation is reported into handling interval beliefs and numerical data in MCDA. The original evidential reasoning (ER) approach is further developed to model such interval uncertainty through a process of combining and normalising interval evidence. All evidence is combined before normalising combined beliefs. Optimisation models and examples are analysed.

2 - Handling various uncertainties and risks in MCDM problems with evidential reasoning approach

Mahmut Sonmez, Business School, Loughborough University, Loughborough University, Business School, Ashby Road, Le11 3tu, Loughborough, Leicestershire, United Kingdom, m.sonmez@lboro.ac.uk

There are various uncertainties and risks inherited in Multiple Criteria Decision Making (MCDM) problems in which decision criteria are of qualitative and quantitative nature. How the evidential reasoning approach based on decision theory and the theory of evidence can treat a variety of uncertainties and risks, is presented.

3 - Handling interval weights in ER-based multiple attribute decision analysis

Jian-Bo Yang, Manchester Business School, The University of Manchester, PO Box 88, Booth Street East, The University of Manchester, M60 1qd, Manchester, England, United

Kingdom, jian-bo.yang@manchester.ac.uk, *Min Guo*,
Kwai-Sang Chin, *Hong-Wei Wang*

MADA problems having quantitative and qualitative attributes under
uncertainty can be modelled using the ER approach. This paper inves-
tigates the generation of interval weights from pairwise comparisons of
alternatives. Nonlinear optimisation models are constructed and exam-
ples studied to estimate the upper and lower bounds of combined belief
degrees and utilities.

■ RB-18

Thursday, 11:00am-12:30pm
Sea Pearl VI

Logistics

Cluster: Logistics
Contributed session

Chair: *Hengqing Ye*, Decision Science, National University of
Singapore, Singapore, Singapore, bizyehq@nus.edu.sg

1 - A Very Large-Scale Neighborhood Search Approach for the Container Pre-Marshalling Problem

Yusin Lee, Civil Engineering, National Cheng Kung
University, 1 University Road, 701, Tainan, Taiwan,
yusin@mail.ncku.edu.tw, *Shih-Liang Chao*

In this research we propose a very large-scale neighborhood search ap-
proach to solve for a least-steps working plan to re-arrange the contain-
ers in a yard such that additional, unproductive container shuffles can
be minimized or eliminated when the containers are being loaded onto
a vessel at a later time.

2 - Inventory Model with Differentiated Demand Classes

Ek Peng Chew, Industrial and Systems Engineering, Faculty
of Engineering, National University of Singapore, 10 Kent
Ridge Crescent, 119260, Singapore, Singapore,
isecep@nus.edu.sg, *Loo Hay Lee*

For a service spare parts hub to stay competitive, it is important to pro-
vide customization in terms of differentiated service levels rather than
"one size fit all" service. In this paper, we develop a good inventory
policy that can serve the different customer classes.

3 - Aircraft Loading Optimization Using Genetic Algorithms and Simulated Annealing

Ahmed Ghanmi, DND Canada, Drdc, Dmgor, 10 Cbs, NDHQ,
101 Col By drive, K1a 0k2, Ottawa, ON, Canada,
Ghanmi.AH@forces.gc.ca, *David Shaw*

This paper presents a loading optimization model, which addresses a
capability gap in current Canadian Forces deployment planning tools.
The model uses a combination of genetic algorithms and simulated an-
nealing to optimize equipment loading across a fleet of transportation
assets. Historical data has been used to validate the model.

4 - DSS for Optimal Sea Cargo Mix

Hengqing Ye, Decision Science, National University of
Singapore, Singapore, Singapore, bizyehq@nus.edu.sg

The sea cargo mix problem arises when a carrier select cargoes to
maximize its profit for some particular voyages. Optimization mod-
els are developed to determine whether to accept or reject a proposed
booking, or to suggest a surcharge or alternate product or service at a
higher/lower price.

■ RB-20

Thursday, 11:00am-12:30pm
Nautilus II

Decision Theory and Analysis I

Cluster: Decision Theory and Analysis
Contributed session

Chair: *Jerzy Michnik*, Business Administration, Kainan
University, No. 1 Kainan Road, 338, Luchu, Taoyuan County 338,
Taiwan, michnik@mail.knu.edu.tw,jmichnik@ae.katowice.pl

1 - Explaining preference reversal with third-generation prospect theory

Ulrich Schmidt, Finanzmarkttheorie, Königsworther Platz 1,
30167, Hannover, us@bwl.uni-kiel.de

We present and test a new variant of (cumulative) prospect theory
which is in cotrast to earlier variants able to explain the well-known
preference reversal phenomenon by allowing reference points to be
state-dependent. In our model preference reversals can be caused by
probability weighting or by loss aversion.

2 - Aspirations and probabilities of winning and losing

Enrico Diecidue, Decision Sciences, Insead, Bd. De
Constance, 77305, Fontainebleau, France,
enrico.diecidue@insead.edu, *Jeroen Van De Ven*

We propose a model that takes into consideration a finite number of
aspiration levels in decision under risk. We modify expected utility to
include the probabilities of success, failure, and break even. We give a
behavioral foundation to the proposed model.

3 - Selection of Suitable Method of Improving the Process of Information Transmission with the Aid of Stochastic Dominances

Jerzy Michnik, Business Administration, Kainan University,
No. 1 Kainan Road, 338, Luchu, Taoyuan County 338,
Taiwan, michnik@mail.knu.edu.tw,jmichnik@ae.katowice.pl,
Mei-Chen Lo

The virtual business work flow depend on reliable information trans-
mission since knowledge management (KM) has become a vital busi-
ness tool. The proposed approach uses stochastic dominances (SD) to
identify the most suitable way of improving the whole process in the
current business flow.

4 - Expert Combination

Stephen Hora, School of Business, University of Hawaii at
Hilo, 200 W. kawili St., 96720, Hilo, HI, United States,
hora@hawaii.edu

We examine combining experts' probabilistic judgments using
weighted linear rules. Optimal weights are developed using test ques-
tions to maximize the calibration or proper score. Results using al-
manac questions with real experts in a training environment show im-
provement virtually vanishes when the results are validated using split
samples.

■ RB-21

Thursday, 11:00am-12:30pm
Lehua Suite

Applied Probability and OR Models II

Cluster: Applied Probability

Invited session

Chair: *Hsing Paul Luh*, Dept. of Mathematical Sciences, National Chengchi University, Taipei, Taiwan, slu@nccu.edu.tw

1 - Extended optimal age-replacement policy with minimal repair

Chien Yu-Hung, Statistics, National Taichung Institute of Technology, 129 Sec. 3, San-min Road, Taichung 404, Taiwan, 404, Taichung, yhchien@ntit.edu.tw

An operating system is subject to shocks that arrive according to a non-homogeneous Poisson process. An age replacement policy for such a system is proposed and analyzed.The aim of this study is to find the optimal policy that minimizes the long-run expected cost per unit time.

2 - An Empirical Evaluation of the Relevance between Ownership Structure, Corporate Governance, and Firm Value

Cheng-Hwai Liou, Department of Accounting, National Taichung Institute of Taichung, No. 129 Sec. 3 Sanmin Rd. Taichung, 404, 404, Taichung, Taiwan, jhliou@ntit.edu.tw

Good corporate governance practices could result in better management efficiency and disclosure. We construct a prediction model by a multiple regression model, using the samples of 186 listed companies in Taiwan Stock Exchange from 2002 to 2003, to examine the relations between governance mechanisms and ownership impact the firm value.

3 - System Integration: Faster Response Time of Front-line Staffs in Changeable Business

Chih-Chin Liang, Graduate Institute of Business Administration, National Central University, Jung-da Rd., Jung-li City, Taoyuan, Taiwan 320, R.O.C., 300, Jung-li City, Taiwan, lgcwow@gmail.com

CHT has great number of software developed on client/server architectures. To provide solution for system consistence, to balance packet distribution loading and lower the error rate, each dispatching server sends packets to no more than three other servers and they are delivered with Fire and Forget Delivery System (FnFDS).

4 - Reliability and Sensitivity Analysis of a System with Multiple Unreliable Servers and Standby Switching Failures

Jyh-Bin Ke, Department of Applied Mathematics, National Chung-Hsing University, 250 Kuo-Kuang Road., 402, Taichung, jbke@amath.nchu.edu.tw, *Kuo-Hsiung Wang*

This paper presents the reliability of a system with primary and standby units, and R unreliable service stations where standby units switching might fail. The related failure or sevice times are assumed to follow exponential distributions. Expressions for system reliability and MTTF are derived. Sensitivity analysis are also investigated.

■ RB-22

Thursday, 11:00am-12:30pm
Kahili I

DEA08: Applications in DEA IV

Cluster: Data Envelopment Analysis and Performance Management

Invited session

Chair: *Ana Camanho*, Faculdade de Engenharia, Universidade do Porto, Demegi - Gein, Rua Dr. Roberto Frias, 4200-465, Porto, Portugal, acamanho@fe.up.pt

1 - Performance assessment of loan credit guarantee institutions in Asia

Te-hao Chou, Graduate School of Management Sciences,College of Management, Aletheia University, No. 32, Chen-Li Street, Tamsui, Taipei 251, Taiwan, 4th Fl., 6 Roosevelt Rd., Sec. 1, Taipei, Taiwan 100 R. O. C., 251, Taipei, Asia, Taiwan, harvard_92@yahoo.com.tw, *Shinn Sun*

Performance assessment of loan credit guarantee institutions in Asia Te-Hao Chou and Shinn Sun Graduate School of Management Sciences, Aletheia University

The purpose of this paper is to assess the operational performance of 13 loan credit guarantee institutions in Asia; and measure productivity changes in those organizations 1994-2003. Results of this study can be used by the management level in delivering better and efficient service to the business community. Keywords: Data Envelopment Analysis; Malmquist Index; Performance Measurement; loan credit guarantee institutions

2 - Benchmarking Philippine Cooperatives using DEA

Maria Socorro Calara, Economics, University of Santo Tomas, 124 Sulipan, Apalit, Pampanga 2016 Philippines, 2016, Apalit,, Pampanga, mpcalara@mnl.ust.edu.ph, *Emilyn Cabanda*

Credit cooperatives play a significant role in Philippine financial sector. Over the past decade, cooperatives tend to do multiple functions, a case of multi-purpose cooperative. The paper shows that single-purpose credit cooperatives have higher total factor productivity due to technical change while multi-purpose cooperatives are good at catching up.

3 - Efficiency and Productivity in the Philippine Banking Industry: DEA and SFA Approaches

Nelson Bool, Banknotes & Securities Printing Department, Bangko Sentral Ng Pilipinas, East Avenue, Diliman, Quezon City, Philippines, 1123, Quezon City, Philippines, nels_bsp@yahoo.com, *Emilyn Cabanda*

This paper examines the performance of 36 Philippine banks (commercial, universal and savings banks), 1998-2003 using frontier approaches. Findings indicate that there are technical inefficiencies found as relate to size, age, and ownership of Philippine banks. The Philippine banking industry needs to catch up technologically to boost its productivity growth.

4 - On the Efficiency of German Banks

Armin Varmaz, Department of Finance, University of Bremen, Faculty of Business Studies and Economics, Hochschulring 4, 28359, Bremen, Germany, varmaz@uni-bremen.de

We analyse the efficiency of the German financial industry using DEA models. Especially, we focus on important aspects such as credit risk

and the influence of the market environment, which were not considered so far in recent studies. We apply also DEA-Cone-Ratio to derive more feasible advice for efficiency improvements.

■ RB-23

Thursday, 11:00am-12:30pm

Kahili II

Strategic OR applications

Cluster: Strategic OR: Sustaining an advantage using OR

Invited session

Chair: *Peter Bell*, Richard Ivey School of Business, University of Western Ontario, N6a 3k7, London, Ontario, Canada, pbell@ivey.ca

1 - Progress in crew pairing optimization at Sabre Airline Solutions

Tina Shaw, Sabre Airline Solutions, 3150 Sabre Drive, 76092, Southlake, TX, United States, tina.shaw@sabre.com, *Ellis Johnson*

This presentation will update progress and developments in crew pairing optimization at Sabre Airline Solutions since the presentation of the work in the 1990 Edelman Prize competition.

2 - OR and the Hanshin Expressway since 1994

Toshiharu Hasegawa, Dept. Information and Telecommunication Eng., Nanzan University, 27 Seirei-Cho, Seto, Aichi, 489-0853, Seto, thasegaw@it.nanzan-u.ac.jp, *Ryouichi Iwata*, *Yoshiteru Ichiyanagi*, *Kiyofumi Kumamoto*

Hanshin expressway in Osaka, Japan initiated an LP-based automatic traffic control system in 1970. This presentation updates the history of this important public sector OR application since the 1994 Edelman competition and discusses some new developments in yield management for toll roads.

3 - An Introduction to Strategic OR

Peter Bell, Richard Ivey School of Business, University of Western Ontario, N6a 3k7, London, Ontario, Canada, pbell@ivey.ca

We define "strategic OR" as OR work that creates a sustainable competitive advantage, and will briefly describe of some of our research on strategic OR applications. The applications to be presented in this session will be discussed from the perspective of our research findings on their strategic importance.

■ RB-24

Thursday, 11:00am-12:30pm

Hibiscus I

Business Applications II

Cluster: Business Applications

Contributed session

Chair: *Hans.W. Ittmann*, Centre for Logistics and Decision Support, Csir, P O Box 395, Pretoria, 0001, Pretoria, South Africa, hittmann@csir.co.za

1 - Two Stage Inference Using DEA Efficiency Measurements in Univariate Production Models

Geraldo Souza, Statistics, University of Brasilia, SHIN QI 10 Conj. 01 Casa 13, Lago Norte, 71525-010, Brasilia, DF, geraldo.souza@embrapa.br

For a deterministic model with non iid inefficiency errors it is shown the strong consistency of the DEA production function and how one can model effects causing inefficiencies using a technique similar to stochastic frontier analysis. Statistical results are illustrated by means of an empirical application and Monte Carlo simulation.

2 - An Option Method for Employee Evaluation in a Competitive Environment

Tsutomu Mishina, Akita Perfectural Univeristy, Japan, mishina@akita-pu.ac.jp

This paper explains an employee's achievement evaluation method based on his future work performance by using the logic of real option. We discuss three factors: employee's general knowledge, efforts to increase work abilities, and goals to accomplish. This method is especially effective for application in the public sector.

3 - The Life and Times of an Operations Research Group

Hans.W. Ittmann, Centre for Logistics and Decision Support, Csir, P O Box 395, Pretoria, 0001, Pretoria, South Africa, hittmann@csir.co.za

This paper deals with an OR group operating in South Africa from within an R&D organisation. Over the years the group has been involved in many interesting and challenging projects. An overview will be presented on the successes, failures, survival, type of projects and work of the group, etc.

4 - Lp-based Capacity Planning In Semiconductor Wafer Fabrication

You In Choung, System Engineering Team, Samsung Electronics, San #16 Banwol-Ri, Taean-Eup, 445-701, Hwasung-City, Gyeonggi-Do, Korea, Republic Of, youin@samsung.com, *YoungJoong Lee*

Wafer fabrication in semiconductor manufacturing has been an essential area. Machine capacity planning draws a great deal of attention because of a direct financial impact. In this research, the methodology based on linear programming is proposed to simulate which type and how many machines must be invested.

■ RB-25

Thursday, 11:00am-12:30pm

Hibiscus II

Changing US Army Infrastructure

Cluster: Military Applications

Invited session

Chair: *David Olwell*, Systems Engineering, Naval Postgraduate School, 777 Dyer Road, Bu 113, 93943, Monterey, CA, dholwell@nps.edu

1 - Changing United States Army Infrastructure: Analyses to help make Billion Dollar Decisions.

David Olwell, Systems Engineering, Naval Postgraduate School, 777 Dyer Road, Bu 113, 93943, Monterey, CA,

dholwell@nps.edu, *Robert Dell*, *William Tarantino*, *David Smitn*, *Lee Ewing*, *Johannes Royset*

The United States military just announced substantial changes to its infrastructure as part of the Base Realignment and Closure (BRAC) process. In this panel session, we review a collection of models that helped the Army make its BRAC decisions.

2 - Overview of the 2005 BRAC process

William Tarantino, Total Army Basing Study, US Army, Arlington, United States, William.Tarantino@us.army.mil, *David Smitn*, *Lee Ewing*

The panel session will begin with a discussion of the 2005 BRAC process and how the Army organized to conduct the analysis to support its recommendations.

3 - Modelling to support infrastructure decisions

Robert Dell, Operations Research, Naval Postgraduate School, 93943, Monterey, CA, United States, dell@nps.edu, *Johannes Royset*

In this portion of the panel discussion, we discuss some of the models developed to support the Army recommendations.

Thursday, 1:30-3:00pm

■ RC-01

Thursday, 1:30-3:00pm
Honolulu I

Energy and Environmental Modeling I

Cluster: Renewable and Natural Resources
Invited session

Chair: *Steven Gabriel*, Civil & Env. Engin./ Applied Math and Scientific Computation Program, University of Maryland, 1143 Martin Hall, 20742, College Park, MD, sgabriel@umd.edu

1 - A Stochastic Complementarity Model for Natural Gas Markets

Steven Gabriel, Civil & Env. Engin./ Applied Math and Scientific Computation Program, University of Maryland, 1143 Martin Hall, 20742, College Park, MD, sgabriel@umd.edu, *Jifang Zhuang*

We develop a stochastic, mixed complementarity model of the natural gas market considering price-taking producers, storage , peak gas and pipeline operators. In addition, marketers are depicted as Nash-Cournot agents serving four consumption sectors.

2 - Optimization model analyses for measuring the effects of introducing diversified power generating plant MGT's

Tatsuo Oyama, School for Policy Studies, National Graduate Institute for Policy Studies, 2-2 Wakamatsu-cho, Shinjuku-ku, 162-8677, Tokyo, Tokyo, Japan, oyamat@grips.ac.jp

We build a mathematical programming model to obtain an optimal introduction of diversified power generating facility MGT into the market aiming at maximizing the total "saving" obtained at large demand customers such as hotels, schools, and hospitals. Numerical results obtained from applying the model to a Japanese power company are shown.

3 - A unit commitment-based electricity price model

Chung-Li Tseng, Engineering Management & Systems Engineering, University of Missouri-Rolla, University of Missouri-Rolla, 65409, Rolla, MO, chungli@umr.edu

Electricity prices have been observed to be highly volatile with "jumps". The price jumps are commonly modeled by artificial discrete probability distributions such as Poisson processes, without considering system issues that produce the effects. A unit commitment-based electricity price model is proposed, which can naturally reveal occurrence of price jumps.

■ RC-02

Thursday, 1:30-3:00pm
Honolulu II

Simulation and Optimization

Cluster: Scheduling and Timetabling
Invited session

Chair: *Jean-Paul Watson*, Discrete Algorithms and Mathematics, Sandia National Laboratories, P.O. Box 5800, MS 1110, 87185, Albuquerque, NM, United States, jwatson@sandia.gov

1 - The Support Enterprise Model for Logistics Simulation

Jean-Paul Watson, Discrete Algorithms and Mathematics, Sandia National Laboratories, P.O. Box 5800, MS 1110, 87185, Albuquerque, NM, United States, jwatson@sandia.gov, *Bruce Thompson*

We provide an overview Sandia National Laboratories Support Enterprise Model or SEM. SEM is a global logistics simulation tool that provides integrated stochastic modeling of part demands, supply/repair chains, maintenance tasks, part repair/build, and transportation. We discuss and contrast discrete event and agent-based implementations, and survey specific application domains.

2 - Optimization for the Support Enterprise Model

Bruce Thompson, System Sustainment & Readiness Technologies, Sandia National Laboratories, Po Box 5800, Ms 1176, 87185, Albuquerque, NM, United States, bmthomp@sandia.gov, *Jean-Paul Watson*

Simulation-based optimization for the Support Enterprise Model is a major challenge due to problem scale and the expense of simulations. We describe the architecture and algorithms that, through a careful balance of simulation output analysis, heuristics, mixed-integer programs, and local search, achieves low-cost, high-quality solutions for a full-scale distribution network.

3 - Decision Support for Technology Management

Kimberly Paradeise, Sandia National Labs, PO Box 5800 - MS 1176, 87185-1176, Albuquerque, NM, United States, kmparad@sandia.gov, *Rossitza Homan*

Technology Management provides continued affordability and supportability by integrating multiple lifecycle domains with approaches for optimally refreshing or inserting new technology solutions. We will present framework for a generic modeling and simulation decision support aide in enterprise level proactive Technology Management throughout a complex system's lifecycle.

4 - Future Combat Systems Simulation and Optimization Modeling

Craig Lawton, System Sustainment & Readiness, Sandia National Laboratories, P.O. Box 5800, 87185, Albuquerque, New Mexico, United States, crlawto@sandia.gov

The Unit of Action, at the core of the Future Combat Systems, is a system of combat vehicles, support vehicles and equipment that must possess a minimal logistics footprint while sustaining required performance characteristics. We will present a modeling capability to assess the multi-objective domain of the Future Combat Systems.

■ RC-03

Thursday, 1:30-3:00pm
Honolulu III

Stochastic Models II

Cluster: Stochastic Programming
Contributed session

Chair: *Naoki Makimoto*, Department of Business Sciences, Tsukuba University, 3-29-1 Otsuka, Bunkyo, 112-0012, Tokyo, Japan, makimoto@gssm.otsuka.tsukuba.ac.jp

1 - On the Convexity of the Two Threshold Policy for an M/G/1 Queue with Vacations

Zhe George Zhang, Dept. of Decision Sciences/Faculty of Business Administration, Western Washington University/Simon Fraser University, Bellingham, WA, USA/Burnaby, BC, Canada, 98225, Bellingham, Washington, United States, george.zhang@wwu.edu

We consider a single server queueing system with server vacations of two types and a two threshold policy. Under a cost and revenue structure the long-run average cost function is proven to be convex in the lower threshold for a fixed difference between the two thresholds. Based on this property, a simple procedure for determining the conditionally optimal policy is proposed for the practical systems that fit the model. Numerical examples are presented to illustrate the use of the procedure. We also discuss the managerial implications of the model and potential applications to practical waiting line situations.

2 - Cascades of Queues

Jeff Griffiths, Mathematics, Cardiff University, Mathematics Institute Cardiff University, Senghennydd Road, Cf24 4ag, Cardiff, United Kingdom, griffiths@cardiff.ac.uk

This paper presents results from a bulk service queueing system, where the main service takes place at fixed time intervals, but where back-up (or relief) services may be introduced in times of heavy demand on the system. Sample numerical results and a simple cost analysis are provided.

3 - A multi-server processor sharing queue and its application

Naoki Makimoto, Department of Business Sciences, Tsukuba University, 3-29-1 Otsuka, Bunkyo, 112-0012, Tokyo, Japan, makimoto@gssm.otsuka.tsukuba.ac.jp

We consider a multi-server queue which operates under processor sharing discipline. By using matrix-analytic approach, we develop analytical and numerical methods for obtaining performance measures of the queue. Numerical results as well as application to capacity planning of information systems are also provided.

■ RC-04

Thursday, 1:30-3:00pm
Iolani I

Locational Decisions in Logistic Networks

Cluster: Location Analysis
Invited session

Chair: *Marija Bogataj*, Faculty of Economics KMOR & Faculty of Maritime studies and Transport, University of Ljubljabna, Kardeljeva ploscad 17, Si 1000, Ljubljana, Slovenia, marija.bogataj@guest.arnes.si

1 - Applying optimization and simulation model for locating ambulance facilities

Hozumi Morohoshi, School for Policy Studies, National Graduate for Policy Studiea, 2-2 Wakamatsu-cho, Shinjuku-ku, 162-8677, Tokyo, Tokyo, Japan, morohosi@grips.ac.jp, *Tatsuo Oyama*, *Hidetaka Kawai*

An ambulance location problem is considered through optimization methods and computer simulations. We first give the formulation of the problem based on a capacitated facility location problem and report the

case studies on a part of Tokyo metropolitan area. Queuing simulations are also given to analyze the solution of optimization model.

2 - Protecting critical infrastructures: The p-median interdiction problem with fortification

Maria Paola Scaparra, Kent Business School, University of Kent, The University, Ct2 7pe, Canterbury, M.P.Scaparra@kent.ac.uk, *Richard Church*

We introduce a new model which optimally allocates fortification resources among the facilities of a p-median system so that the impact of maximally disruptive attacks to the system is minimized. We present an integer programming model and a bilevel program and device solution methods tailored to the two formulations.

3 - Locating Facilities that Serve Cycles, Not Nodes

Michael Metzger, Operations Research, Mit, 34 Shadetree Lane, 11577, Roslyn Heights, NY, mmetzger@mit.edu, *Richard Larson*

Consider a variant of the k-median/k-center problems. "Customers" are not nodes but cycles on the graph . 'Servers' at the p-facilities travel to the tours and 'service' each tour customer following the tour path. We present methods for locating facilities, including optimal methods and heuristics for the general case.

■ RC-05

Thursday, 1:30-3:00pm

Iolani II

Risk Inventory Management and Pricing

Cluster: Dynamic Pricing & Revenue management

Invited session

Chair: *Opher Baron*, Operations Management, University of Toronto, Rotman School of Management, M5s 3e6, Toronto, Ontario, Canada, opher.baron@rotman.utoronto.ca

1 - The Hotel Yield Management with Overbooking, Upgrade and Room Price Setting

Hiroaki Ishii, Osaka University, Japan, ishii@ist.osaka-u.ac.jp, *Akira Miichi*

This paper considers the hotel booking problem of twin room and single room for a fixed date under two price setting of single room, that is, early discount and normal, and upgrade. We seek the optimal price and room number for early discount case maximizing the total profit.

2 - Tour Revenue Management

Chris Anderson, University of Western Ontario, Canada, canderson@ivey.uwo.ca, *Ben Marcus*

A tour operator acts as intermediary between service providers and consumers. They enter risk-sharing contracts with service providers to mitigate uncertainty. Advance purchase of capacity may be obtained at a discount. The tour operator can be viewed as holding a basket of options. We analyze the tour operator's capacity commitments.

3 - The Influence of Shortages Cost on Optimal Pricing

Opher Baron, Operations Management, University of Toronto, Rotman School of Management, M5s 3e6, Toronto, Ontario, Canada, opher.baron@rotman.utoronto.ca

Many pricing models ignore the cost of shortages. We compare the difference in optimal prices once ignoring or considering shortages.

In general, considering the cost of shortages increases price and decreases the demand; moreover the optimal price when shortages are backlogged is higher than when shortages are lost.

4 - Risk in Revenue Management and Dynamic Pricing

Yuri Levin, School of Business, Queen's University, Goodes Hall, K7l 3n6, Kingston, Ontario, Canada, ylevin@business.queensu.ca, *Jeffrey McGill, Mikhail Nediak*

We present a model for optimal dynamic pricing of perishable products that incorporates a simple loss-probability risk measure that permits control of the probability that total revenues fall below a minimum acceptable level. This model is particularly appropriate for inventory clearance of high-value items, sales of single-class transportation services or hotel accommodations.

■ RC-06

Thursday, 1:30-3:00pm

Iolani III

Internet Applications

Cluster: Internet Applications

Contributed session

Chair: *Hiroyuki Kawano*, Department of Information and Telecommunication Engineering, Nanzan University, Seirei-cho 27, Seto, Aichi, Japan, 4890863, Seto, kawano@it.nanzan-u.ac.jp

1 - Topological Optimization Modeling of Internet GDI Data

Sydney Chu, Department of Mathematics, University of Hong Kong, Pokfulam Road, 00000, Hong Kong, SAR, China, schu@hku.hk, *James Ho*

We construct topologically driven model for the question of what "shape" the Global Diffusion of Internet (GDI) is in. It bases on data from sources like the GDI framework of Wolcott to visualize the dimensions of GDI data and produce the maximum resolution of usage/provider determinants of internet diffusion.

2 - An Analysis of WebSphere Application Scalability

Hugh Smith, BEC Consultants,Inc., 633 Post Street, Pmb 340, 94109, San francisco, Ca, netizena2003@yahoo.com, *Edward Montgomery*

Web applications are required to handle significant workload increases after implementation. Scalable applications should be able to make effective use of additional resources to maintain service levels. For installed systems scalability is a non-linear function rather than a fixed percentage. This paper analyzes the scalability of a distributed Websphere application.

3 - Evaluation of peer-to-peer contents delivery system using internet emulation

Hiroyuki Kawano, Department of Information and Telecommunication Engineering, Nanzan University, Seirei-cho 27, Seto, Aichi, Japan, 4890863, Seto, kawano@it.nanzan-u.ac.jp

We propose peer-to-peer contents delivery system with information filtering, which is based on web mining techniques. By using analytical method of hierarchical routing mechanism, we evaluate query routing performance of our system. We have more accurate evaluation by emulating internet characteristics, such as transmission delay and so on.

■ RC-07

Thursday, 1:30-3:00pm
Iolani V

Cutting and Packing I

Cluster: Cutting and Packing

Invited session

Chair: *Jose Fernando Oliveira*, Feup / Inesc, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465, Porto, Portugal, jfo@fe.up.pt

1 - Genetic Algorithm for Two-Dimensional Bin Packing Problems to Minimise the Maximum Lateness

Julia Bennell, School of Management, University of Southampton, Highfield, So17 1bj, Southampton, Hampshire, United Kingdom, jab2@soton.ac.uk, *Lai-Soon Lee*, *Chris Potts*

A two-dimensional bin-packing problem is considered, where bins have processing times, and rectangles have due dates. A new placement heuristic which dynamically searches for the best placement is presented. The search is controlled by a GA with alternative fitness functions for minimising the number of bins and the maximum lateness.

2 - The cutting stock and pattern sequencing integrated problem

Horacio Yanasse, Cte, Inpe, Av. dos Astronautas 1758, Cp 515 - Inpe/cte, 12227-010, São José dos Campos, São Paulo, horacio@lac.inpe.br, *Maria Jose Pinto*

In this work the cutting stock problem and the pattern sequencing problem are considered in an integrated way. The integrated problem is formulated as a linear integer programming problem and a lagrangian relaxation is suggested to solve it. The dual problem is solved using a modified subgradient method. Computational tests using unidimensional cutting problem instances are reported.

3 - Cut Order Planning Using Metaheuristics

Ahlem Bouziri, ISG Tunis, 19 rue ElAacha, 2083, Ghazela (Ariana), Tunisia, ahlembou@yahoo.com, *Rym M'Hallah*

Cut order planning (COP) searches for the combination of ordered sizes that optimizes material utilization. COP estimates the length of the layouts instead of solving the corresponding layout problems; yielding suboptimal solutions. Herein, the COP and layout problems are combined and solved using Simulated Annealing, Genetic Algorithms, and Genetic Annealing.

4 - A XML format for data representation in Nesting Problems

Jose Fernando Oliveira, Feup / Inesc, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465, Porto, Portugal, jfo@fe.up.pt, *Antonia Carravilla*, *Cristina Ribeiro*, *A. Miguel Gomes*

In this paper we will present a format for the representation of all data describing a nesting problem. This format is based on XML and is used in ESICUP website for the test problems repository. The information considered in this format includes the no-fit-polygons description.

5 - A Hybrid Random Key Based Genetic Algorithm for the Two-Dimensional Knapsack Problem

José Fernando Gonçalves, Faculdade de Economia, Universidade do Porto, Rua Dr. Roberto Frias S/N, 4200-464, Porto, Portugal, jfgoncal@fep.up.pt

The two-dimensional knapsack problem consists in cutting a number of rectangular pieces from a single large rectangle so as to maximize the value of the pieces cut. We consider the special case in which the items cannot be rotated. A hybrid genetic algorithm based on random keys is presented.

■ RC-08

Thursday, 1:30-3:00pm
Iolani VI

Supply Chain Management Applications

Cluster: Supply Chain Management

Invited session

Chair: *Sergio Maturana*, Ingenieria Industrial y de Sistemas, P. Universidad Catolica de Chile, Casilla 306 Correo 22, Santiago, Chile, smaturan@ing.puc.cl

Chair: *Fernando Crespo*, 14 de Octubre 580, Cerrillos., 7272728, Santiago, Región Metropolitana, Chile, facrespo@puc.cl

Chair: *Jorge Bastias*, Lan Airlines, Apoquindo 4944, Las Condes, 6772275, Santiago, RM, Chile, jorge.bastias@lan.com

1 - Multi-scale Online Planning and Scheduling in The Pharmaceutical Industry

Hlynur Stefansson, Centre for Process Systems Engineering, Imperial College of London, Imperial College London, Sw7 2az, London, United Kingdom, hlynur.stefansson@ic.ac.uk, *Pall Jensson*, *Nilay Shah*

In this contribution we propose an approach for online production planning and scheduling for a full scale real world problem. A hierarchical algorithm has been developed to cope with a continuous dynamic decision process and novel optimization models and solution techniques proposed to support decisions at each level.

2 - Distribution Channel Management for a Commercial Airline

Jorge Bastias, Lan Airlines, Apoquindo 4944, Las Condes, 6772275, Santiago, RM, Chile, jorge.bastias@lan.com, *Sergio Maturana*

Internet has greatly affected distribution channels in the travel industry. Airlines have to decide how to manage the different distribution channels, such as new direct internet-based channels and traditional travel agencies. A simulation model is developed to generate insights on the effects of different policies for a commercial airline.

3 - Key Supplier Selection model in SCM - Data Ming with AHP Approach

Rong-Ho Lin, Business Management, National Taipei University of Technology, #1, Section 3, Chung-hsaio Road, Taipei, Taiwan, ROC, 106, Taipei, Taiwan, rhlin@ntut.edu.tw, *Chun-Ling Chuang*

Supplier selection becomes an important goal in SCM. This article integrates an AHP and extended association rule algorithm to enable a reduction in the number of suppliers and find the best suppliers. An example of finding the key suppliers of SCM in an electronic devices manufacturer in Taiwan is described.

■ RC-09

Thursday, 1:30-3:00pm
Iolani VII

Metaheuristics II

Cluster: Metaheuristics
Invited session

Chair: *J E Beasley*, Department of Mathematical Sciences, Brunel University, Ub8 3ph, Uxbridge, United Kingdom, john.beasley@brunel.ac.uk

1 - Efficiency of classical and probabilistic model building genetic algorithms on high epistasie deceptive problems

Robin Gras, Inria, Campus de Beaulieu, 35042, Rennes, France, robin.gras@isb-sib.ch

Number of different properties are involved in the complexity of global combinatorial optimization problems. Among them, deceptiveness and epistasie are particularly important. We present an exhaustive study of the efficiency of classical and probabilistic model building genetic algorithms to solve high epistasie deceptive problems. We also propose a specific strategy dramatically improving the performances of probabilistic model building approach on complex deceptive problems.

2 - Neighbourhood Design by Consistency Checking

Michel Vasquez, Lgi2p, Ecole des Mines d'Alès, Parc scientifique Georges Besse, 30035 Cedex 1, Nîmes, France, Michel.Vasquez@ema.fr, *Audrey Dupont*, *Djamal Habet*

We present a general approach for solving Constraint Optimization Problems. We design a Consistent Neighbourhood which, after each variable assignment, deletes conflicting variables to maintain the constraint consistency. Instead of allowing infeasible moves on complete configurations, we work only on partial consistent ones until a solution is found. This approach is applied in solving real-life problems.

3 - Combining global and local search : a useful technique

Mireille Palpant, Laboratoire d'Informatique d'Avignon, 339, chemin des Meinajaries, Agroparc BP 1228, 84911, Avignon, mireille.palpant@univ-avignon.fr, *Christian Artigues*, *Philippe Michelon*

We propose a general framework that combines global and local search for solving combinatorial optimisation problems. The main idea is to iteratively generate and solve subproblems of the global problem. We present experimental results that show the effectiveness of this approach on two distinct problems.

4 - Scatter search and bionomic algorithms for the aircraft landing problem

J E Beasley, Department of Mathematical Sciences, Brunel University, Ub8 3ph, Uxbridge, United Kingdom, john.beasley@brunel.ac.uk, *Hélène Pinol*

The problem of deciding how to land aircraft approaching an airport involves assigning each aircraft to an appropriate runway, computing a landing sequence for each runway and scheduling the landing time for each aircraft. The objective is to achieve effective runway use.

The multiple runway case of the static Aircraft Landing Problem is considered. Two heuristic techniques are presented: Scatter Search and the Bionomic Algorithm, population heuristic approaches that have not been applied to this problem before.

Computational results are presented for test problems involving up to 500 aircraft and 5 runways.

■ RC-10

Thursday, 1:30-3:00pm
Tapa Ballroom I

Quality, Reliability and Statistics in Nano-Technology

Cluster: Tutorials
Invited session

Chair: *Fugee Tsung*, Ieem, Hong Kong University of Science and Technology, Clear Water Bay, 852, Kowloon, Hong Kong, Hong Kong, season@ust.hk

1 - Quality, Reliability and Statistics in Nano-Technology

Jye-Chyi Lu, Industrial and Systems Engineering, Georgia Institute of Technology, 765 Ferst Drive NW, 30332, Atlanta, GA, United States, jclu@isye.gatech.edu, *S.-l. Jeng*, *S. C. Lin*, *Ni Wang*, *M. K. Jeong*

Nano-technology has been recognized as a revolution that will impact virtually every sector of our economy and our daily lives. The NSET subcommittee in the National Science and Technology Council has identified nano-manufacturing and nanoscale devices and systems as some of their "program component areas". Several government agencies (e.g., the NSF, DARPA, NIST, etc.) have funded many research projects on this and related topics. This tutorial presentation will introduce background of the nano-manufacturing and nano-device development, address opportunities of quality, reliability and statistics in these fields and summarize its funding sources. Q&A will be encouraged during the session.

■ RC-11

Thursday, 1:30-3:00pm
Tapa Ballroom II

Combinatorial Optimization Applications

Cluster: Combinatorial Optimization
Invited session

Chair: *Michael Trick*, Tepper School of Business, Carnegie Mellon University, Gsia 3431b, Carnegie Mellon University, 15213, Pittsburgh, PA, United States, trick@cmu.edu

1 - Nonphotorealistic rendering via large-scale integer programming

Robert Bosch, Mathematics, Oberlin College, 10 North Professor St., King Building 205, 44074, Oberlin, Ohio, bobb@cs.oberlin.edu

We will present a number of large-scale integer programming models that can be used to create interesting nonphotorealistic renderings of target images. Up close, these renderings appear to be completely abstract. But from afar, they closely resemble the target image.

2 - A Genetic Algorithm for the Home-Delivered Meals Location-Routing Problem

Hakan Yildiz, Tepper School of Business, Carnegie Mellon University, 2634 Mt. Royal Rd., 15217, Pittsburgh, PA,

United States, hakanyil@andrew.cmu.edu, *Michael Johnson, Stephen Roehrig*

Home-delivered meals (HDM) provision is a volunteer-staffed activity for which little strategic planning is currently performed. We present and evaluate a Genetic Algorithm to solve the HDM location routing problem (LRP). This planning model addresses facility location, allocation of demand to facilities, and design of delivery routes, while balancing efficiency and effectiveness considerations. Preliminary computational results on LRP instances are very encouraging.

3 - Large-scale unweighted set covering: beat the computer!

Jakob Krarup, Dept. of Computer Science, University of Copenhagen, Universitetsparken 1, Dk-2100, Copenhagen, Denmark, krarup@diku.dk

The answer to a brain teaser published in 2003 can be found by solving a highly structured instance of Unweighted Set Cover defined on a square matrix of size 531,441. Since CPLEX required no less than 72 hours of CPU time before optimality was reached for a similarly structured instance of size 243, even the mere thought of further experiments with CPLEX or the like had to be abandoned. What has been achieved so far by paper and pen- cil will instead be accounted for.

■ RC-12

Thursday, 1:30-3:00pm
Tapa Ballroom III

Dynamic Transportation Models

Cluster: Transportation
Invited session

Chair: *Alan Erera*, School of Industrial and Systems Engineering, Georgia Institute of Technology, 765 Ferst Drive, 30306, Atlanta, GA, alerera@isye.gatech.edu

1 - A Dynamic Car Distribution Model: Solution Quality and Sensitivity Analysis

Belgacem Bouzaiene-Ayari, Operations Research & Financial Eng'g, Princeton University, E-Quad, Room E-316, Princeton University, 08544, Princeton, NJ, United States, belgacem@princeton.edu, *Warren Powell*

We present a dynamic model for the rail car distribution problem. The problem consists of finding a plan for satisfying demands of empty cars over a planning horizon. The issues related to solution quality and convergence rate will be analyzed and discussed. We also present computational results that show the robustness and usefulness of the model to perform what-if scenario studies.

2 - Waiting Strategies for Anticipating Service Requests from Known Customer Locations

Barrett Thomas, Management Sciences, University of Iowa, 108 John Pappajohn Building, 52242-1000, Iowa City, IA, barrett-thomas@uiowa.edu

We maximize the number of previously unknown customer service requests that can be inserted into a prespecified route when the unknown requests arrive throughout the time horizon and all customer locations are known with certainty. We model the problem as an MDP, provide structural results, and present heuristics.

3 - Robust models for dynamic transportation asset repositioning

Alan Erera, School of Industrial and Systems Engineering, Georgia Institute of Technology, 765 Ferst Drive, 30306, Atlanta, GA, alerera@isye.gatech.edu, *Juan Morales, Martin Savelsbergh*

We develop a new robust approach for dynamic asset repositioning problems with demand uncertainty. Uncertainty is modeled using intervals about nominal values, and a parameter which controls conservatism. We develop the ideas for a weekly repositioning decision problem, and introduce necessary and sufficient conditions for robust flows.

■ RC-13

Thursday, 1:30-3:00pm
Sea Pearl I

Application of Simulation in Quality and Reliability

Cluster: Quality, Statistics and Reliability
Invited session

Chair: *Szu Hui Ng*, Nus, Singapore, Singapore, isensh@nus.edu.sg

1 - A note on a Markovian deteriorating system with uncertain repair

Nobuyuki Tamura, Electrical and Electronic Engineering, National Defense Academy, 1-10-20 Hashirimizu, 239-8686, Yokosuka, Japan, tamura@nda.ac.jp

We consider a Markovian deteriorating system where uncertain repair or replacement can be taken as maintenance action. When uncertain repair is taken, we decide whether to inspect the system or not. Several properties of an optimal maintenance policy minimizing the expected total discounted cost for unbounded horizon are derived.

2 - Inventory Control for Critical Parts with Deterioration

Rong Li, Operations Management, Singapore Management University, 469 Bukit Timah Road, 259756, Singapore, rongli@smu.edu.sg

We study a Bayesian inventory model for service parts that are subject to deterioration. Information regarding part deterioration can be captured through condition monitoring. Optimal inventory policies are determined for parts that are ordered periodically according to endogenous demand (i.e., demand driven by life distributions and part deterioration).

3 - Improving gradient estimation and step size determination in Response Surface Methodology

Loo Hay Lee, Industrial and Systems Engineering, National University of Singapore, Singapore, iseleelh@nus.edu.sg, *Szu Hui Ng*

In the onset of Response Surface Methodology, first-order polynomials are fit locally to estimate the path of steepest ascent. The search for higher responses then proceeds along this path. Several step size determination proposals along this path are studied and a budget allocation scheme is proposed to improve the estimation.

■ RC-14

Thursday, 1:30-3:00pm
Sea Pearl II

Intelligent Methods

Cluster: Computational Software Development
Invited session

Chair: *Erik Rolland*, Anderson Graduate School of Management, University of California Riverside, Riverside, CA, United States, erik.rolland@ucr.edu

1 - Bayesian Networks Learned with Evolutionary Programming for Direct Marketing Forecasting

Geng Cui, Dept. of Marketing and Int'l Business, Lingnan University, 8 Castle Peak Road, 00000, Tuen Mun, N.T., Afghanistan, gcui@ln.edu.hk, *Man Leung Wong*

For direct marketing forecasting models, this study applied machine learning and stochastic optimization using Bayesian networks learned by evolutionary programming. The results of a ten-fold cross-validation experiment suggest that Bayesian networks have distinctive advantages over competing methods in accuracy of forecast, transparency of procedures, interpretability of results, and explanatory insight.

2 - A Bayesian Network Method for Inferring Causality from Data

Eric Zheng, Anderson Graduate School of Management, University of California, Riverside, CA, United States, eric.zheng@ucr.edu, *Paul Pavlou*

This paper introduces a Bayesian Networks method to address a limitation of data analysis techniques. Based on conditional probabilities, the proposed method can inductively test conditional independence among variables and infer probabilistic causal relationships. We apply the method to predict the TAM model, and discuss new insights and advantages.

3 - Constraint Addition in RIng Selection Networks

Erik Rolland, Anderson Graduate School of Management, University of California Riverside, Riverside, CA, United States, erik.rolland@ucr.edu, *Raymond Patterson*

In this research we describe a ring selection problem for telecommunication networks. Since solving large instances of the problem by is hard, we develop a technique based on constraint addition. The solution procedure iteratively solves a set-covering problem and stops upon reaching an optimal solution to the original design problem

■ RC-15

Thursday, 1:30-3:00pm
Sea Pearl III

Decision-Making Techniques for Agricultural Businesses

Cluster: Decision Technologies for Agricultural and Food Business
Invited session

Chair: *Burak Kazaz*, School of Business Administration, University of Miami, 33134, Coral Gables, Florida, United States, bkazaz@miami.edu

1 - Campaign Planning and Scheduling for Multi-Product Batch Operations

Kumar Rajaram, UCLA Anderson School, Los Angeles, CA, United States, krajaram@anderson.ucla.edu

We develop methods for planning and scheduling of multi-product batch operations in the food processing industry. These methods are applied to data from a leading food processing company. Our results suggest that our methods could reduce total annual costs by about 7.7%, translating to an annual savings of around $7 million.

2 - Efficiency Analysis of Agricultural Market Advisory Services

Hayri Onal, University of Illinois, United States, h-onal@uiuc.edu, *Silvina Cabrini*, *Scott Irwin*, *Darrel Good*, *Joao MArtines-Filho*, *Brian Stark*

Agricultural market advisory services provide commodity specific marketing advice (program) to grain producers. We use a nonlinear integer programming model to determine an efficient portfolio of advisory programs. Results show that efficient portfolios incorporating a small number of programs can provide significant risk and return benefits compared to external benchmarks.

3 - Scheduling in two-stage food manufacturing with intermediate storage: the influence of product mix

Renzo Akkerman, Faculty of Management and Organization, University of Groningen, P.O. Box 800, 9700 Av, Groningen, Netherlands, r.akkerman@rug.nl, *Dirk Pieter Van Donk*, *Gerard Gaalman*

We study the effect of differences in the product mix in a two-stage hybrid flowshop under various scenarios for the capacity (number of tanks) and nature of intermediate storage. We focus on the food-processing industry, where both capacity and time constraints add to complexity of scheduling.

4 - Early Pricing vs. Price Postponement in Agricultural Businesses

Burak Kazaz, School of Business Administration, University of Miami, 33134, Coral Gables, Florida, United States, bkazaz@miami.edu

This study investigates the optimality conditions for agricultural businesses that can set prices before or after harvesting. The agricultural business has the objective of maximizing expected profits while determining the optimal amounts of production quantity and sale price under yield and demand uncertainty.

■ RC-16

Thursday, 1:30-3:00pm
Sea Pearl IV

Coalition and Alliance Formation I

Cluster: Game Theory
Invited session

Chair: *Agnieszka Rusinowska*, Nijmegen School of Management, Radboud University Nijmegen, P.O. Box 9108, 6500 Hk, Nijmegen, Netherlands, a.rusinowska@fm.ru.nl

1 - Applying relational algebra and RelView to coalition formation

Agnieszka Rusinowska, Nijmegen School of Management, Radboud University Nijmegen, P.O. Box 9108, 6500 Hk, Nijmegen, Netherlands, a.rusinowska@fm.ru.nl, *Rudolf Berghammer, Harrie De Swart*

We present an application of relational algebra to a coalition formation model. This leads to specifications, which can be executed with the help of RelView. We formulate the notions of feasibility and stability for governments in relation-algebraic terms. This enables us to use RelView to compute which governments are stable.

2 - European Constitutional Treaty and EU Budget

Mika Widgren, Department of Economics, Turku School of Economics, Rehtorinpellonkatu 3, 20500, Turku, Finland, mika.widgren@tukkk.fi

Power indices perform very well in explaining member states' receipts from EU budget. This paper examines the effects of various voting rules in the EU Council on budget allocation in EU15, EU25, EU27 and EU29 using the Shapley-Shubik index and modified versions of it that allow pre-play coalition formation.

3 - The Shapley value for games on lattices

Michel Grabisch, Lip6, Universite Paris I - Pantheon-Sorbonne, 8, rue du Capitaine Scott, 75015, Paris, France, Michel.Grabisch@lip6.fr

We present a general view of games on lattices, giving an interpretation in terms of elementary and compound actions. We introduce the cumulative and incremental Shapley values, and give an axiomatization in the case of a product of linear lattices.

■ RC-17

Thursday, 1:30-3:00pm
Sea Pearl V

Real-World MCDA Interventions - Action and Research

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *Gilberto Montibeller*, Dept. of Business Information Management, Kingston Business School, Kingston University, Kingston Hill Campus, Kingston upon Thames, Kt2 7lb, London, United Kingdom, G.Montibeller@kingston.ac.uk

1 - Supporting The Distribution Of Software Development Work In Virtual Teams With Multi-criteria Decision Analysis

Ana Barcus, Cibc, Apt. 3, 749 Marlee Avenue, M6j3b8, Toronto, Ontario, Canada, AnaBarcus@source2trade.com, *Gilberto Montibeller*

Projects in software industry are increasingly developed by virtual teams where project distribution faces specific challenges.

This paper presents multi-criteria model for supporting virtual team work allocation decision in a global software company. The model was developed with a group of top managers using decision conferencing and Multi-Attribute Value Theory.

2 - Group Decision in action: Improving the Production Planning and Control of a small factory in Brazil

Sandro Noronha, Rua Frei Caneca, 520, apt. 203, 88025000, Florianopolis, SC, Brazil, sanmac@floripa.com.br

This work presents a real-world decision support in a factory in Brazil, where the managers were deciding how to improve their production planning and control. We employed a multi-criteria method that we recently developed for supporting this group decision making, which takes into account individual value trees to rank alternatives.

3 - Multicriteria Modelling for Fisheries Rights Allocations in South Africa

Theo Stewart, Statistical Sciences, University of Cape Town, 7701, Rondebosch, South Africa, tjstew@iafrica.com, *Alison Joubert, Ron Janssen*

Many fisheries in South Africa are suffering decreased stocks and increased poaching. The state has to select applicants for fishing rights, with objectives of preserving threatened stocks and securing socio-economic upliftment. We report on working with communities to structure their perceptions and goals, and incorporating these into a DSS.

4 - In the Search of a Theory of MCDA Practice: Research Methodologies for Real-World Interventions

Gilberto Montibeller, Dept. of Business Information Management, Kingston Business School, Kingston University, Kingston Hill Campus, Kingston upon Thames, Kt2 7lb, London, United Kingdom, G.Montibeller@kingston.ac.uk, *Alec Morton*

With the maturation of the MCDA field, we see a need for a theory of MCDA practice, which codifies and structures the practical knowledge of the analyst. We discuss alternative methodologies of research that may be useful for creating such theory and offer some suggestions for a way forward.

■ RC-18

Thursday, 1:30-3:00pm
Sea Pearl VI

Production and Inventory Systems I

Cluster: Production and Inventory Systems
Contributed session

Chair: *Juhwen Hwang*, Business Administration, National Dong Hwa University, 1, Sec. 2, Da Hsueh Rd., Shou-Feng, 97401, Hualien, Taiwan, hjw@mail.ndhu.edu.tw

1 - An EOQ system with partial backlogging depending exponentially on waiting-time and stockout-period

Joaquín Sicilia, Dpt. de Estadística, Investigación Operativa y Computación, Universidad de La Laguna., La Laguna. Tenerife., Canary Islands, Spain, jsicilia@ull.es, *Luis A. San-José, Juan Garcia-Laguna*

An EOQ system with partial backlogging is addressed. The backlogging rate is an exponential function, which depends on waiting-time and stockout-period. In this system three significant costs are considered: order cost, holding cost and shortage cost. The shortage cost includes unit backlogging cost, opportunity cost and goodwill cost. A general approach for finding the optimal policy is developed. Numerical examples are reported.

2 - Single-Stage Resource Allocation and Economic Lot Scheduling on Multiple, Non-Identical Production Lines

Ramesh Bollapragada, College of Business, San Francisco State University, Bus 206a, 1600 Holloway Avenue, 94132, San Francisco, CA, United States, rameshb@sfsu.edu, *Uday Rao*

The talk focuses on simultaneous resource allocation, lot-sizing and scheduling in a multimachine, deterministic ELSP environment. The objective is to minimize the long-run average production, setup, inventory, and shortage penalty costs. We develop a concave minimization model of the problem, generate heuristic solutions, lower bounding methods and present computational results.

3 - Economic Lot Size Problem with Economies of Scale Production Costs

Vernon Hsu, School of Management, George Mason University, Mail Stop 5F4, School of Management, George Mason UNiversity, 22030, Fairfax, VA, vhsu@gmu.edu

We consider an economic lot size problem with general economies of scale production costs and concave inventory and backlogging costs. We develop an approximation solution to this NP-hard problem and establish worst-case performance results. Some computational results will also be presented.

4 - Economic Order Quantity for a Multiple-Product System with Joint Order and Restricted Capacity

Juhwen Hwang, Business Administration, National Dong Hwa University, 1, Sec. 2, Da Hsueh Rd., Shou-Feng, 97401, Hualien, Taiwan, hjw@mail.ndhu.edu.tw

This paper discusses the optimal policy for a multi-product retailer system with capacity limitations. A model for the system will be presented to maintain appropriate inventory levels and minimize the total cost. The cost structure of the model includes inventory holding, loss of goodwill, and joint order costs.

■ RC-20

Thursday, 1:30-3:00pm

Nautilus II

Decision Theory and Analysis II

Cluster: Decision Theory and Analysis

Contributed session

Chair: *Nataliya Kalashnykova*, Physics and Mathematics, Universidad Autonoma de Nuevo Leon, Pedro de Alba S/N, San Nicolas de los Garza, N.L., 65415, San Nicolas de los Garza, Nuevo Leon, nkalash@fcfm.uanl.mx

1 - Business Process Reengineering (BPR): Conceptual and Analytical Extensions

Germaine Saad, MIS and Decision Sciences, Widener University, One University Place, Chester, PA, 19013, Chester, PA, United States, Germaine.H.Saad@Widener.edu, *Monique Guignard*, *Siqun Wang*

This paper introduces decision rules that help maximize the value added from BPR for each industry type in the VAT Classification. An AHP model is developed that incorporates basic quantitative and qualitative factors affecting the reengineering outcomes. IP modeling will be explored. Initial results will be presented.

2 - Compensatory Fuzzy Programming for Decentralized Two-Level Linear Fractional Programming (DTLLFP) Problems with Fuzzy Parameters

Fatma Tiryaki, Faculty of Art and Sciences, Department of mathematics, Yildiz Technical University, Davutpasa Kampusu -ISTANBUL, Turkey, 34, Istanbul, Turkey, ftiryaki@yildiz.edu.tr, *Mehmet Ahlatcioglu*

This paper presents compensatory fuzzy programming for decentralized two-level linear fractional programming problems with fuzzy parameters, considering the experts' vague or fuzzy understanding of the nature of the parameters in the problem formulation process. Using the level sets of fuzzy parameters, this problem is solved depending on the compensation parameter.

3 - Conjectural Variations Equilibrium in a Human Migration Model

Nataliya Kalashnykova, Physics and Mathematics, Universidad Autonoma de Nuevo Leon, Pedro de Alba S/N, San Nicolas de los Garza, N.L., 65415, San Nicolas de los Garza, Nuevo Leon, nkalash@fcfm.uanl.mx, *Vyacheslav Kalashnikov*

A human migration model is proposed and a conjectural variations techniques is used to examin equilibrium states. Different forms of necessary and sufficient conditions are obtained to help us designing efficient algorithms to compute the equilibrium states.

■ RC-21

Thursday, 1:30-3:00pm

Lehua Suite

Applied Probability and OR Models III

Cluster: Applied Probability

Invited session

Chair: *Hsing Paul Luh*, Dept. of Mathematical Sciences, National Chengchi University, Taipei, Taiwan, slu@nccu.edu.tw

1 - Simulation of Queue Sequencing Policies for Optimizing Inland Waterway Transportation

Robert Nauss, Logistics and Operations Management, U of Missouri-St. Louis, 209 Ccb, 1 University Blvd, 63121, St. Louis, MO, robert_nauss@umsl.edu, *James Campbell*, *Ray Mundy*, *L. Douglas Smith*, *Don Sweeney*

We simulate a congested portion of an important segment of an inland navigation system. After model validation, we simulate the use of various lock queue tow-dispatch policies. These policies were developed to measure the efficacy of different tow/barge sequencing rules in order to reduce total barge-hour wait times.

2 - An Economic Analysis of Long-term Cost effectiveness on Warehouse investment Decisions

Earl Juei Wang, Industrial Management, National Pingtung University of Science and Technology, 1 Hseuh-Fu Road, Nei-Pu Hsiang, 912, Pingtung, Taiwan, second@mail.npust.edu.tw

This paper provides a systematic methodology of analyzing long-term cost effectiveness on warehouse investment problems through a real

studied firm. The proposed model composes of operational modes with transportation functions and warehouse capacity and involves novel scenarios currently under consideration in the studied firm.

3 - Fair Budget Allocation of Precomputation in All-IP Networks

Chia-Hung Wang, Department of Mathematical Sciences, National Chengchi University, 64, Sec. 2,Zhi-nan Rd., Wenshan, Taipei 116, Taiwan, Republic of China, 11605, Taipei, 93751502@nccu.edu.tw, *Hsing Paul Luh*

We present an approach for the fair resource allocation problem in All-IP networks that offer multiple services to users. The objective of the optimization problem is to determine the amount of required bandwidth for each class to maximize the sum of the users' utility. We attempt to provide a proportionally fair treatment of all the competing classes. We will show that an achievement function can map different criteria subject to various utility onto a normalized scale. Using the bandwidth allocation model, we find a Pareto optimal allocation of bandwidth which provides the proportional fairness to every class.

4 - A single-server retrial system with a variant vacation policy

Jau-Chuan Ke, Department of Statistics, National Taichung Institute of Technology, No 129, Sec. 3, Sanmin Rd. Taichung, 404, Taiwan, 404, Taichung, Taiwan, jauchuan@ntit.edu.tw

We consider a M/G/1 retrial queue, where the server operates a variant vacation policy when the orbit is empty. If the server is busy or on vacation, an arriving customer either enters an orbit or balks. If the orbit is empty, the server takes at most J vacations

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■ RC-22

Thursday, 1:30-3:00pm
Kahili I

DEA09: Applications in DEA V

Cluster: Data Envelopment Analysis and Performance Management

Invited session

Chair: *Emilyn Cabanda*, Graduate School, University of Santo Tomas, UST Graduate School, Espana, Manila Philippines, 1008, Manila, dr_cabanda@yahoo.com

1 - Data Envelopment Analysis and Performance Management in Education: Outstanding Problems

David Mayston, Economics And Related Studies, University Of York, University Of York, Y010 5dd, York, United Kingdom, dm3@york.ac.uk

The paper examines several outstanding theoretical and practical problems in the application of Data Envelopment Analysis and related techniques to performance management in the education sector. Failure to adequately address these problems can result in perverse incentives and dysfunctional outcomes that are of major policy importance in this key sector.

2 - Multicriteria comparison of pension funds in the Czech Republic

Josef Jablonsky, Dept. of Econometrics, University of Economics Prague, W.Churchill sq. 4, 13067, Praha 3, Czech Republic, jablon@vse.cz

The paper compares the efficiency of available pension funds in the Czech Republic. The decision problems contains 12 alternatives and up to 8 inputs and outputs. For their evaluation we use data envelopment analysis models and several multicriteria decision making methods and analyze the sensitivity of given results.

3 - Performance Evaluation of Philippine Higher Educational Institutions: Application of Frontier Approaches

Mary Caroline Castano, College Of Commerce, University Of Santo Tomas, Espana , Manila, Philippines, 1008, Manila, carol_castano@yahoo.com, *Emilyn Cabanda*

This paper evaluates the efficiency performance of Philippine Higher Educational Institutions using frontier methods. Robust findings suggest that higher technological progress boosted productivity growth of these institutions. Technical inefficiency is significantly related to size and ownership. These findings add to the performance management of Philippine higher institutions.

■ RC-23

Thursday, 1:30-3:00pm
Kahili II

Data Envelopment Analysis I

Cluster: Data Envelopment Analysis

Contributed session

Chair: *Hong Kyu Han*, Dept. of Computer Science and Industrial Systems Engineering, Yonsei University Shichondong 134 Seoul, Korea, 120-749, Seoul, Korea, Republic Of, hkhan@yonsei.ac.kr

1 - A Methodology for Adjusting DEA for Variation in Site Characteristics: An Application to the U.S. Electric T&D Industry

Ron Norton, Maine Office of the Public Advocate, 112 Stae House Station, 04333-0112, Augusta, maine, ron.n.norton@maine.gov, *Thomas Sexton*, *Richard Silkman*

Many DMUs argue correctly that they operate under site characteristics that unfairly influence their efficiency ratings. Some authors attempt to account for site characteristics by treating them as either inputs or outputs, of which they are neither. This paper presents an appropriate procedure for removing the influence of site characteristics.

2 - Assessing the operational performance of urban bus companies in Taipei

Chi-I Chang, Graduate School of Management Sciences,College of Management, Aletheia University, No. 32, Chen-Li Street, Tamsui, Taipei 251, Taiwan, 10Fl-2,No.47,Chin-Hua St.Taipei 100 Taiwan, 100, Taipei, chiison@ms57.hinet.net, *Shinn Sun*

The purpose of this paper is to assess the operational performance of 12 urban bus companies in Taipei; and measure productivity changes in those companies over 1997-2003. Results of this study can be used by the company management levels in delivering better and efficient service to the community.

3 - Efficiency measurement for hospitals owned by the Iranian Social Security Organization

Hossein Hajialiafzali, Public Health, Adelaide University, 13/2a Karu Crescent, Mitchell Park, 5043, Adelaide, SA, Australia, hossein.hajialiafzali@student.adelaide.edu.au

Hospital efficiency measurement is becoming recognised as an essential tool for improving management.In the majority of studies, the variables employed have been based only on physical performance This study aims to construct a new model to select the most appropriate variables to measure Iranian hospital efficiency.

4 - Data Envelopment Analysis for Efficiency of Air base Inventory Management

Hong Kyu Han, Dept. of Computer Science and Industrial Systems Engineering, Yonsei University Shichondong 134 Seoul, Korea, 120-749, Seoul, Korea, Republic Of, hkhan@yonsei.ac.kr, *So Young Sohn*

Supply squadrons of ROKAF are making efforts to effectively implement the inventory management by measuring performances. However, associated input factors for each airbase have not been considered. In this paper, DEA is applied in order to give fair evaluation of efficiency of airbase inventory management.

■ RC-24

Thursday, 1:30-3:00pm

Hibiscus I

Business Applications III

Cluster: Business Applications

Contributed session

Chair: *Jae H. Min*, School of Business, Sogang University, #1, Shinsoo-dong, Mapo-ku, 121-742, Seoul, Korea, Republic Of, jaemin@ccs.sogang.ac.kr

1 - A Scoring Method Using Boosting

Hideo Suzuki, Graduate School of Systems and Information Engineering, University of Tsukuba, 1-1-1 Ten-nodai, 305-8573, Tsukuba, Ibaraki, hsuzuki@sk.tsukuba.ac.jp

This research proposes a scoring model for purchase prediction on the basis of boosting. Empirical studies are conducted to examine the effectiveness of the proposed model, compared to conventional models. Moreover, a method for evaluating models and determining the targeting size is shown, which is based on a profit index.

2 - Why Are You Here? A Study of Foreign Investment Success in the U.S. Midwest

Thomas Groleau, Business Administration, Carthage College, 2001 Alford Park Drive, 53140, Kenosha, WI, United States, tgroleau@carthage.edu

While many U.S. firms move abroad in search of lower costs, many foreign firms move in to fill the void left behind. For this study, foreign-owned firms in various Midwestern communities were contact to identify the success factors that brought them to the U.S. and keep them here.

3 - The Application of Management Science in Korean Firms: A Sample Survey

Jae H. Min, School of Business, Sogang University, #1, Shinsoo-dong, Mapo-ku, 121-742, Seoul, Korea, Republic Of, jaemin@ccs.sogang.ac.kr

This paper presents a sample view of the use of management science by Korean companies, which includes frequency of utilization of selected OR/MS techniques, level of their contribution to current work, extent of application, obstacles to implementation, and areas of future contribution. It also indicates the differences among industries.

■ RC-25

Thursday, 1:30-3:00pm

Hibiscus II

ORCEN Impact on the Army

Cluster: Military Applications

Invited session

Chair: *Michael Kwinn*, Operations Research Center, US Military Academy, Department of System Engineering, 10996, West Point, NY, michael.kwinn@usma.edu

Chair: *David Sanders*, 10 country Manor Dr, 22406, Fredericksburg, VA, david.m.sanders@us.army.mil

1 - ORCEN Support of Army Condition Based Maintenance

Michael Kwinn, Operations Research Center, US Military Academy, Department of System Engineering, 10996, West Point, NY, michael.kwinn@usma.edu, *Steve Henderson*

The United States Army's legacy maintenance strategy overlooks how variations in environmental conditions, component stresses, and other exogenous factors effect the lifetime of specific components across the force. Our presentation describes ORCEN efforts to assist the Army in transitioning to a new maintenance strategy that accounts for these factors.

2 - The Support Leader's Digital Asistant (SLDA)

Michael Kwinn, Operations Research Center, US Military Academy, Department of System Engineering, 10996, West Point, NY, michael.kwinn@usma.edu, *Wiley Rittenhouse*

The Support Leader's Digital Assistant (SLDA) is designed to provide support leaders in combat units the means to determine accurate supply forecasts without having to regularly seek outside assistance. It is intended to run as an application on PocketPC devices already in use in the Army.

3 - Creating Requirements for High-Resolution Infantry Simulations

Michael Kwinn, Operations Research Center, US Military Academy, Department of System Engineering, 10996, West Point, NY, michael.kwinn@usma.edu, *Grant Martin*, *Jeffrey Schamburg*

The Army acquisition community requires high-resolution simulations that represent the Infantry soldier and allow differentiation among individual weapons and types of equipment. This presentation focuses on the construction of detailed requirements, scenarios, and required inputs and outputs for modeling and simulation, based strictly on the requirements of the acquisition community.

Thursday, 3:30-5:00pm

■ RD-01

Thursday, 3:30-5:00pm
Honolulu I

Energy and Environmental Modeling II

Cluster: Renewable and Natural Resources
Invited session

Chair: *Steven Gabriel*, Civil & Env. Engin./ Applied Math and
Scientific Computation Program, University of Maryland, 1143
Martin Hall, 20742, College Park, MD, sgabriel@umd.edu

1 - Price Signals and Technology Adoption Decisions

Chao-ning Liao, Economics, National Cheng-Kung
University, No 1 University Road, 701, Tainan, Taiwan,
cnliao@mail.ncku.edu.tw

Sending right price signals can enhance overall efficiency in tradable
permit market. This research further shows when technology adoption
is incorporated as a binary variable, average shadow price derived from
mixed-integer programming problems can be used as a reference to en-
courage firms' investment on new pollution abatement equipment.

2 - Uncertainty Analysis in Energy Policy Modeling - An EPA Example

Elliot Lieberman, Clean Air Markets Division, U.S.
Environmental Protection Agency, 1200 Pennsylvania
Avenue, NW, Mail Code 6204J, 20460, Washington, D.C.,
Afghanistan, lieberman.elliot@epa.gov, *Jaeseung Lee*, *Barry
Galef*

This presentation will describe the analysis under way to quantify un-
certainty in cost projections from several energy models used by the
U.S. Environmental Protection Agency to assess the impact of air emis-
sion policies on the U.S. electric power sector. Methodology, key is-
sues, and preliminary results will be explored.

3 - An Analysis of the European Natural Gas Market Using GASTALE-A Complementarity Model

Steven Gabriel, Civil & Env. Engin./ Applied Math and
Scientific Computation Program, University of Maryland,
1143 Martin Hall, 20742, College Park, MD,
sgabriel@umd.edu, *Ruud Egging*

We present a model of the European natural gas grid based on a im-
perfect competition approach among producers. Other players such as
storage operators are also modeled but from a perfect competition per-
spective. The resulting nonlinear complementarity problem is solved
and the results analyzed.

■ RD-02

Thursday, 3:30-5:00pm
Honolulu II

Scheduling and Timetabling I

Cluster: Scheduling and Timetabling
Contributed session

Chair: *W. C. Ng*, Industrial and Manufacturing Systems
Engineering, The University of Hong Kong, The University of
Hong Kong, Hong Kong, Hong Kong, ngwc@hku.hk

1 - Permutation distance for a new meta-heuristic algorithm

Shintaro Mohri, Faculty of Economics, Kobegakuin
University, 518 Arise Ikawadani Nishi-ku, 6512180, Kobe,
mohri@eb.kobegakuin.ac.jp

Permutation is one of the most popular coding for combinatorial opti-
mization problem. Especially it is useful in some meta-heuristic algo-
rithms. I define the distance between two permutations, and develop
the new meta-heuristic algorithm based on genetic algorithm with per-
mutation distance. We apply our algorithm for TSP and Scheduling
problem.

2 - Parallel machine problem with splitting jobs using genetic algorithms and simulated annealing

Jaime Mora Vargas, Industrial Engineering, Itesm-cem, Carr
Lago de Guadalupe Km 3.5, 52926, Atizapan de Zaragoza,
Estado de Mexico, Mexico, jmora@itesm.mx, *Eduardo
Diaz-Santillan*, *Ivan Roa*

We compare Simulated annealing and Genetic algorithms to find a
schedule that minimize total tardiness for the problem of n independent
jobs on m parallel machines. It is possible to split jobs into lots and to
process each lot on different machine. There are sequence-dependent
set-up times among jobs.

3 - A Genetic Algorithm for Scheduling Container Trucks in Port Container Terminals

W. C. Ng, Industrial and Manufacturing Systems Engineering,
The University of Hong Kong, The University of Hong Kong,
Hong Kong, Hong Kong, ngwc@hku.hk, *Yuxuan Zhang*

This paper studies the container truck scheduling problem with differ-
ent ready times. A mathematical model is developed and a genetic
algorithm using novel crossover scheme is proposed to minimize the
makespan. The results indicate the proposed genetic approach is a sim-
ple but effective means for solving the problem.

■ RD-03

Thursday, 3:30-5:00pm
Honolulu III

Stochastic Models III

Cluster: Stochastic Programming
Contributed session

Chair: *Steven Harrod*, Qaom, University of Cincinnati, 828
Summerville Dr., 40504, Lexington, KY, United States,
harrodss@email.uc.edu

1 - Genetic Algorithm Approach to Stochastic Image Compression Problem

Yasunari Yoshitomi, Environmental Information, Kyoto
Prefectural University, 1-5 Nakaragi-cho Shimogamo
Sakyo-ku Kyoto 606-8522 JAPAN, 606-8522, Kyoto, Kyoto,
Japan, yoshitomi@kpu.ac.jp

We have expanded Genetic Algorithm for stochastic programming. In
this study, we have applied the method to stochastic color image com-
pression problem. The coefficient of Discrete Cosine Transform (DCT)
is treated as the stochastic variable. The good condition for quantiza-
tion of the DCT coefficient is obtained by the present method.

2 - A Bayesian approach to Personnel Ranking

L. Paul Fatti, Statistics & Actuarial Science, University of the Witwatersrand, P.O. Wits, 2050, Johannesburg, South Africa, fatti@stats.wits.ac.za

This paper discusses the use of "forced ranking" of personnel in large organisations such as General Electric. A Bayesian approach is proposed for combining the votes received by an employee into an overall score. Use of this approach for ranking the employees in a large South African corporation is described.

3 - Estimation Of Smoothing Constant In Exponential Smoothing Method Slotted In Moving Average Model And Its Application To Time Series

Mio Morio, 208,1-20-6 Sirasagi-cho, 599-8107, Sakai, Japan, mio715@sakai.zaq.ne.jp, *Kazuhiro Takeyasu*

Focusing that each values of exponential smoothing method do not show same weight in the operation term, new method of estimation of smoothing constant in exponential smoothing method is proposed. We compared this method with ARIMA model. This method is applied to airline industry. Some good results are obtained.

4 - Numerical Methods for Nonstationary Poisson Processes

Steven Harrod, Qaom, University of Cincinnati, 828 Summerville Dr., 40504, Lexington, KY, United States, harrodss@email.uc.edu, *David Kelton*

We discuss three algorithms for the generation of Poisson processes with piecewise linear nonstationary cumulative arrival rates. We test these algorithms in C programs and make comparisons of accuracy, speed, and stability across disparate microprocessor architectures. Optimal choice of algorithm could not be predicted without knowledge of microprocessor architecture.

■ RD-04

Thursday, 3:30-5:00pm
Iolani I

Location Model

Cluster: Location Analysis
Invited session
Chair: *Atsuo Suzuki*, Dept. of Mathematical Sciences, Nanzan University, 27 Seirei-cho, 4890863, Seto, Aichi, atsuo@nanzan-u.ac.jp

1 - An analytical model of time-dependent traffic flow over a network with continuous trip distributions

Ken-ichi Tanaka, Management Science, Tokyo University of Science, 1-3, Kagurazaka, Shinjuku-ku, Tokyo, 223-8522, Japan, ken1@ms.kagu.tus.ac.jp, *Osamu Kurita*

This paper develops a method for deriving time-dependent traffic flow on a network over which endpoints of trips are continuously distributed when a commuters' arrival-time distribution is given. We present some results calculated on simple networks and focus on how arrival-time patterns of commuters influence traffic congestion over the network.

2 - Hub arc location problems in a competitive environment with flow threshold

Mihiro Sasaki, Mathematical Sciences, Nanzan University, 27 Seirei, 489-0863, Seto, Aichi, Japan,

mihiro@ms.nanzan-u.ac.jp, *Mohan Krishnamoorthy*, *Andreas Ernst*

We extend the hub arc location model to incorporate the competitive environment in which rival firms "locate" their services. We consider a case, where two competitors locate their own hub arcs – which translates to the decision on which of their routes should flow be consolidated with larger, fuel-efficient aircraft flying on these "consolidation routes".

3 - The higher-order network Voronoi diagrams and its application to location problems

Takehiro Furuta, Graduate School of Business Administration, Nanzan University, 27 Seirei, 4890863, Seto, Aichi, Japan, d02bb001@nanzan-u.ac.jp, *Keisuke Inakawa*, *Atsuo Suzuki*

We introduce the algorithm of the higher-order network Voronoi diagrams (HNVD). The alogrithm is based on the Dijkstra's algorithm. The program constructs the diagram for the network with effective computational time. We show that the HNVDs are useful by applying it to the real road network.

4 - Locating Multiple Facilities in a Planar Competitive Environment

Atsuo Suzuki, Dept. of Mathematical Sciences, Nanzan University, 27 Seirei-cho, 4890863, Seto, Aichi, atsuo@nanzan-u.ac.jp, *Zvi Drezner*, *Tammy Drezner*

We investigate the location of one or more facilities in an area in which several competing facilities already exist. The attractiveness of each facility is modeled by a utility function and the objective is to attract the most buying power. We employ the Laguerre Voronoi diagram to generate the set of candidate locations and solve the problem.

■ RD-05

Thursday, 3:30-5:00pm
Iolani II

Bilevel and Game-Theoretic Approaches to Dynamic Pricing

Cluster: Dynamic Pricing & Revenue management
Invited session
Chair: *Gilles Savard*, Mathématiques et génie industriel, École Polytechnique, C.P. 6079, Succ. Centre-ville, H3c 3a7, Montréal, Québec, Canada, gilles.savard@polymtl.ca

1 - A bilevel approach for a capacitated network design and tariff setting problem

Luce Brotcorne, Lamih-roi, Universite de Valenciennes, Le Mont Houy, 59313, Valenciennes cedex 9, France, luce.brotcorne@univ-valenciennes.fr, *Patrice Marcotte*, *Gilles Savard*, *Mickael Wiart*

To optimize revenue, service firms must integrate within their pricing policies the reaction of customers to their price schedules as well as the network interactions. We present a bilevel model for the capacitated network design and tariff setting problem. Next, we describe a primal dual algorithm and present numerical results.

2 - Price Competition in Rental Car and Durable Goods Markets

Chris Anderson, University of Western Ontario, Canada, canderson@ivey.uwo.ca, *Mike Moffatt*

Websites such as Expedia have made it near costless for consumers to compare prices across firms. We expand on the existing game theory literature to construct models of price competition in oligopolistic markets. Both one-period and multi-period models of price competition are considered.

3 - Optimal pricing and inventory control: a dynamic revenue management framework

Gilles Savard, Mathématiques et génie industriel, École Polytechnique, C.P. 6079, Succ. Centre-ville, H3c 3a7, Montréal, Québec, Canada, gilles.savard@polymtl.ca, *Jean-Philippe Côté*, *Patrice Marcotte*

With its ability to incorporate detailed behaviour models, bilevel programming is well-suited for modeling Revenue Management issues. We present enhancements to our basic strategic model in order to capture the dynamic aspect found in an operational environment. Examples of optimal pricing and seat allocation decisions from real situation are provided.

■ RD-06

Thursday, 3:30-5:00pm
Iolani III

Quality, Statistics and Reliability

Cluster: Quality, Statistics and Reliability
Contributed session
Chair: *Fausto Pedro Garcia Marquez*, Economia y Empresa, Universidad de Castilla-La Mancha, ETSII, Edificio Politecnica, C/ Camilo Jose Cela, s/n, 13071, Ciudad Real, Ciudad Real, Spain, FaustoPedro.Garcia@uclm.es

1 - Analysis Capability Maturity Model

Robert Covey, The Aerospace Corporation, 15049 Conference Center Drive, CH2-220, 20151-3818, Chantilly, Virginia, United States, robert.w.covey@aero.org, *David Hixon*

Selecting an organization to produce analysis that meeets the needs of decision takers must be based on more than personal predilection. Appraisals against Capability Maturity Models (CMM) have been used in other intellectual endeavors; i.e., software and systems engineering. We report an Analysis CMM for assessment and continuous process development.

2 - Appraising an Analysis Organization Using the Analysis Capability Maturity Model (ACMM)

David Hixon, Nsg, The Aerospace Corporation, 15049 Conference Center Drive, 20151, Chantilly, VA, david.j.hixon@aero.org, *Robert Covey*

The ACMM provides a process framework for operations research or systems analysis organizations that prepare quantitative, quality products for executive decisions regarding the development, acquisition, management, process improvement, and appraisal of products and services. The ACMM was used successfully to appraise an analysis organization. Appraisal process and results are presented.

3 - A Digital Filter Based Approach to the Remote Condition Monitoring

Fausto Pedro Garcia Marquez, Economia y Empresa, Universidad de Castilla-La Mancha, ETSII, Edificio Politecnica, C/ Camilo Jose Cela, s/n, 13071, Ciudad Real, Ciudad Real, Spain, FaustoPedro.Garcia@uclm.es, *Diego José Pedregal Tercero*

The author proposes a Kalman filter (KF) for the linear discrete data filtering problem encountered when using current sensor data in a points condition monitoring system. The reason for applying KF in this study was to increase the reliability of the model presented to the rule based decision mechanism

■ RD-07

Thursday, 3:30-5:00pm
Iolani V

Cutting and Packing II

Cluster: Cutting and Packing
Invited session
Chair: *Jose Fernando Oliveira*, Feup / Inesc, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465, Porto, Portugal, jfo@fe.up.pt
Chair: *Gerhard Waescher*, Fakultät für Wirtschaftswissenschaft, Otto-von-Guericke Universitaet Magdeburg, Postfach 4120, Magdeburg, Germany, gerhard.waescher@ww.uni-magdeburg.de

1 - The Practice of Pallet Loading - Results from an Empirical Investigation

Gerhard Waescher, Fakultät für Wirtschaftswissenschaft, Otto-von-Guericke Universitaet Magdeburg, Postfach 4120, Magdeburg, Germany, gerhard.waescher@ww.uni-magdeburg.de

In practice, pallet loads are often found being far from optimal, creating excessive logistics costs. The author develops a model according to which these inefficiencies can be quantified. For a large real-world data set it is shown what savings can be achieved by using available pallet loading techniques.

2 - New large benchmark instances for the two-dimensional strip packing problem

Hermann Gehring, Dept. of Information Systems, University of Hagen, 58084 Hagen, Hagen, FR Germany, Germany, winf@fernuni-hagen.de, *Andreas Bortfeldt*

This contribution introduces 36 instances for the two-dimensional strip packing problem with 1000 pieces each. Parameters such as the quotient of the container width and the mean item dimension are varied in a systematical way. Results for the 36 instances calculated by a genetic algorithm are also reported.

3 - A robust procedure for obtaining the nofit polygon using Minkowski sums

Julia Bennell, School of Management, University of Southampton, Highfield, So17 1bj, Southampton, Hampshire, United Kingdom, jab2@soton.ac.uk, *Xiang Song*

The nofit polygon is a powerful tool for handling the geometry of nesting problems. A procedure using the mathematical concept of Minkowski sums for calculating the nofit polygon is presented. It

is more efficient and reliable than other Minkowski Sum approaches. Computational experience shows that it is general and accessible.

4 - LocalCompact II - a Neighbourhood Structure for Nesting Problems

A. Miguel Gomes, FEUP / INESC Porto, Rua Dr. Roberto Frias s/n, 4200-465, Porto, Portugal, agomes@fe.up.pt, *Jose Fernando Oliveira*

This talk describes a neighbourhood structure for Nesting Problems. Two types of movements are allowed: the swap movement (pieces exchanging) and the insertion movement (hole filling). Special rules are used to select the adequate type of movement to apply to pieces.

5 - Multiprocessor scheduling via stock cutting

Eugene Zak, TietoEnator Inc., 8343 154th Avenue NE, 98052, Redmond, WA, United States, eugene.zak@tietoenator.com

A new method for solving a multiprocessor scheduling problem (MPSP) exploits the problem "proximity" to a cutting stock problem (CSP). An iterative adjustment of the CSP results in coincidence between a stock size and the minimal processor make-span, thus effectively conveying the CSP inherent column generation power to the MPSP.

■ RD-08

Thursday, 3:30-5:00pm
Iolani VI

Supply Chain Management IV

Cluster: Supply Chain Management
Contributed session
Chair: *Chang Sup Sung*, Industrial Engineering, Korea Institute of Science & Technology, 373-1 Kusong-dong, Yusong-Ku, 305-701, Daejon, cssung@kaist.ac.kr

1 - Pricing and ordering policies of a retailer facing price dependent stochastic demand in newsvendor framework under different risk preferences

Gopalan Srinivasan, Faculty Of Administration, University Of New Brunswick, P.o. Box 4400, E3b5a3, Fredericton, new brunswick, srini@unb.ca, *Francisco Arcelus*, *Satyendra Kumar*

This paper evaluates the pricing and ordering policies of risk-neutral, risk-averse and risk-seeking retailers facing price-dependent stochastic demand in a newsvendor framework. Optimal pricing and ordering policies are obtained for different demand functions and error structures and performance measures such as expected profit and service level are evaluated across models.

2 - The Impacts of By-products for Optimal Supply Chain Design

Roar Grønhaug, Norwegian University of Science and Technology, Trondheim, Norway, roar.gronhaug@iot.ntnu.no, *Marielle Christiansen*

The metal producers' profits are squeezed to an extreme. To help a major actor manage this challenge, we developed a strategic MIP-model. The key decisions are future plant structure and the production portfolio at each plant. Here we focus on how the by-product production affect the optimal supply chain design.

3 - An integrated periodic review inventory model for a fixed-life perishable commodity in an (M:N) supply chain

Chang Sup Sung, Industrial Engineering, Korea Institute of Science & Technology, 373-1 Kusong-dong, Yusong-Ku, 305-701, Daejon, cssung@kaist.ac.kr, *Sukun Park*

This paper considers an integrated (M:N) distribution system for a fixed-lifetime perishable commodity. For the proposed system, a periodic review inventory model is considered at the warehouses and retailers where demands arrive in a stationary Poisson process. The objective is to maximize total expected profit of the whole supply chain.

■ RD-11

Thursday, 3:30-5:00pm
Tapa Ballroom II

Combinatorial Optimization II

Cluster: Combinatorial Optimization
Invited session
Chair: *Satoru Fujishige*, Research Institute for Mathematical Sciences, Kyoto University, Sakyo-ku, 606-8502, Kyoto, fujishig@kurims.kyoto-u.ac.jp

1 - On the limits of reduction in population disparity of the single-seat constituency in Japan

Keisuke Hotta, Department of Business and Information, Bunkyo University, 1100 Namegaya, 253-8550, Chigasaki, Kanagawa, Japan, khotta@shonan.bunkyo.ac.jp, *Toshio Nemoto*

For the single-seat constituencies in Japan, we show that the limit of reduction in the disparity ratio is 1 to 1.750 under the present election law. Furthermore, even if the principle of population proportional apportionment is sacrificed, the ratio is reduced only to 1 to 1.722.

2 - On the Minimum Vertex Ranking Spanning Tree Problem

Shigeru Masuyama, Toyohashi University of Technology, Toyohashi City, Japan, masuyama@tutkie.tut.ac.jp

The minimum vertex ranking spanning tree problem is to find a labeling of vertices where the maximum label is minimum among labelings satisfying that any path between two vertices with the same label has a vertex with a greater label. Its NP-completeness proof and polynomially solvable cases are introduced.

3 - Polynomial-time algorithms on unit disk graphs in small field

Atsushi Hashimoto, Kyoto University, Kyoto, Japan, hashimoto@lab2.kuis.kyoto-u.ac.jp, *Hiro Ito*

Many NP-hard problems remain NP-hard even if it is restricted on unit disk graphs. On the other hand, some applications treat unit disk graphs bounded in very small fields only. We show many of these problems can be solved in polynomial-time in such a restriction.

4 - SDP Approximations for a HAT Optimization in Sports Scheduling

Tomomi Matsui, Department of Mathematical Informatics, Graduate School of Information Science and Technology, University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, 113-8656, Tokyo, Japan, tomomi@mist.i.u-tokyo.ac.jp, *Ayami Suzuka*, *Akiko Yoshise*, *Ryuhei Miyashiro*

We consider an Optimal Home-Away-Table problem which is a sub-problem of the traveling tournament problem and given as follows: For a given schedule of round-robin tournament , find a home-away assignment which minimizes the total traveling distance. We formulate the problem as a MIN-RES-CUT problem and give its SDP approximation.

■ RD-12

Thursday, 3:30-5:00pm

Tapa Ballroom III

Iterative Variation & Selection Methods and Rapid Branch & Bound (R-B&B) for transportation problems

Cluster: Transportation

Invited session

Chair: *Andreas Reinholz*, Computer Science, University Dortmund, Josef von Fraunhofer 20, 44227, Dortmund, andreas.reinholz@gmx.de

1 - Iterative Variation & Selection Methods and Rapid Branch & Bound (R-B&B) for transportation problems

Andreas Reinholz, Computer Science, University Dortmund, Josef von Fraunhofer 20, 44227, Dortmund, andreas.reinholz@gmx.de

We present a standardized procedure that uses the same variation operators for Neighborhood Search, Iterated Local Search (ILS), Variable Neighborhood Search (VNS), Hybrid Evolutionary Algorithms and Rapid Branch & Bound (R-B&B) techniques. This standardized procedure has been successfully applied to several Vehicle Routing Problems, Quadratic Assignment Problems and Location-Allocation Problems.

2 - Hybrid Evolutionary Algorithms, Recursive Iterated Local Search (R-ILS) and Rapid Branch & Bound (R-B&B) techniques for the Quadratic Assignment Problem (QAP)

Andreas Reinholz, Computer Science, University Dortmund, Josef von Fraunhofer 20, 44227, Dortmund, andreas.reinholz@gmx.de

Many important transportation problems can be modeled as extensions of the Quadratic Assignment Problem (QAP). This talk presents Hybrid Evolutionary Algorithms, Recursive Iterated Local Search (R-ILS) and Rapid Branch & Bound (R-B&B) techniques for the QAP. Promising experimental results are given for the mainstream benchmarks of the QAP.

3 - Performance evaluation of different methods for the p-hub problem

Hilmar Heinrichmeyer, Transportation Logistics, Fraunhofer-Institute Material Flow and Logistics,

Joseph-von-Fraunhofer-Str. 2-4, 44227, Dortmund, Germany, hmeyer@iml.fhg.de

The optimization task of finding the optimal number and location of hubs and the allocation of depots to these hubs was examined on large real world parcel networks with Neighborhood Search and Evolutionary Algorithms. The efficiency of these methods and optimized parameter configurations were determined in an empirical investigation.

4 - An iterated local search algorithm for the vehicle routing of express delivery services

Hans-Werner Graf, Wirtschaftsinformatik, Business and Information Technology School, Reiterweg 26b, 58636, Iserlohn, Germany, Hans-Werner.Graf@spectral-logistik.de

The vehicle routing problem for the delivery operation of express delivery services has some special properties including time window constraints and depot stopover. An iterated local search algorithm motivated by the ruin and recreate principle was implemented for this problem and examined on a large real world parcel network.

■ RD-13

Thursday, 3:30-5:00pm

Sea Pearl I

Statistical Issues in Simulation Optimization

Cluster: Simulation

Invited session

Chair: *Jeff Hong*, Hkust, Kowloon, Hong Kong, hongl@ust.hk

1 - Application of Simulation Optimization Methodology for Supply Chain Sourcing Using Multi-Objective GAs

Jeff Joines, Textile Engineering, Chemistry, and Science, North Carolina State University, College of Textiles, Campus Box 8301, 27695, Raleigh, NC, jeffjoines@ncsu.edu, *Rusty King*, *Ali Gocke*

A critical decision companies are faced with on a regular basis is the ordering of products and/or raw materials. This paper addresses optimizing sourcing decisions within a supply chain to determine robust solutions utilizing an existing supply chain simulator and a genetic algorithm optimization methodology on real industrial case.

2 - Forward-inverse Simulation Metamodels for Simulation-based Design

Russell Barton, Smeal College of Business, The Pennsylvania State University, 801 Business Administration Building, 16802, University Park, PA, United States, rbarton@psu.edu, *Martin Meckesheimer*

Metamodels provide estimates of simulation output as a function of design parameters. On would like to map system performance requirements to design parameters via an inverse model. Inverse metamodels can be fitted 'for free.' This paper examines experiment design construction strategies for simultaneously fitting of forward and inverse approximation models.

3 - Revised COMPASS for Discrete Optimization via Simulation

Jeff Hong, Hkust, Kowloon, Hong Kong, hongl@ust.hk, *Barry L. Nelson*

COMPASS is an efficient algorithm to solve practical discrete optimization-via-simulation problems. We further improve COMPASS

by using a more flexible and less restrictive rule to allocate simulation observations. We show that the resulting algorithm, called the revised COMPASS algorithm, converges almost surely and satisfies a central limit theorem.

■ RD-14

Thursday, 3:30-5:00pm
Sea Pearl II

Optimization Tools Present and Future

Cluster: Computational Software Development
Invited session

Chair: *Michael Saunders*, Management Science and Engineering, Stanford University, Terman Engineering Building, 94303-4026, Stanford, CA, saunders@stanford.edu

1 - A Distributed Algorithm for Sensor Localization

Holly Jin, Dept of Management Sci & Eng, Stanford University, Terman Engineering Centre, 94305, Stanford, CA, United States, hollyjin@stanford.edu, *Michael Carter*, *Michael Saunders*

A distributed algorithm is proposed to localize sensors in networks of arbitrary size. The full sensor network is divided into clusters. Each cluster elects a cluster head that is responsible for localizing all sensors within the cluster. The authors' solver SpaseLoc is applied in parallel to the clusters.

2 - Disciplined Convex Programming

Michael Grant, Electrical Engineering, Stanford University, 1025 Windsor Drive, 94025, Menlo Park, CA, United States, mcg@algorithmguy.com, *Stephen Boyd*, *Yinyu Ye*

We present a modeling methodology and software for specifying, analyzing, and solving convex programs. The methodology imposes simple conventions which do not limit generality, but allows the solution process to be fully automated. Even nondifferentiable problems are supported without loss of performance.

3 - LUSOL: A basis package for constrained optimization

Michael Saunders, Management Science and Engineering, Stanford University, Terman Engineering Building, 94303-4026, Stanford, CA, saunders@stanford.edu, *Michael O'Sullivan*

LUSOL is currently the BFP (basis factorization package) for several optimization packages, including MINOS, SNOPT, PATH, and lp_solve. Threshold Rook Pivoting is an important feature for basis repair (recovery from unexpected singularity). We review the open source Fortran and C implementations of LUSOL.

■ RD-16

Thursday, 3:30-5:00pm
Sea Pearl IV

Coalition and Alliance Formation II

Cluster: Game Theory
Invited session

Chair: *Agnieszka Rusinowska*, Nijmegen School of Management, Radboud University Nijmegen, P.O. Box 9108, 6500 Hk, Nijmegen, Netherlands, a.rusinowska@fm.ru.nl
Chair: *Jose Zarzuelo*, Applied Economics IV, Upv/ehu, F. CC. Economicas, Lehendakari Aguirre, 83, 48015, Bilbao, elpzazaj@bs.ehu.es

1 - Static vs. Dynamic Cartel Formation

Norma Olaizola, University of the Basque Country, Lehendakari Agirre 83, 48015, Bilbao, etpolorn@bs.ehu.es, *Jeroen Kuipers*

We study the endogenous formation of cartels in two contexts. First, we consider internal-external stability based models. Second, we introduce the dynamic aspect of coalition formation. That is, when considering a cartel we take into account also any other cartel that can be reached through a succession of moves.

2 - Strategic bargaining in cost allocation problems

Josune Albizuri, Applied Economics IV, Upv/ehu, Fac. Economics, Lehendakari Aguirre, 83, 48015, Bilbao, Spain, elpalirm@bs.ehu.es, *Jose Zarzuelo*

We study the problem of how to allocate the total cost in a production process of a single homogeneous good jointly shared by a group of agents. We construct a non cooperative game whose unique subgame perfect equilibrium are coalition-proof Nash equilibria and corresponds to the serial cost-sharing rule.

3 - Consistency in coalitional bargaining games

Jose Zarzuelo, Applied Economics IV, Upv/ehu, F. CC. Economicas, Lehendakari Aguirre, 83, 48015, Bilbao, elpzazaj@bs.ehu.es, *Eulalia Romero*

We introduce two modifications of the property of consistency proposed by Hart and Mas-Colell (1989). With the first one we characterize the Harsanyi solution and the Egalitarian solutions on NTU games. While the second characterizes the Shapley NTU solution and the Egalitarian solutions also.

■ RD-17

Thursday, 3:30-5:00pm
Sea Pearl V

Methodology Issues in MCDA

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *Cathal Brugha*, Management Information Systems, University College Dublin, Quinn School of Business, Belfield, 4, Dublin 4, Ireland, Cathal.Brugha@ucd.ie

1 - Habitual Domain and Fuzziness in Multiple Criteria Decision Making

Yen-Chu Chen, Dept. of Information Management, Hsiuping Institute of Technology, No.11, Gongye Road, Dali City,

412-80, Taichung County, Taiwan, yenchuchen@gmail.com, *Po-Lung Yu*

In this article, we will use the concepts and tools of Habitual Domains Theory to help clarify the fuzziness in MCDM and show how we can use contingency plans to cope with fuzziness in MCDM. The concepts of Competence Set will also be introduced to handle problems with fuzziness in MCDM.

2 - Systemic planning and multi-criteria decision analysis: Towards a tetra-logical approach to planning and assessment

Steen Leleur, Centre for Traffic and Transport, Technical Univ. of Denmark, Building 115, Ctt - Dtu, Dk-2800, Lyngby, Denmark, sl@ctt.dtu.dk

This paper presents systemic planning (SP) with emphasis on multi-criteria decision analysis (MCDA). Specifically, SP is presented as a "tetra-logical" methodology approach including MCDA. By using the Danish-Swedish Øresund Fixed Link as application case it is shown how decision support for major, long-range investment decisions can be improved.

3 - Using MCDM to deal with the time value of money

Cathal Brugha, Management Information Systems, University College Dublin, Quinn School of Business, Belfield, 4, Dublin 4, Ireland, Cathal.Brugha@ucd.ie

We consider difficulties with the traditional "time value of money" approach to synthesise different streams of costs and benefits over time into a present "value" when applied to areas such as environmental planning where long-term horizons makes discounted approaches unusable. We show how multicriteria relative measurement can resolve these problems

■ **RD-21**

Thursday, 3:30-5:00pm
Lehua Suite

Queues and Related Models

Cluster: Applied Probability
Invited session

Chair: *Hsing Paul Luh*, Dept. of Mathematical Sciences, National Chengchi University, Taipei, Taiwan, slu@nccu.edu.tw

1 - Models For Design And Control Of Single Buffer Computer And Communication Systems

Thomas Lee, Information and Decision Sciences (M/C 294), University of Illinois, 601 S. Morgan Street, 60607-7124, Chicago, ILLINOIS, yslee@uic.edu

Models and analytical techniques are developed to evaluate the performance of computer and communication systems using a single buffer multiple queues system. Special cases of our model includes server with mixed multiple and single vacations, stopping server with alternating vacation and idle time. Performance measures of the system are computed.

2 - Response time of the demand in a fork-join inventory queue

Kuo-Hwa Chang, Department of Industrial Engineering, Chung Yuan Christian University, 200, Chung Pei Rd., 320,

Chung-Li, Taiwan, Taiwan, kuohwa@cycu.edu.tw, *Huifen Chen*

We analyze the response time of the demand in an inventory queue with base-stock, in which the service station is a fork-join assembly system. We define the Lindley's equation for the waiting time in a fork-join queue and investigate its relation with the response time.

3 - Optimal Control of the N Policy M/G/1 Queueing System with Server Breakdowns and General Startup Times

Kuo-Hsiung Wang, Department of Applied Mathematics, National Chung-Hsing University, Department of Applied Mathematics, National Chung-Hsing University, 402, Taichung, Taiwan, khwang@amath.nchu.edu.tw

We study the N policy M/G/1 queue whose arrivals form a Poisson process, service and startup times are generally distributed. When the queue length reaches N, the server needs startup time before providing service. We develop the total expected cost to determine the optimal policy N at minimum cost.

4 - Analytics of RED Queueing Model

Hsing Paul Luh, Dept. of Mathematical Sciences, National Chengchi University, Taipei, Taiwan, slu@nccu.edu.tw, *Hong-Qi Xu*

Among active queue management schemes on internet congestion control, RED(Random Early Detection) queue is one of the most attractive models. The parameter setting of RED queue is still an open issue. With its adjustable parameters, we make some justification of the original RED model to achieve greater network management performance.

■ **RD-22**

Thursday, 3:30-5:00pm
Kahili I

DEA10: Applications in DEA VI

Cluster: Data Envelopment Analysis and Performance Management
Invited session

Chair: *Taraneh Sowlati*, Wood Science, University of British Columbia, 2931-2424 Main Mall, V6t1z4, Vancouver, BC, Canada, taraneh.sowlati@ubc.ca

1 - Measuring Efficiency and Productive Performance of Colleges at the University of Santo Tomas

Babeth Isa Fernando, Graduate School, University of Santo Tomas, Espana, Manila, Philippines, 1015, Manila, Philippines, bsfernando@mnl.ust.edu.com.ph, *Emilyn Cabanda*

The paper estimates relative efficiency and productive performance of 13 Colleges of the University of Santo Tomas from 1998-2003. Three input-three output DEA multi-stage and Malmquist models are employed to calculate overall performance. Empirical findings show that lack of technological innovation pulled down the productivity level despite their efficient performance.

2 - A DEA Based DSS tool for Community Water Systems

J. W. Rogers, Systems Engineering, University of Virginia, 151 Engineers Way, Olsson Hall, 22903, Charlottesville, VA, United States, jwr9f@virginia.edu

The goal of this study is to improve the accountability of CWS to their stakeholders. The objective of this study is to develop a DEA based DSS tool that facilitates effective financial resource allocation decisions among CWS through a comparative efficiency analysis technique.

3 - Performance Analysis of Philippine Electric Cooperatives: An Application of DEA-Malmquist Model

Ramon Posadas, Graduate School, University of Santo Tomas, UST Graduate School, España St., Manila, Philippines, 1008, Manila, Philippines, luelco_apo@yahoo.com, *Emilyn Cabanda*

This paper analyzes the relative performance of 117 electric cooperatives (ECs) in the Philippines 1999-2003, classified into size and regional groupings. Based on DEA-Malmquist model, TFP is attributed much by innovations. A new robust result suggests that productive performance of ECs is related to alternative measurements of size.

4 - Model for Evaluation of Educational Organizations Management Performance under the prisms of the efficiency, efficacy, effectiveness and relevance criteria

Maria Gorete Brotti, Reitoria, Universidade Estadual do Oeste do Paraná (UNIOESTE), Rua Universitária, 1619 - Jardim Universitário - Cx. P. 701, 85819-110, Cascavel, Paraná, Brazil, goretebrotti@hotmail.com, *Jair dos Santos Lapa*

How can we evaluate the management performance of educational organizations taking into account the efficiency, efficacy, effectiveness and relevance criteria, simultaneously, was studied. It is shown that this management performance can be evaluated through a performance frontier built on the application of a data envelopment analysis model.

■ RD-23

Thursday, 3:30-5:00pm

Kahili II

Data Envelopment Analysis II

Cluster: Data Envelopment Analysis

Contributed session

Chair: *Hiroshi Morita*, Department of Information and Physical Sciences, Osaka University, 2-1 Yadama-oka, 5650871, Suita, Japan, morita@ist.osaka-u.ac.jp

1 - A Variable Benchmark Approach for the Two-Group Discriminant Problem

Yi Chun Kuo, Business Administration, National Central University, No.300, Jhongda Rd, Jhongli City, Taoyuan,, Taiwan 320, R.O.C., 320, Jhongli, Taiwan, chun@msa.vnu.edu.tw, *Dong Shang Chang*

The basic idea is inspired that observations belonging to the same group should have the same production possibility set and be dominated by the same frontier. The merit of proposed approach is that the discriminant functions are formed by the benchmarks without the need to specify the classification function form.

2 - A comparison of DEA and the stochastic frontier model using Panel Data

John Ruggiero, Economics and Finance, University of Dayton, 517 Miriam Hall, 45469-2251, Dayton, Ohio, ruggiero@notes.udayton.edu

DEA and the stochastic frontier model, two approaches for measuring performance, fail to disentangle efficiency and measurement error in cross-sectional models. The performance of the stochastic frontier model improves dramatically in panel data settings. In this paper, I will compare DEA and the stochastic frontier approaches using panel data.

3 - Efficiency in Analysis of Variance

Hiroshi Morita, Department of Information and Physical Sciences, Osaka University, 2-1 Yadama-oka, 5650871, Suita, Japan, morita@ist.osaka-u.ac.jp

We consider the inefficiency identification in analysis of variance to improve the accuracy of estimation, where the disturbance term is decomposed to normally distributed error term and subjective inefficiency term. We use the manner of stochastic frontier estimation and derive the sophisticated estimators of effect and variance.

4 - Efficiency Evaluation of Information Technology Investments Using Two-stage Data Envelopment Analysis

Jungnam An, Mis, Seoul National University, seoul national university SK building # 512, 607, Seoul, Korea, Republic Of, jnan1@snu.ac.kr, *Sangkyu Rho*

DEA models that identify efficient frontiers of a two-stage production process linked by intermediate variables have been developed. We extend this production process DEA model to include input and output slacks to evaluate the effect of IT investments on the performance of a firm.

■ RD-24

Thursday, 3:30-5:00pm

Hibiscus I

E-Business

Cluster: Business Applications

Contributed session

Chair: *Mirjana Prokic*, Bussines Information Systems, The Faculty Of Economics, 9-11 Segedinski Street, 24000, Subotica, prokicm@eccf.su.ac.yu

1 - A Strategic Royal Marketing Model on e-business-as a new generation marketing model

Takeshi Makino, Web Business Technology, The Kyoto College of Graduate Studies for informatic, 7, Tanaka Monzen-cho, Sakyo-ku, 606-8225, Kyoto, Japan, m04w0024@m1.kcg.edu, *Ryan Chiu*, *Takao Nakaguchi*, *Adachi Ryota*, *Hong Seung Ko*

In use e-business marketing strategies haven't be able to catch customers due to customers easily move one web site to other site within one click. Our Royal Marketing model is the resolution which overcomes e-business marketing difficulty. Driving firms loyal to their customers furthermore provide firms with long term profit.

2 - Analysis of Sense and Respond Supply Chain Stability

Bala Ramachandran, IBM Research, Route 134, Kitchawan Road, 10598, Yorktown Heights, NY, United States, rbala@us.ibm.com, *Karthik Sourirajan*, *Lianjun An*

Sense and Respond supply chains use real time information to update strategic and operational policies, managing execution based on context, not according to a preset plan. In this paper, we analyze the bullwhip effect and stability in supply chains using different control theory based policies.

3 - Mobile Services for Small and Medium Enterprises

Mirjana Prokic, Bussines Information Systems, The Faculty Of Economics, 9-11 Segedinski Street, 24000, Subotica, prokicm@eccf.su.ac.yu, *Sasa Bosnjak*

The mobility in SMEs sector is necessity. Based on this fact we developed a full transaction oriented mobile services with a particular focus on GPRS, and including a potential impact of mobile services to growth of SMEs sector. In this article we also describe the framework for our m-commerce solution.

■ RD-25

Thursday, 3:30-5:00pm

Hibiscus II

Critical Organizational Assessment

Cluster: Military Applications

Invited session

Chair: *William Klimack*, Department of Systems Engineering, US Military Academy, Mahan Hall, 10996, West Point, NY, United States, william.klimack@us.army.mil

1 - Effects Based Assessment Support System (EBASS)

Michael Kwinn, Operations Research Center, US Military Academy, Department of System Engineering, 10996, West Point, NY, michael.kwinn@usma.edu, *Thomas Morel*

The Effects Based Assessment Support System (EBASS) is a distributed operational assessment tool based on the principles of Value Focused Thinking (VFT) developed jointly by the ORCEN and the ITOC at the US Military Academy. Its genesis is work done in support of the military command in Afghanistan in 2002.

2 - Multiobjective Decision Analysis in Designing Organizations

Gregory Parnell, Systems Engineering, United States Military Academy, Mahan 432, 10996, West Point, NY, gregory.parnell@usma.edu, *Timothy Trainor*

This study used a decision analysis approach to evaluate the current structure of the US Army's Installation Management Agency, and provided recommendations for potential alternative structures. To compare organizational design alternatives, the study team developed a quantitative analysis model using the organization functions as the foundation for the evaluation.

3 - Army BRAC 2005 Implementation

Gregory Parnell, Systems Engineering, United States Military Academy, Mahan 432, 10996, West Point, NY, gregory.parnell@usma.edu, *John Harris*

The Army has implemented four Base Realignment and Closure (BRAC) rounds. The purpose of BRAC 2005 is to save dollars by reducing excess capacity. This research focused on complexity of BRAC implementation. We interviewed stakeholders, analyzed the historical data, and developed a decision tool to assess installation complexity.

4 - Military Base Realignment: The Case of Combined Service Force in Taiwan

Shinn Sun, Department of Business Administration, Chung-Kuo Institute of Technology, No 56, Section 3, Hsing-Lung Road, 116, Taipei, Taiwan, shinn.sun@msa.hinet.net

The purpose of this study is two-fold: (1) to develop appropriate organizational structures for regional logistics units in Combined Service Force (CSF), Taiwan; (2) to establish appropriate manpower for logistics units in CSF. Results of this study can be used by CSF to realign its logistics support units.

Friday, 9:00-10:30am

■ FA-01

Friday, 9:00-10:30am
Honolulu I

Applications in Mining

Cluster: Renewable and Natural Resources
Invited session

Chair: *Alexandra Newman*, Division of Economics and Business, Colorado School of Mines, 1500 Illinois Street, 80401, Golden, CO, United States, newman@mines.edu

1 - Models for underground and open pit copper mining

Rafael Epstein, Industrial Engineering, University of Chile, Santiago, Chile, repstein@dii.uchile.cl, *Andrés Weintraub*

We present large-scale models to determine long-range extraction decisions and infrastructure investments for open pit and underground copper mines in Chile. The models, presently in use by CODELCO, the largest copper producer in the world, have yielded significant improvements in the value of the mines.

2 - Network Modeling for Underground Mines

Doreen Thomas, Department of Electrical and Electronic Engineering, University of Melbourne, Melbourne, Victoria, Australia, d.thomas@ee.unimelb.edu.au

The dominant working structure of an underground mine is a set of interconnected tunnels which provides access and haulage of ore from ore zones to the mill. This set of interconnected tunnels forms a network. We describe variations of a basic network model that are helpful in reducing mining costs.

3 - Integrating Long- and Short-term Production Scheduling at an Underground Mine

Michael Martinez, Division of Economics and Business, Colorado School of Mines, Golden, CO, United States, micmarti@mines.edu, *Alexandra Newman*, *Mark Kuchta*

LKAB's underground mine in Kiruna, Sweden uses integer programming to plan its long-term ore extraction sequence. We present an updated optimization model that combines short- and long- term decisions, and give both computational results and implementation insights.

4 - Optimizing Feeder Movements at an Open Pit Mine

Alexandra Newman, Division of Economics and Business, Colorado School of Mines, 1500 Illinois Street, 80401, Golden, CO, United States, newman@mines.edu

Sand and gravel (aggregate) is extracted from an open pit site with front-end loaders and hauled to a feeder, which releases the aggregate onto a conveyor belt connected to a processing plant. We present a method for determining when the feeder should be moved closer to the current extraction location.

■ FA-02

Friday, 9:00-10:30am
Honolulu II

Scheduling and Timetabling II

Cluster: Scheduling and Timetabling
Contributed session

Chair: *Guillermo Duran*, Ingenieria Industrial, University of Chile, Republica 701, 1000, Santiago, gduran@dii.uchile.cl

1 - Integrating An Artificial Neural Network Model With The Optimal Scheduling Model: Application To A Commercial Shrimp Farm

Run Yu, Department of Economics, Department of Molecular Biosciences and Bioengineering, University of Hawaii at Manoa, 3050 Maile Way, Gilmore 111, 96822, Honolulu, HI, United States, run@hawaii.edu, *PingSun Leung*

This study integrates an artificial neural network model for predicating shrimp growth with the optimal scheduling model for a multi-cycle and multi-pond shrimp operation. Applying this model to a commercial shrimp farm in Hawaii demonstrates that it can help increase shrimp production when compared to the existing schedule.

2 - Summer Scheduling at the United States Air Force Academy

John Dulin, Dept of Management, US Air Force Academy, 2354 Fairchild Dr, Ste 6H-130, 80840, US Air Force Academy, CO, United States, john.dulin@usafa.af.mil, *Jeffery Hendricks*, *Andrew Armacost*

This paper proposes a model to create the US Air Force Academy's cadet summer schedules. Existing algorithms correctly schedule only 40% of 3000 students to 50 summer programs in three time periods, with the remainder scheduled by hand. Our model assigns all cadets to feasible schedules while optimizing cadet preferences.

3 - Scheduling the Chilean Soccer League using Integer Programming

Guillermo Duran, Ingenieria Industrial, University of Chile, Republica 701, 1000, Santiago, gduran@dii.uchile.cl, *Andrés Weintraub*, *Sebastián Souyris*

We present an IP model that was used to schedule the 2005 Chilean Soccer League. Both economic and sporting constraints are considered to make the tournament more interesting and equitable. Our proposal has replaced this year the old scheduling which was made by manual methods.

■ FA-03

Friday, 9:00-10:30am
Honolulu III

Integer Programming I

Cluster: Integer Programming
Contributed session

Chair: *Marija Cileg*, Quantitative methods in economy, Faculty of Economics, Segedinski put 9-11, 24000, Subotica, Serbia, Serbia and Montenegro, macileg@yahoo.com

1 - A Dynamic Programming Approach to the Multiple-Choice Multi-Period Knapsack Problem

Edward Y.H. Lin, Department of Business Management, National Taipei University of Technology, 1, Sec. 3, Chung-Hsiao East Road, 106, Taipei, line@ntut.edu.tw

Multiple-choice multi-period knapsack problem has been studied in recent literature. Unlike the previously proposed solution approaches based mainly on integer programming, we present a dynamic programming approach associated with a computer code using IBM's APL2 that can conduct the recursive calculation to locate the true optimum and alternate optima, if exist.

2 - Polyhedral analysis of a production model with fixed costs

Gilles Fasbender, Isro, Université Libre de Bruxelles, bd. du Triomphe, CP 210/01, 1050, Brussels, Belgium, gfasbend@ulb.ac.be, *Martine Labbé*, *Yves Pochet*

We study, from a polyhedral point of view, a production model where the demands for different product types have to be satisfied. Production is done using different production modes; each one induces a fixed cost and a variable cost depending on the produced quantity.

3 - A branch-and-bound algorithm based on column ranking

Eugene Zak, TietoEnator Inc., 8343 154th Avenue NE, 98052, Redmond, WA, United States, eugene.zak@tietoenator.com

A special branch-and-bound algorithm, that solves a knapsack problem, is generalized for tackling a broader class of integer programs. The algorithm elaborates on the idea of a preliminary column ranking for effective enumeration of feasible solutions during the best-first search with backtracking. The algorithm competes successfully with the conventional branch-and-bound method.

4 - Integer Programming and Intervals of Validity of Dual Prices

Marija Cileg, Quantitative methods in economy, Faculty of Economics, Segedinski put 9-11, 24000, Subotica, Serbia, Serbia and Montenegro, macileg@yahoo.com, *Tibor Kis*

This paper deals with the determination of interval of validity of dual prices of LP and integer programming models, and with the possible changes of these values in the function of the type of the condition and resource shortcomings. At the end we give appropriate algorithm and economic interpretation.

■ FA-04

Friday, 9:00-10:30am
Iolani I

Location Analysis I

Cluster: Location Analysis
Invited session

Chair: *Oded Berman*, Rotman School of Management, University of Toronto, 105 St. George Street, L4j 3b7, Toronto, ON, Canada, berman@rotman.utoronto.ca

1 - A Modeling Framework for Facility Location of Medical Services for Large-Scale Emergencies

Fernando Ordonez, Industrial and Systems Engineering, University of Southern California, 3715 McClintock Ave, Ger

240, 90089, Los Angeles, CA, United States, fordon@usc.edu, *Hongzhong Jia*, *Maged Dessouky*

We present a survey of facility location problems and discuss their applicability to large-scale emergencies. We propose a general facility location model for large-scale emergencies that includes requirements of quantity and quality of coverage. This model, which can be a covering, P-median, or P-center problem, is illustrated with a few examples.

2 - Locating Large Radiological Databases

Mark Daskin, Dept. of IE/MS, Northwestern University, 2145 Sheridan Road, Dept. of IE/MS, Northwestern U., 60208, Evanston, IL, United States, m-daskin@northwestern.edu, *Marisa Ruffolo*

Within a few years, 100,000 petabytes of radiological data will need to be stored globally. Radiologists want to retrieve digital images quickly. We formulate and solve models that identify the location and number of copies of the images that should be stored to facilitate the required download times.

3 - Districting Problem of Response Areas for Facilities of Emergency Vehicles

Keisuke Inakawa, Dept. of Mathematical Sciences, Nanzan University, 27 Seirei-cho, 4890863, Seto, Aichi, Japan, d02bb002@seto.nanzan-u.ac.jp, *Atsuo Suzuki*

This paper considers a districting problem of response areas for emergency vehicles. In this model, demands occur in Poisson manners, and they are served by the nearest available emergency vehicle. We construct a continuous-time Markov chain model and apply it to the problem to minimize the expected response time.

4 - Strategic Decisions in Congested Networks

Opher Baron, Operations Management, University of Toronto, Rotman School of Management, M5s 3e6, Toronto, Ontario, Canada, opher.baron@rotman.utoronto.ca, *Oded Berman*, *Dmitry Krass*

A novel approach to making decisions on number, location and capacities of facilities is presented. Facilities are modeled as single server queues where arrival of calls and service times are general. The objective is to minimize the cost of opening facilities and allocating capacity subject to coverage, closest assignments and service level constraints. We show how the overall problem can be decomposed into separate sub-problems

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■ FA-05

Friday, 9:00-10:30am
Iolani II

Applications of Revenue Management in Automotive Related Businesses

Cluster: Dynamic Pricing & Revenue management
Invited session

Chair: *Jorge Silva-Risso*, Power Information Network, LLC, 2625 Townsgate Road, 91361, Westlake Village, California, jorge.silva-risso@powerinfonet.com

Chair: *Kuang Wei*, Ford Motor Company, New York, NY, United States, kwei@ford.com

1 - Developing Regional Promotional Programs in the Automotive Industry Based on Transaction Data

Jorge Silva-Risso, Power Information Network, LLC, 2625 Townsgate Road, 91361, Westlake Village, California, jorge.silva-risso@powerinfonet.com

We operationalize several variables that affect the decision to acquire a car using sales transaction data and incorporate them into a heterogenous multinomial logit model of automobile choice using Hierarchical Bayesian methods. Using data from 1999-2000 we show how the model can be used for promotional planning in the automobile market

2 - Pricing Optimization in the Automotive Finance Industry

Sean Geraghty, Khimetrics, 85251, Scottsdale, Arizona, United States, SGeraghty@khimetrics.com, *Thomas Qi*

Conventional pricing models of auto financing add required spreads on top of costs to achieve required returns on investment. We present a demand-based pricing optimization approach where demand-price relationship and costs are jointly considered. We further demonstrate that demand-based pricing decisions improve returns on investment by about 0.10%.

3 - An Experimental Study of Lease Contracts in Durable Goods Markets

Kay-Yut Chen, Decision Technology Department, Hewlett-Packard Laboratories, MS1141, HP Labs, 1501 Page Mill Road, 94303, Palo Alto, Ca, kay-yut.chen@hp.com

Economics experiments, with human subjects playing as consumers, were used to study interactions between lease contracts and an underlying used-goods market, which have enormous revenue implications to manufacturers such as Ford. Results have confirmed qualitative features predicted by the theoretical model while biases in the quantitative predictions have been observed.

■ FA-06

Friday, 9:00-10:30am

Iolani III

Graphs and Networks I

Cluster: Graphs and Networks

Contributed session

Chair: *Ljiljana Pavloviæ*, Institute of Mathematics, Faculty of Natural Sciences and Mathematics, Radoja Domanoviæa 12, 34 000, Kragujevac, Serbia and Montenegro, pavlovic@knez.uis.kg.ac.yu

1 - Perfectness and Imperfectness of Intersection Graphs on Lattice Points

Yuichiro Miyamoto, Sophia University, Kioicho 7-1, Chiyoda-ku, 102-8554, Tokyo, Japan, y-miyamo@sophia.ac.jp, *Tomomi Matsui*

We discuss perfectness and imperfectness of unit disk graphs on triangular lattice points and of the k-th power of lattice graphs. The discussion implies polynomial time approximation algorithms for the multicoloring (weighted coloring) problem and the maximum weighted stable set problem on these graphs.

2 - The new approach to the Randic index

Ljiljana Pavloviæ, Institute of Mathematics, Faculty of Natural Sciences and Mathematics, Radoja Domanoviæa 12, 34 000, Kragujevac, Serbia and Montenegro, pavlovic@knez.uis.kg.ac.yu

Let G(k,n) be a set of connected graphs without multiple edges or loops with n vertices and the minimum degree of vertices is k. We found the extremal graphs for the Randic index when the number of vertices of degree k is greater or equal n-k by quadratic programming.

■ FA-07

Friday, 9:00-10:30am

Iolani V

Cutting and Packing III

Cluster: Cutting and Packing

Invited session

Chair: *Jose Fernando Oliveira*, Feup / Inesc, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465, Porto, Portugal, jfo@fe.up.pt

Chair: *Julia Bennell*, School of Management, University of Southampton, Highfield, So17 1bj, Southampton, Hampshire, United Kingdom, jab2@soton.ac.uk

1 - Multiple periods cutting stock problems

Kelly Poldi, Icmc, Av. Trabalhador São-Carlense, 400, Caixa Postal 668, 13560-970, Sao Carlos, Sao Paulo, Brazil, kelly@icmc.usp.br, *Marcos Arenales*

In each period of a finite planning horizon, a cutting problem should be solved (called multiple periods cutting stock problem). Its formulation considers demand of items in periods, which production can be either anticipated or not. Multiple periods problems allow transference of unused inventory from a period to the next.

2 - Algorithm based on graphs for the non-guillotinable two-dimensional packing problem

Mª Eduarda Pinto Ferreira, Department of Mathematics, Isep, Bernardino de Almeida 431, 4200-072, Porto, Portugal, epf@isep.ipp.pt, *Jose Fernando Oliveira*

The problem we are going to present is an algorithm based on graph-theoretic characterization of a feasible two-dimensional orthogonal packing problem. This characterization allows for the construction of sub optimal solutions for this type of two-dimensional packing problems with n¿100 pieces. Finally, we present computational results of the implemented algorithm.

3 - An improved TOPOS constructive algorithm for nesting problems

Julia Bennell, School of Management, University of Southampton, Highfield, So17 1bj, Southampton, Hampshire, United Kingdom, jab2@soton.ac.uk, *Xiang Song*

A constructive approach for nesting problems based on the TOPOS algorithm is presented and improved via a more powerful nofit polygon generator that can efficiently represent holes in the partial solution. Hence the solution quality is less dependent on the placement order and new "best fit" criteria can be utilised.

■ FA-08

Friday, 9:00-10:30am
Iolani VI

Supply Chain Management V

Cluster: Supply Chain Management
Contributed session

Chair: *Nobuyuki Ueno*, Management and Information Sciences, Hiroshima Prefectural University, Nanatuka, Shobara, Hiroshima, 727-0023, Shobara, Japan, ueno@bus.hiroshima-pu.ac.jp

1 - Investment Strategies for Reducing Supply Chain Delivery Variance

Alfred Guiffrida, Industrial Engineering, University at Buffalo (SUNY), School of Engineering and Applied Sciences, 301 Lawrence D. Bell Hall, 14260-2050, Buffalo, New York, United States, guiffrid@buffalo.edu, *Mohamad Jaber*

Contemporary management theories advocate variance reduction as a key step in improving overall system performance. We model delivery time to the final customer in a supply chain as the n-fold convolution of the individual stage lead times. Cost-based models are examined under various investment strategies for reducing delivery variance.

2 - Optimization of Supply Chain for Mass Customization by Reinforcement Learning Approach

Koji Okuhara, Management and Information Sciences, Hiroshima Prefectural University, 562 Nanatuka, 727-0023, Shyobara, Hiroshima, Japan, okuhara@bus.hiroshima-pu.ac.jp, *Junko Shibata, Nobuyuki Ueno*

It is important to optimize the supply chain for mass customization. We regard mass customization as dispersion of order from maker to supplier, and treat maker's order, that is demand of supplier as probability variable. We propose production planning in ordet to avoid a shortage of stock using reinforcement learning.

3 - Production Planning System Corresponding to Mass Customization in Supply Chain with Multi-item

Nobuyuki Ueno, Management and Information Sciences, Hiroshima Prefectural University, Nanatuka, Shobara, Hiroshima, 727-0023, Shobara, Japan, ueno@bus.hiroshima-pu.ac.jp, *Koji Okuhara, Kyozo Furuta, Hiroaki Shibuki, Toshiaki Kuramoto*

In the automobile industry, usual business model has a problem to realize mass customization, because it is difficult to satisfy the diversification of the customer needs. This paper proposes a multi-item production and inventory planning method of the mass customization that considers the restriction of daily manufacturing capacity.

■ FA-10

Friday, 9:00-10:30am
Tapa Ballroom I

New Generation Revenue Management: Product Design and Optimal Control

Cluster: Tutorials
Invited session

Chair: *Soulaymane Kachani*, Industrial Engineering & Operations Research, Columbia University, S.W. Mudd Building Room 334, 500 W. 120th St, 10027, New York, NY, kachani@ieor.columbia.edu

1 - New Generation Revenue Management: Product Design and Optimal Control

Guillermo Gallego, Industrial Engineering and Operations Research, Columbia University, Nyc, NY, United States, gmg2@columbia.edu

We discuss win-win products that appeal to capacity consumers and can potentially improve the expected revenues of capacity providers. Examples include flexible and callable products, partially refundable fares and contracts between companies and capacity providers. A flexible product, such as a morning flight from New York to San Francisco, is sold at a discount to self-selected low fare customers who grant the capacity provider the option of assigning a specific product near the end of the booking process. A callable product is sold to self-selected low-fare customers that allow the capacity provider to recall and reschedule capacity in exchange for a pre-specified compensation. Partially refundable fares allow better market segmentation even in the absence of fences like Saturday night stays. Finally, a fairly priced "last-seat availability contract", that guarantees reservations as long as capacity is available may provide the cost relief that companies seek and the revenue stream that airline companies need to survive in the current environment.

■ FA-11

Friday, 9:00-10:30am
Tapa Ballroom II

Combinatorial Optimization III

Cluster: Combinatorial Optimization
Invited session

Chair: *David Hartvigsen*, Management, University of Notre Dame, 354 Mendoza College of Business, 46556-5646, Notre Dame, IN, Hartvigsen.1@nd.edu

1 - Robust Network Design and Fixed Routing Templates

Bruce Shepherd, Mathematical Sciences Research, Bell Laboratories, 600 Mountain Ave., Murray Hill, NJ, United States, bshep@research.bell-labs.com, *C. Chekuri, Gianpaolo Oriolo, Maria Grazia Scutellà, P. Winzer, Martin Zirngibl*

We consider network capacity allocation problems where we must support a class of traffic matrices. Our focus is the case where traffic for each commodity follows some predetermined template, (its oblivious to the demand matrix). We compare several models with regard to carrying IP traffic on a WDM network.

2 - Frequency Assignment by Vertex Packing

Gianpaolo Oriolo, Universita' Roma Tor Vergata, Italy, oriolo@disp.uniroma2.it, *L. Sunil Chandran, C. Mannino*

We consider a class of graphs, generalizing interval graphs, where the stable set problem is easy to solve, when a certain representation is available. We apply our ideas to the solution of the frequency assignment problem, improving the best known solutions for almost all the instances of an important benchmark.

3 - The Maximum-Flow Problem and K3,3 Minors

Donald Wagner, Mathematical, Computer & Information Sciences, Onr, 875 N. Randolph Street, 22203, Arlington, VA, United States, wagnerd@onr.navy.mil

Consider the maximum-flow problem on an undirected graph having no K3,3 minor through the "return" edge. Two solution techniques are presented: the "top-most" path algorithm, generalizing a Ford-Fulkerson algorithm for (s,t)-planar graphs; and a reduction to a sequence of shortest-path problems on (s,t)-planar graphs. Both use graph decomposition.

4 - Maximum 1-restricted Simple 2-matchings

David Hartvigsen, Management, University of Notre Dame, 354 Mendoza College of Business, 46556-5646, Notre Dame, IN, Hartvigsen.1@nd.edu

A k-restricted simple 2-matching in a graph is a subgraph whose components are paths and cycles, each with length greater than k. We present a new polynomial time algorithm for finding a 1-restricted simple 2-matching with a maximum number of edges.

■ FA-12

Friday, 9:00-10:30am
Tapa Ballroom III

City Logistics

Cluster: Transportation

Invited session

Chair: *Teodor Gabriel Crainic*, Management and Technology, Univ. du Québec à Montréal, C.P. 8888, succ. Centre-Ville, H3c 3p8, Montréal, Québec, Canada, theo@crt.umontreal.ca

1 - City Logistics

Teodor Gabriel Crainic, Management and Technology, Univ. du Québec à Montréal, C.P. 8888, succ. Centre-Ville, H3c 3p8, Montréal, Québec, Canada, theo@crt.umontreal.ca, *Nicoletta Ricciardi, Giovanni Storchi*

City Logistic systems aim to improve the efficiency of freight transportation within urban areas and, consequently, reduce its environmental impact, by proposing integrated planning and operations based on consolidation and coordination. We present the main issues, concepts, and approaches of City Logistics, discuss challenges, and identify promising research directions.

2 - City Logistics in Padova: from research to a concrete implementation

Roberto Montemanni, Università della Svizzera Italiana, Istituto Dalle Molle di Studi sull'Intelligenza artificiale (IDSIA), Ch-6928, Manno-Lugano, Canton Ticino, Switzerland, roberto@idsia.ch, *Luca Maria Gambardella, Cossu Paola, Alberto V. Donati, Marciani Massimo, Rizzoli Andrea*

This paper presents some research experiences in the area of Vehicles Routing Optimization that conduce to the implementation of a concrete City Logistic distribution project in the City of Padova. Research

algorithms and the current state of the Padova CityPorto project are described.

3 - Models for Two-Tier City Logistics

Teodor Gabriel Crainic, Management and Technology, Univ. du Québec à Montréal, C.P. 8888, succ. Centre-Ville, H3c 3p8, Montréal, Québec, Canada, theo@crt.umontreal.ca, *Nicoletta Ricciardi, Giovanni Storchi*

We address the short-term planning of operations of a two-tier City Logistics system. We briefly present the general issue and focus on the routing component. Models and algorithmic directions will be discussed. We will also discus the application of this methodology to the more classic case of single-tier systems.

■ FA-13

Friday, 9:00-10:30am
Sea Pearl I

Simulation Applications in Production and Inventory Management

Cluster: Simulation

Invited session

Chair: *Young Lee*, Mathematical Sciences Department, IBM Research, 1101 Kitchawan Road, 10598, Yorktown Heights, New York, United States, ymlee@us.ibm.com

1 - Scheduling Batch Fabric Dyeing Operations

Kristin Thoney-Barletta, Textile & Apparel, Technology & Management, North Carolina State University, Box 8301, 27695, Raleigh, NC, United States, kristin_thoney@ncsu.edu

First, an approach is briefly presented to characterize setup matrices in batch fabric dyeing operations based on color physics. Then, the performance of a new heuristic is compared to that of an existing heuristic when both are implemented within a simulation-based job shop scheduling system with batch fabric dyeing machines.

2 - Simulation of Availability Planning and Scheduling for a Computer Hardware Business with Complex Configuration

Young Lee, Mathematical Sciences Department, IBM Research, 1101 Kitchawan Road, 10598, Yorktown Heights, New York, United States, ymlee@us.ibm.com, *Soumyadip Ghosh, Thomas Ervolina, Feng Cheng, Barun Gupta*

When availability planning/scheduling is based on the finished goods level, changing market demand and supply could easily result in constraints and excesses of supply and unsatisfactory customer services due to inaccurate view of component availability. We have developed a simulation model to assess business improvement opportunities with component-based planning/scheduling.

3 - Using a Simple Spreadsheet Simulator to Develop a Finished Goods Inventory Model

Jeff Joines, Textile Engineering, Chemistry, and Science, North Carolina State University, College of Textiles, Campus Box 8301, 27695, Raleigh, NC, jeffjoines@ncsu.edu, *Ben Martin*

An intimate apparel company was faced with global competition and in an effort to retain market share was attempting to lower finished

goods inventory while maintaining/increasing service levels. Using simple spreadsheet simulations with their historical data, a new inventory model was developed and then implemented for their 25,000 SKUs.

■ FA-16

Friday, 9:00-10:30am
Sea Pearl IV

Differential Games

Cluster: Game Theory
Invited session

Chair: *Fouad El Ouardighi*, Logistics, production and service, ESSEC Business School, Avenue Bernard hirsch, BP 105, 95021, Cergy Pontoise, France, elouardighi@essec.fr

1 - Strategic options for interdependent chains with monopolist manufacturer and duopolist retailers

Fouad El Ouardighi, Logistics, production and service, ESSEC Business School, Avenue Bernard hirsch, BP 105, 95021, Cergy Pontoise, France, elouardighi@essec.fr

In this paper, we consider two interdependent chains involving a monopolist manufacturer and duopolist retailers. From this structure, four strategic configurations may emerge, that is: - The manufacturer is facing competing retailers; - The manufacturer is facing coalescing retailers; - The manufacturer forms a supply chain with one retailer, while the other remains non-cooperative; - The manufacturer forms a supply chain with each of the retailers, so that supply chains' competition emerges. In order to establish a preference ranking among these strategic configurations, we formulate a differential game and use a qualitative analysis as well as a numerical study.

2 - Values of the Balanced Decision-Making between Supply Chain Partners

Bowon Kim, Graduate School of Management, Kaist, 207-43 Cheongryangri Dongdaemoon-Ku, 130-722, Seoul, Korea, Republic Of, bowonkim@kgsm.kaist.ac.kr

Coordination in decision-making between supply chain partners is critical to effective supply chain management. We consider two types of the decision-making structure: a balanced structure, where the partners share their decision-making right, and a dominated one, where the stronger partner dominates it. Our analysis using the differential games approach indicates that the shared decision-making produces better results for both partners in the supply chain, and its value comes from more effective resource utilization than the dominated case. In this paper, we endeavor to show the detailed analytical process through which such a conclusion can be derived.

3 - Perfect Uncontrollable Differential Games

Luca Lambertini, Economics, University of Bologna, Strada Maggiore 45, 40125, Bologna, lamberti@spbo.unibo.it, *Roberto Cellini*, *George Leitmann*

We analyse the time consistency of open-loop Nash and Stackelberg equilibria in differential games. We identify the conditions for both Nash and Stackelberg open-loop equilibria to be strongly time consistent. One such example, based on a duopoly model with advertising (Leitmann and Schmitendorf, 1978) is provided.

4 - Simultaneous Adoption of Process and Product Innovation: a Differential Game Approach

Andrea Mantovani, Department of Economics, University of Bologna, Strada Maggiore 45, 40125, Bologna, mantovan@spbo.unibo.it, *Luca Lambertini*

We investigate the timing of adoption of product and process innovation in a differential game. Depending on initial conditions, (i) firms activate both types of investment; (ii) firms initially invest only in one R&D and then adopt the other one; (iii) firms do not invest at all.

■ FA-18

Friday, 9:00-10:30am
Sea Pearl VI

Production and Inventory Systems II

Cluster: Production and Inventory Systems
Contributed session

Chair: *Udatta Palekar*, Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign, 1206 W. Green Street, 61801, Urbana, Illinois, United States, palekar@uiuc.edu

1 - Ordering policies for multi-constrained multi-item inventory systems with incremental quantity discounts

John Moussourakis, Management Sciences, Rider University, 2083 Lawrenceville Road, 08648-3099, Lawrenceville, NJ, United States, moussourakis@rider.edu, *Cengiz Haksever*

Determining order quantities is based mostly on a fixed or an independent cycle approach, neither of which always outperforms the other. In this paper, we examine a model that suggests which of the two approaches is most cost-effective in the presence of a number of resource limitations and incremental discounts.

2 - An inventory model with random supply interruptions

Esmail Mohebbi, Industrial and Management Systems Engineering, University of Nebraska-Lincoln, 175 Nebraska Hall, 68588-0518, Lincoln, US, emohebbi@unlnotes.unl.edu

We present an inventory model with random demand and random lead time where the availability/unavailability of a single supplier at an order placing epoch is governed by a two-state time homogeneous Markov chain. The proposed model takes explicit account of the impact of the supplier's availability on the replenishment lead time.

3 - A 2-product joint replenishment model with display space based demand elasticity

Udatta Palekar, Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign, 1206 W. Green Street, 61801, Urbana, Illinois, United States, palekar@uiuc.edu

We consider the problem in which 2 products exhibit demand elasticity based on the amount on display. The product demand rate is affected by its own display as well as the amount on display of the other product. We study the problem for independent as well as joint replenishment times.

4 - A perishable inventory model with Markovian arrival demand

Zhaotong Lian, Faculty of Business Administration, University of Macau, Taipa, Macao SAR, China, lianzt@umac.mo

We analyze an (s,S) continuous review perishable inventory system with fixed lifetime and a Markoian arrival demand process. Using a Markov renewal approach, we obtain closed-form solutions for the steady state probability distribution of the inventory level and system performance measures. We then construct a closed-form expected cost function.

■ **FA-20**

Friday, 9:00-10:30am
Nautilus II

Decision Support Systems I

Cluster: Decision Support Systems
Contributed session

Chair: *Michael Mullens*, Iems, University of Central Florida, P.O. Box 162993, 32816-2993, Orlando, FL, mullensm@mail.ucf.edu

1 - Decision support systems based on the Life Cycle Inventory (LCI) - part of a Life CycleAssessment (LCA) for Municipal Solid Waste (MSW) Management under Uncertainty

Boguslaw Bieda, Management Department, AGH-University of Science and Technology, ul. Gramatyka 10, 30-067, Krakow, Poland, bbieda@wzn6.zarz.agh.edu.pl, *Ryszard Tadeusiewicz*

LCI method was used for two scenarios for the waste pyrolysis process. The paper uses stochastic modeling based on the IRR and NPV values of the new and actually equipments. The Monte Carlo simulation with the Excel spreadsheet and Crystal Ball® software was used to develop scenarios for uncertainty inputs.

2 - Optimization of TV Self-Promotion Space

Fernando A. C. C. Fontes, Dept of Mathematics for Science and Technology, University of Minho, Campus de Azurem, 4800-058, Guimaraes, Portugal, ffontes@mct.uminho.pt, *Paulo Pereira, Luis Machado, Dalila Martins Fontes*

TV stations typically reserve a promotion space (broadcasting time) for self-promotion (future programs, etc.). Each product to promote has a given target audience that is best reached at specific time periods during the week. We report on the development of a Decision Support System to plan the best assignment of the weekly self-promotion space for one of the main TV stations in Portugal.

3 - Data Collection and Predictive Modeling in Industrialized Housing

Michael Mullens, Iems, University of Central Florida, P.O. Box 162993, 32816-2993, Orlando, FL, mullensm@mail.ucf.edu, *R. Scott Broadway*

This paper describes an innovative wireless bar-code approach for collecting, analyzing, reporting and using labor data to manage industrialized housing operations. The paper focuses on verification and analysis of production data collected at a modular housing manufacturer and its potential for use in predictive modeling of production performance.

■ **FA-21**

Friday, 9:00-10:30am
Lehua Suite

Markov Decision Processes

Cluster: Applied Probability
Invited session

Chair: *Michael Fu*, The Robert H. Smith School of Business and Institute for Systems Research, University of Maryland, Van Munching Hall, 20742, College Park, MD, United States, mfu@umd5.umd.edu

1 - Optimal Scheduling of a Simple Reentrant Manufacturing Line

Emmanuel Fernandez, Electrical & Comp. Eng. & Comp. Science, University of Cincinnati, Cincinnati, OH, United States, emmanuel@ececs.uc.edu, *Jose Ramirez-Hernandez*

We present a (infinite-horizon-discounted-cost) Markov Decision Process for a simple reentrant line, where decisions are based on job sequencing and input regulation. We propose the utilization of a weighted cost criterion as a trade-off between short and long-term performance as well as a simulation-based optimization using Neuro-Dynamic Programming (e.g, Q-Learning).

2 - Optimality Inequalities for Average Cost MDPs and their Inventory Control Applications

Eugene Feinberg, Department of Applied Mathematics, Stony Brook University, and Statistics, 11794-3600, Stony Brok, NY, eugene.feinberg@sunysb.edu, *Mark Lewis*

We extend the assumptions guaranteeing the existence of a solution to the average cost optimality inequalities. Inventory and stochastic cash balance models with fixed costs are natural candidates for the application of our results. We discuss extensions of the classic models to general demand distributions.

3 - Population-Based Evolutionary Approaches for Solving Markov Decision Processes

Michael Fu, The Robert H. Smith School of Business and Institute for Systems Research, University of Maryland, Van Munching Hall, 20742, College Park, MD, United States, mfu@umd5.umd.edu, *Jiaqiao Hu, Steven Marcus, Hyeong Soo Chang*

For solving infinite horizon discounted reward Markov Decision Processes, we present algorithms that are based on evolving a population of policies, in contrast to the usual policy iteration approach, which updates a single policy. Convergence results and numerical results are presented.

■ **FA-24**

Friday, 9:00-10:30am
Hibiscus I

Marketing I

Cluster: Marketing
Contributed session

Chair: *Wouter Buckinx*, Marketing, Ghent University, Hoveniersberg 24, 9000, Ghent, wouter.buckinx@UGent.be

1 - Enriching an NPTB model with sequential information modelled by sequence-analysis methods: a home-appliances application.

Anita Prinzie, Department of Marketing, Ghent University, Hoveniersberg 24, Ghent, 9000, Ghent, Belgium, anita.prinzie@UGent.be, *Dirk Van den Poel*

We present a multinomial-choice model predicting which home appliance the customer will acquire next. Modeling the time-varying covariates by sequence-analysis methods (including Markov, MTD/MTDg and event-history analysis) overcomes the inability of classification methods like multinomial probit to capture sequential patterns and improves the predictive performance of the final NPTB model.

2 - Investigating the impact of complaint handling on subsequent customer behavior by using survival analysis techniques

Bart Larivière, Marketing, Ghent University, Hoveniersberg 24, 9000, Ghent, bart.lariviere@ugent.be, *Dirk Van den Poel*

Firms increasingly view each contact with their customers as an opportunity that needs to be managed. In this study we investigate the post-complaint period of 2,326 customers. By means of survival forests we find that complaint handling variables have a significant and time-varying impact on complainants' subsequent actual behavior.

3 - The predictive accuracy of survival analysis in customer attrition

Jonathan Burez, Faculty of Economics and Business Administration, Department of Marketing, Ghent University, Hoveniersberg 24, B 9000 Gent, B 9000, Gent, Jonathan.Burez@Ugent.Be, *Dirk Van den Poel*

In customer churn prediction, some binary classification techniques are still the standard. The performance of those methods is compared with survival analysis using time-varying predictors. Moreover, the influence of splitting up data in too many variables is investigated. Data of a pay TV company is used.

4 - Building cross-selling models on loyal customers only

Geert Verstraeten, Marketing, Ghent University (UGent), Vakgroep Marketing, Hoveniersberg 24, 9000, Gent, Geert.Verstraeten@ugent.be, *Dirk Van den Poel*

While cross-selling models are currently built on all customers, conceptually, they should be built on loyal customers only, because only these customers exhibit their total product needs. In this study, we will compare the predictive performance of models built on all customers with those built on loyal customers only.

5 - Efficient Catalog Allocation in a FMCG Retail Environment.

Wouter Buckinx, Marketing, Ghent University, Hoveniersberg 24, 9000, Ghent, wouter.buckinx@UGent.be, *Dirk Van den Poel*

The efficient allocation of catalogs is still a major issue in the domain of CRM. We propose a procedure to compose mailing lists by making use of incremental modelling and defining the optimal mailing depth. Our results show an increase in profit thanks to a reduction of dissipated mailings.

Friday, 11:00am-12:30pm

■ FB-01

Friday, 11:00am-12:30pm

Honolulu I

Fish & Game

Cluster: Renewable and Natural Resources

Invited session

Chair: *Andrés Weintraub*, University of Chile, Santiago, Chile, aweintra@dii.uchile.cl

1 - Regime Switching in a Fishery with Stochastic Stock and Price

Linda Nøstbakken, Department of Economics, Norwegian School of Economics and Business Administration, Helleveien 30, N-5045, Bergen, Norway, linda.nostbakken@nhh.no

I develop a model of an uncertain fishery. With linear control, it is optimal to harvest either at minimum or full capacity. I assume fixed costs to switching between the two harvest capacities. There are two switching curves in stock-price space. Numerical methods are used to characterise the optimal policy.

2 - The potential of portfolio selection theory in African wildlife management

John Hearne, Mathematical and Geospatial Sciences, RMIT University, GPO Box 2476v, 3001, Melbourne, Victoria, Australia, john.hearne@rmit.edu.au

Techniques that have been used for many decades by investment analysts are relatively unknown in wildlife management despite the many similarities. In this talk the application of the ideas behind the portfolio selection problem to some African wildlife management problems will be explored.

3 - Multicriteria Models for Operational and Strategic Fisheries Policy Evaluation

Daniel Lane, School of Management, University of Ottawa, 136 Jean-Jacques Lussier Prive, K1n6n5, Ottawa, Ontario, Canada, dlane@uottawa.ca

Operational and strategic fisheries systems problems are analysed involving conflicting criteria. Fisheries problems viewed as decision support opportunities include: (1) spatial-temporal decisions of diverse activities of coastal marine zones; (2) stock assessment estimates leading to exploitation regulations; (3) strategic policy evaluation, and (4) planning scientific projects under prescribed mandates.

■ FB-02

Friday, 11:00am-12:30pm

Honolulu II

Scheduling and Timetabling III

Cluster: Scheduling and Timetabling

Contributed session

Chair: *Homayoun Khamooshi*, Management Science, George Washington Uinversity, 302H Monroe Hall, 2115 G Street N.W., 20052, Washington, DC, hkh@gwu.edu

1 - Due Date Setting For Single-machine Scheduling Problems.

James Holsenback, Management, Francis Marion University, School of Business, 29501, Florence, SC, United States, jholsenback@fmarion.edu, *Margie Covington*

The method of setting due dates for single machine problems has remained virtually unchanged for nearly 30 years. This study proposes three different methods of setting due dates. We then investigate the effects of each proposed method with respect to solution time required for optimal solutions and solution quality for two well-known heuristics.

2 - A Project Management Simulation (PMSIM) Game

Amnon Gonen, Technology Management, Holon Academic Institute of Technology, 52,Golomb St., 58102, Holon, Israel, agonen1@bezeqint.net, *Ofer Zwikael*

The presented paper describes a simulation tool for training and research. It simulates the project management process during the project execution. The simulation provides the "players" realistic events on which they have to decide and react. The game is designed for either one team or several teams competing among themselves.

3 - Expediting a Project, an Optimized Strategy Approach

Homayoun Khamooshi, Management Science, George Washington Uinversity, 302H Monroe Hall, 2115 G Street N.W., 20052, Washington, DC, hkh@gwu.edu

A new crashing model has been developed. The proposed model aims at assessing a pragmatic estimate of the cost of the delay and proposes a solution by optimizing the use of the limited expediting budget to maximize the gains in achieving the objectives of the project through Integer Programming.

4 - The automatic assignment system for the proctor of the entrance examination of Nanzan University

Kana Yamamoto, Mathematical Sciences, Nanzan University, 27 Seirei, 4890863, Seto, Japan, m04mm044@msie.nanzan-u.ac.jp, *Maiko Uchida*, *Atsuo Suzuki*

In this paper, the automatic assignment system for the proctor of the entrance examination of Nanzan University is devised and implemented in PC. The system has flexibility for various conditions such as room size, personal inconvenience or language restrictions of foreign professors.

■ FB-03

Friday, 11:00am-12:30pm

Honolulu III

Integer Programming II

Cluster: Integer Programming

Contributed session

Chair: *Nicholas Beaumont*, Management, Monash University, P.O. Box 197, 3145, Caulfield East, Victoria, Australia, Nicholas.Beaumont@buseco.Monash.edu.au

1 - Branch-and-Price Approach for the Fixed Charge Multiple Knapsack Problem

Seiji Kataoka, Computer Science, The National Defense Academy, 1-10-20 Hashirimizu, Yokosuka,, Kanagawa, JAPAN, 239-8686, Yokosuka, seiji@nda.ac.jp

Consider a fixed cost for using each knapsack. The 'fixed charge multiple knapsack problem' decides which items to load, which knapsacks to use, and the assignment between them. We apply branch-and-price method to this problem. Computational experiments show our approach succeeds in solving the problem with somewhat many knapsacks.

2 - Isomorphism with small integers

Francois Margot, Tepper School of Business, Carnegie Mellon University, 5000 Forbes Avenue, 15213-3890, Pittsburgh, PA, United States, fmargot@andrew.cmu.edu

Integer linear programs having a feasible set with a large symmetry group are usually difficult to solve. For problems with binary variables, notable improvements are obtained by recognizing and pruning isomorphic subproblems. This talk presents a generalization to problems with general integer variables.

3 - Planning Optimization As Program Verification

Shenghan Xu, Isenberg School of Management, University of Massachusetts Amherst, Department of Finance and Operation Management, 121 Presidents Drive, 01003, Amherst, MA, shenghan@som.umass.edu, *Li Tan*

Software verification is to algorithmically verify a program against its logic requirement. Due to the demands of reliable computer systems, software verification is among some of highly investigated techniques in Computer Science in past decade.

4 - A Generalisation of Special Ordered Sets Type 1

Nicholas Beaumont, Management, Monash University, P.O. Box 197, 3145, Caulfield East, Victoria, Australia, Nicholas.Beaumont@buseco.Monash.edu.au

The solution of some Mixed Integer Programs can be accelerated by exploiting special structures exemplified by the Special Ordered Set type 1 (SOS1), in which exactly one of a set of variables is non-zero. We consider efficient arbitration of sets of variables of which at most k are non-zero.

■ FB-04

Friday, 11:00am-12:30pm
Iolani I

Location Analysis II

Cluster: Location Analysis
Contributed session

Chair: *Adilson Elias Xavier*, Graduate School of Engineering, Federal University of Rio de Janeiro, P.O. Box 68511, Ilha do Fundão - Centro Tecnologia - H319, 21941-972, Rio de Janeiro, RJ, Brazil, adilson@cos.ufrj.br

1 - Using the hypercube queuing model embedded into a genetic algorithm to analyze emergency medical systems on highways

Ana Iannoni, Production Engineering, Federal University of São Carlos, Rua Nove de Julho 2767, 13560-560, Sao Carlos, Sao Paulo, Brazil, papi@iris.ufscar.br, *Reinaldo Morabito*, *Cem Saydam*

We analyze configuration and operation of emergency medical systems on highways using an extension of the hypercube model. To determine optimal response districts we develop an algorithm that embeds our model into a genetic algorithm. We apply the algorithm to a Brazilian highway EMS operating with a non-traditional dispatch policy.

2 - Uncapacitated Multiple Allocation Hub Location Problem in Continuous Space

Shutaro Kawasaki, Department of System Design, Keio University, 3-14-1 Hiyoshi, Kohokuku, 223-8522, Yokohama, Kanagawa, schumch@nippon.email.ne.jp, *Tatsuya Kishimoto*

This study presents a stochastic method of solution for uncapacitated multiple allocation hubs location problem in continuous space. Problem is formulated as a non-linear programming and a method of heuristic iterative solution based on stochastic convergence process is shown. Location examples are demonstrated, and usefulness of the method is confirmed.

3 - Stochastic Method for Multiple Facilities Location Problems in Continuous Space

Tatsuya Kishimoto, Department of System Design, Keio University, 3-14-1 Hiyoshi, Kohokuku, 223-8522, Yokoama, kishimoto@sd.keio.ac.jp

Stochastic optimization methods for Multiple Facilities Location Problems are presented. Methods of solution are simple and robust, and applicable to complex problems. Several location solutions on both single-allocation model using Nearest-neighbor Hypothesis and multiple-allocation model using Spatial Interaction Models are demonstrated, and the usefulness of the presented method are examined.

4 - "The Use of the Hyperbolic Smoothing Clustering Method for Planning the Tasks of Sanitary Agents in Combating Dengue".

Adilson Elias Xavier, Graduate School of Engineering, Federal University of Rio de Janeiro, P.O. Box 68511, Ilha do Fundão - Centro Tecnologia - H319, 21941-972, Rio de Janeiro, RJ, Brazil, adilson@cos.ufrj.br, *Marcos José Negreiros Gomes*, *Nelson Maculan Filho*, *Philippe Michelon*

This new methodology solves the two-level intrinsically non-differentiable minimum sum-of-squares clustering problem, through the solution of a sequence of low dimension completely differentiable unconstrained problems. This tool is applied for solving large-scale instances of literature and for planning the coverage of sanitary agents tasks for the prevention and combat of dengue.

■ FB-05

Friday, 11:00am-12:30pm
Iolani II

Dynamic Pricing in Retail

Cluster: Dynamic Pricing & Revenue management
Invited session

Chair: *Murali Mantrala*, Marketing, University of Missouri, 438 Cornell Hall, 65211, Columbia, MO, United States, mantralam@missouri.edu

1 - Multiperiod Rolling Knapsacks

Sriram Dasu, University of Southern California, Los Angeles, CA, United States, dasu@marshall.usc.edu

We model multi-period capacity rationing problem as dynamic knapsack problem. Each period is treated as a knapsack. Arriving orders are either accepted and assigned to a specific knapsack, or rejected. Orders differ in due date requirement and pay-off to the firm.

2 - Optimal Pricing Strategies for an Automotive Aftermarket Retailer

Murali Mantrala, Marketing, University of Missouri, 438 Cornell Hall, 65211, Columbia, MO, United States, mantralam@missouri.edu, *Rajeeve Kaul, Seethu Seetharaman*

The authors describe development and application of models for demand function estimation and pricing optimization at a major US automotive aftermarket retailer. This firm's objective is to implement optimal micromarketing strategies including store-level pricing and promotion decisions in product subcategories comprised of multiple quality variants.

3 - The Practical Side of Retail Revenue Optimization

Murali Mantrala, Marketing, University of Missouri, 438 Cornell Hall, 65211, Columbia, MO, United States, mantralam@missouri.edu, *Rajeeve Kaul*

So you have heard all the buzz words and believe your firm is ready to implement revenue optimization. But wait- the interplay of optimization goals, technological changes, organizational climate and business expectations creates a daunting maze. This session offers a manager's perspective on how to successfully navigate this maze.

■ FB-06

Friday, 11:00am-12:30pm
Iolani III

Graphs and Networks II

Cluster: Graphs and Networks
Contributed session

Chair: *Yash Aneja*, Odette School of Business, University of Windsor, 401 Sunset Avenue, N9b3p4, Windsor, Ontario, Canada, aneja@uwindsor.ca

1 - A Probabilistic Analysis of a Network Model based on the generalization of the Polya's Urn Problem

Daisuke Harada, Informatics, Kwansei Gakuin University, 2-1, Gakuen, 6691337, Sanda-shi, Japan, scbc0040@ksc.kwansei.ac.jp, *Taizo Chiyonobu, Hiroyoshi Miwa*

Many real networks have a power-law degree distribution and they are called scale-free. It is known that a network generated by a model with the growth and the preferential attachment properties is scale-free. We prove that a network by a model with the only latter property has the geometric distribution.

2 - Solution of the assignment problem using Wang's recurrent neural network with the principle "Winner Takes All"

Maria Teresinha Arns Steiner, Mathematics, Federal University of Parana, Rua Padre Anchieta, 1231, ap. 31,

80730-000, Curitiba, Parana, tere@mat.ufpr.br, *Paulo Henrique Siqueira, Sergio Scheer*

One technique that uses Wang's recurrent neural networks with the principle "the winner takes it all" is presented to solve the assignment problem. With proper choices for the parameters of the recurrent neural network, this technique reveals efficient to solve the assignment problem in real time.

3 - A Simplification Method for High Quality Spatial Data Maintaining Topological Structure

Shigeki Toriumi, Graduate School of Science and Engineering, Chuo University, 1-13-27 Kasuga, 112-8551, Bunkyo-ku, Tokyo, Japan, toriumi@taguchi-lab.ise.chuo-u.ac.jp, *Azuma Taguchi*

We propose to add "scale (precision)" dimension to "time-space" to build a multi-dimensional geographic information system. Using this topological structure of spatial data, we would develop a technique to produce low precision spatial data from high precision spatial data.

4 - Maximizing Residual Flows under an Arc Destruction for all Node-pairs

Yash Aneja, Odette School of Business, University of Windsor, 401 Sunset Avenue, N9b3p4, Windsor, Ontario, Canada, aneja@uwindsor.ca, *Nair Abreu*

In a recent paper, efficient algorithms for two problems relating to single commodity flows were provided. In the first problem, the objective is to determine, for a given pair of nodes s and t, a flow pattern, so that the residual flow, after an arc is destroyed, is maximized.

■ FB-08

Friday, 11:00am-12:30pm
Iolani VI

Supply Chain Management VI

Cluster: Supply Chain Management
Contributed session

Chair: *Seongje Ahn*, Faculty of Business, University of Seoul, 90, Jeonnong-dong, Dongdaemoon-Gu, 130-743, Seoul, Korea, Republic Of, sjahn@uos.ac.kr

1 - Ordering and pricing policies among suppliers, manufacturer, and distributor

Chung-Chi Hsieh, Department of Industrial and Information Management, National Cheng Kung University, 1, University Road, 701, Tainan, Taiwan, jcchsieh@mail.ncku.edu.tw

This study investigates the supplier selection and ordering problem for a manufacturer when it purchases parts from suppliers, who have different discount offers and delivery reliabilities, and the coordination problem among suppliers, a manufacturer and a distributor who coordinate to meet price-sensitive demand of a short-life-cycle product.

2 - A Comparision of Quotation Policies of Price and Lead Time: Dynamic vs Stationary

Xiaoming Liu, Fba, University of Macau, University of Macau, Macau, Na, Macau, xmliu@umac.mo, *Liming Liu, Jiejian Feng*

A supply system of a sales department and a manufacturing department is considered. When a customer arrives, lead time (l) and price (p) are

quoted, this customer accepts it with a probability function q(p,l). The performance of quoting policies with and without utilizing the dynamic manufacturing status is compared.

3 - Profit and Risk Sharing in a Supply Chain

Seongje Ahn, Faculty of Business, University of Seoul, 90, Jeonnong-dong, Dongdaemoon-Gu, 130-743, Seoul, Korea, Republic Of, sjahn@uos.ac.kr

This paper suggests that the profit sharing contract can be Pareto optimal for both supplier and the purchaser. It is shown that Pareto optimal risk sharing contract can be obtained even though the decisions are made in a decentralized manner. We examined various aspects of the risk sharing contract .

■ FB-09

Friday, 11:00am-12:30pm
Iolani VII

Manufacturing Management

Cluster: Operations Management
Invited session

Chair: *Wikrom Jaruphongsa*, Industrial and Systems Engineering, National University of Singapore, Singapore, isejw@nus.edu.sg

1 - The Joint Replenishment Problem with Container-Based Transportation Cost: Policy Improvement

Wikrom Jaruphongsa, Industrial and Systems Engineering, National University of Singapore, Singapore, isejw@nus.edu.sg, *Zhe Liang*

We consider the classical joint inventory replenishments with constant demand. Joint inventory replenishments are shipped using containers with a fixed capacity. Recently, Roundy et al. (2005) successfully developed an efficient heuristic with a finite performance ratio. In this paper, we suggest several ways to improve the solution.

2 - Inventory and Production Decisions for an Assemble-to-Order System with Uncertain Demand and Limited Assembly Capacity

Ke Fu, Industrial Engineering & Engineering Management, Hong Kong University of Science & Technology, Kowloon, Hong Kong, China, kefu@ust.hk, *Vernon Hsu*, *Chung-Yee Lee*

We consider an inventory and production problem for contract manufacturer who faces anticipated order of a single product with uncertain quantity. In such a problem, the manufacturer may need to procure components or even assemble some quantities of the final product before receiving the confirmation of the actual order quantity.

3 - Optimal Pricing and Ordering for Perishable Products

Rujing Liu, Industrial and Systems Engineering, National University of Singapore, 10 Kent Ridge Crescent, 119260, Singapore, g0202826@nus.edu.sg, *Ek Peng Chew*, *Chulung Lee*

For a perishable product with a two-period lifetime, a discount is offered to promote the sales of older products. A dynamic programming model is developed to compute the optimal order quantity and optimal discounted price. We extend our results to a general case where the product has an N-period lifetime.

■ FB-10

Friday, 11:00am-12:30pm
Tapa Ballroom I

Principles of Marketing the O.R. Profession - How Can Your Society Get Started?

Cluster: Tutorials
Invited session

Chair: *Irvin Lustig*, ILOG Direct, Ilog, 25 Sylvan Way, 07078, Short Hills, NJ, United States, ilustig@ilog.com

1 - Principles of Marketing the O.R. Profession - How Can Your Society Get Started?

Irvin Lustig, ILOG Direct, Ilog, 25 Sylvan Way, 07078, Short Hills, NJ, United States, ilustig@ilog.com

INFORMS recently launched a Science-of-Better campaign to help market the operations research profession. The OR Society then adapted the INFORMS materials to suit their own membership and country culture. A key issue for success is understanding the marketing principles used to develop the campaign. We will discuss these fundamental principles of the campaign so as to assist other sister societies that wish to leverage the INFORMS materials in order to effectively but affordably run campaigns in their own countries.

■ FB-11

Friday, 11:00am-12:30pm
Tapa Ballroom II

Network Flows

Cluster: Combinatorial Optimization
Invited session

Chair: *Seffi Naor*, Computer Science, Technion, Technion City, 32000, Haifa, Israel, naor@cs.technion.ac.il

1 - New Algorithms for Disjoint Paths Problem

Sanjeev Khanna, Computer & Information Science, University of Pennsylvania, Philadelphia, Pennsylvania, United States, sanjeev@cis.upenn.edu

The edge-disjoint paths problem (EDP) is the following: a collection of source-destination pairs is given, and the objective is to connect as many pairs as possible in an edge-disjoint manner. We present a new framework that provides much improved approximation algorithms for EDP and it variations in undirected graphs.

2 - An Algorithmic Excursion in Data Streams

Sudipto Guha, Computer Science Dept., University of Pennsylvania, Philadelphia, Pennsylvania, United States, sudipto@central.cis.upenn.edu

We explore some of the recent advances of approximation algorithms in the context of single pass data stream algorithms. We will survey the area of synopsis construction in small space, we will consider Wavelet and Histogram construction and try to identify the key ideas behind them.

3 - Algorithms for Data Migration

Samir Khuller, Computer Science, University of Maryland, College Park, Maryland, United States, samir@cs.umd.edu

Large storage systems typically consist of many devices storing data. This mechanism provides both fault-tolerance as well as opportunities for load balancing. We identify the problem of computing an efficient data migration plan and develop approximation algorithms it. We compare it to several other heuristic algorithms.

4 - On Non-uniform Multicommodity Buy-at-Bulk Network Design

Moses Charikar, Computer Science, Princeton University, Princeton, New Jersey, United States, moses@cs.princeton.edu

We study the multicommodity buy-at-bulk network design problem where the goal is to buy capacity on edges of a network so as to enable the demands between a given set of source-sink pairs to be routed. We present the first non-trivial approximation algorithm for the general case.

■ FB-12

Friday, 11:00am-12:30pm
Tapa Ballroom III

Facility Logistics

Cluster: Transportation
Invited session

Chair: *Kevin Gue*, Industrial and Systems Engineering, Auburn University, 207 Dunstan Hall, Auburn Univeristy, 36849, Auburn, AL, United States, kevin.gue@auburn.edu

1 - Modeling and simulating retail facilities exploiting connective technologies

Benoit Montreuil, Laval University, Quebec City, Canada, benoit.montreuil@centor.ulaval.ca, *Angel Ruiz*

Retailers considering implementing connective technologies, e.g. RFID, face difficulties in assessing their realistic impact which affects real-time knowledge-acquisition and decision-making. Our instrumental research on a retail facilities modeling and simulation platform has a multidisciplinary approach and multi-agent modeling framework. We provide an empirical investigation comparing barcode-technology- vs. RFID-technology-enabled retail facilities.

2 - Modeling Layout Design in Retail Facilities

Brett Peters, Industrial Engineering, Texas A&M University, Tamus 3131, 77843-3131, College Station, TX, United States, bpeters@tamu.edu, *A. Reha Botsali*, *Georgia-Ann Klutke*

Few procedures exist for layout of retail facilities, despite their economic importance. Retail layout differs from manufacturing/logistics layout in several significant ways, thus existing layout procedures are not directly applicable. This presentation provides an overview of retail facility layout, models for designing these layouts, and potential solution procedures.

3 - Location and Sizing of Inventory Control Points in Pull Systems

Ronald Askin, Systems & Industrial Engineering, University of Arizona, 1127 E. North Campus Drive, 85721, Tucson, AZ, United States, ron@sie.arizona.edu

Pull systems provide effective, self-adjusting production control with minimal information requirements in reliable environments with relatively stable demand. We model material flows through multistage-production-systems using pull-control for production authorization. The selection of control points for locating output buffers is determined along with the optimal container (batch) sizes and safety stock.

4 - Performance Bounds for High Density Storage Systems

Kevin Gue, Industrial and Systems Engineering, Auburn University, 207 Dunstan Hall, Auburn Univeristy, 36849, Auburn, AL, United States, kevin.gue@auburn.edu

We describe an abstract model of physical goods storage systems that demonstrates the relationship between storage density and expected system throughput. Our model is based on the insight that aisles are "the absence of product" and products are "the absence of aisles." We show performance bounds for several configurations.

■ FB-13

Friday, 11:00am-12:30pm
Sea Pearl I

Aerospace Simulation Modeling

Cluster: Simulation
Invited session

Chair: *Roberto Lu*, Commercial Airplanes Material & Process Technology, The Boeing Company, PO Box 3707, Mail Code: 19-FA, 98124-2207, Seattle, WA, United States, roberto.f.lu@gmail.com

1 - Distributed Simulation and Dynamic Management for Aerospace Industry Supply Chain

Agostino Bruzzone, DIP University of Genoa, McLeod Institute of Simulation Science, via Opera Pia 15, 16145, Genova, agostino@itim.unige.it

The paper propose an innovative HLA Federation reproducing all the elements of an aerospace industry supply chain; this logistics network is simulated by distributed federates directly integrated with each company ERPs guaranteeing on-line simulation, while intelligent agents support dynamic re-negotiation of the orders for optimizing the whole supply chain.

2 - Optimizing the Effectiveness of Structural Variation Analysis During Large Scale Product Development Efforts

Stephen Walls, Engineering - Product Development, Boeing Commercial Airplane Co., P.O Box 3707, Mail Code 02-TW, 98124-2207, Seattle, WA, stephen.a.walls@boeing.com

The last 10 years in the aerospace industry has seen significant evolution in the capability/usability of 3-dimensional variation analysis tools. What's not matched that capability is the Macro Analysis techniques needed to vector the technical teams to the significant few. This presentation discusses the 7E7 program's variation analysis' management methods.

3 - SMartSim: The Boeing Strategic Airline Market Simulator

Roger Parker, Commercial Airplane Marketing, Boeing, 20222 23rd Pl NW, 98177, Shoreline, WA, United States, roger-a-parker@comcast.net

Marketing at Boeing Commercial Airplanes has developed an agent-based simulation of the revenue generation process in the airline industry. It is being used to study varous airline pricing models in the context of passenger behavior to help understanding industry revenue dynamics. The simulation will be described, execution demonstrated, and results discussed.

4 - Simulation Modeling of Transporter Constrained Aircraft Component Logistics

Roberto Lu, Commercial Airplanes Material & Process Technology, The Boeing Company, PO Box 3707, Mail Code: 19-FA, 98124-2207, Seattle, WA, United States, roberto.f.lu@gmail.com

Traditional logistics system has merchandise ready for transportation devices to pick-up and delivery. When there are limited transportation devices to transport expensive and large items, timings of the merchandise readiness become more critical to the transporter performance. This presentation demonstrates a simulation method that models the transporter centered logistics.

■ FB-14

Friday, 11:00am-12:30pm
Sea Pearl II

Constraint-Based Local Search in Comet

Cluster: Computational Software Development
Invited session

Chair: *Pascal Van Hentenryck*, Department of Computer Science, Brown University, Box 1910, 02912, Providence, RI, pvh@cs.brown.edu

1 - Comet in Context

Laurent Michel, Computer Science & Engineering, University of Connecticut, 371 Fairfied Road, Unit 2155, 06269, Storrs, CT, ldm@engr.uconn.edu, *Pascal Van Hentenryck*

This talk contains a description of COMET, an object-oriented language supporting a constraint-based architecture for neighborhood search. It contrasts COMET to CP languages and shows how they provide similar benefits. COMET supports an architecture cleanly separating modeling and search, constraints encapsulating incremental algorithms, and control abstraction to simplify search.

2 - Constraint-Based Local Search in Comet

Pascal Van Hentenryck, Department of Computer Science, Brown University, Box 1910, 02912, Providence, RI, pvh@cs.brown.edu, *Laurent Michel*

This paper shows how to express a variety of local search algorithms in Comet. The Comet programs clean separates the model from the search, providing modularity, extensibility, and reuse. The applications include frequency allocation, facility location, and resource allocation

3 - Scheduling in Comet

Laurent Michel, Computer Science & Engineering, University of Connecticut, 371 Fairfied Road, Unit 2155, 06269, Storrs, CT, ldm@engr.uconn.edu, *Pascal Van Hentenryck*

Scheduling remains a challenging class of application for all optimization software. Local search algorithms can be extremely effective on Job-shop, open-shop or cumulative scheduling but remain difficult to implement and investigate. This talk will explore vertical extensions and control primitives that substantially simplify the implementation of efficient scheduling software.

4 - Parallel Local Search in Comet

Pascal Van Hentenryck, Department of Computer Science, Brown University, Box 1910, 02912, Providence, RI, pvh@cs.brown.edu, *Laurent Michel*

This talk gives an overview of the parallel abstractions of Comet to implement cooperating local search on multiprocessors. The parallel abstractions abstract the tedious and error-prone aspects of parallel computing and provide a clean separation between the models and the parallelism.

■ FB-15

Friday, 11:00am-12:30pm
Sea Pearl III

Knowledge Work and Management

Cluster: Knowledge Work and Management
Invited session

Chair: *Sriram Bhamidipati*, Symbiotic Solutions, Inc., 28719 Eton Glen, 48331, Farmington Hills, Michigan, United States, sriram_bhamidipati@yahoo.com

Chair: *A.d. Amar*, Management, Seton Hall University, School of Business, 400 South Orange Ave., 07079, South Orange, NJ, United States, amaramar@shu.edu

1 - A Stochastic Model of Human Output Measure Function: An Application of Financial Instrument Valuation Theory

Januj Juneja, Seton Hall University, South Orange, NJ, United States, junejaja@shu.edu

This paper develops a non-linear utility-based stochastic model of human output. It presents underlying quantitative framework for human output and applies it, in conjunction with financial instrument valuation theory, to the development and optimization of a model of human capital. The paper also gives directions for further research.

2 - Nature and Need for Collaboration - Successful Knowledge Management Applications

Sriram Bhamidipati, Symbiotic Solutions, Inc., 28719 Eton Glen, 48331, Farmington Hills, Michigan, United States, sriram_bhamidipati@yahoo.com

Studies of successful KM implementations - nature and need for collaboration; re-organization of the information into collaborative content stores, evolution of "trusted" sources of information, standards of maintenance, self-nominated and structured ontological CoPs; challenges to content acquisition based on completeness, correctness and manipulative requirements, incentive models, and measurements for organizational needs.

3 - Successful Practices and Applications Research on Increasing Innovation in Organizations

A.d. Amar, Management, Seton Hall University, School of Business, 400 South Orange Ave., 07079, South Orange, NJ, United States, amaramar@shu.edu, *Januj Juneja*

In the absence of grounded research in managing of knowledge workers, this paper provides a compilation of successful drivers of human innovation from a survey of applied and practitioner research. Citing cases from various firms, it also provides guidelines on how can managers create an effective system to implement them.

4 - Ontologies and Social Engineering in Knowledge Management

Sriram Bhamidipati, Symbiotic Solutions, Inc., 28719 Eton Glen, 48331, Farmington Hills, Michigan, United States, sriram_bhamidipati@yahoo.com, *Ravi Sharma*

This paper deals with ontologies and their impact on social engineering in the context of cross-functional collaboration within an enterprise and the cross-community collaboration among multiple enterprises. The paper presents ontologies and their need, enterprises and their unique requirements, defines effective communication rules of engagement, the existing and future KM tools.

■ FB-16

Friday, 11:00am-12:30pm
Sea Pearl IV

Game Theory

Cluster: Game Theory
Contributed session

Chair: *Teruhisa Nakai*, Sistems Management Engineering, Kansai University, 3-3-35 Yamate, 564-8680, Suita, Osaka, nakai@iecs.kansai-u.ac.jp

1 - Game theory and statistical physics for optimization

Stefan Bieniawski, Aeronautics & Astronautics, Stanford University, 250 Durand Building, Dept. Aero/Astro, 94305, Stanford, CA, stefanb@stanford.edu, *David Wolpert*

Recent work has shown that the foundations of optimization theory, statistical physics, and game theory are strongly related. This provides new techniques for reducing complex optimization problems to simpler ones. We outline and compare two ways to solve those simpler problems: a distributed algorithm and one using standard optimization techniques.

2 - Search Allocation Game and Its Extensions

Ryusuke Hohzaki, Dep. of Computer Science, Japan National Defense Academy, 1-10-20 Hashirimizu, 239-8686, Yokosuka, Kanagawa, Japan, hozaki@cc.nda.ac.jp

Search allocation game is a two-person zero-sum game, where a target moves to evade a searcher and the searcher allocates his searching effort to detect the target. I propose a linear programming formulation for optimal strategies of the players, which has the flexibility to incorporate a variety of extensions.

3 - Search Problems on a Finite Graph with Examination Cost

Kensaku Kikuta, School of Business Administration, University of Hyogo, Gakuen-nishi 8-2-1,Nishi-ku, 651-2197, Kobe, Japan, kikuta@biz.u-hyogo.ac.jp

A search game and a rendezvous search problem on a finite graph are analyzed. The search area is the nodes in the graph. Players move along edges. When the cost for examining nodes are assumed as well as the traveling cost, special cases are solved.

4 - Fuzzy Subjective Game Considering Non-Additive Feelings

Teruhisa Nakai, Sistems Management Engineering, Kansai University, 3-3-35 Yamate, 564-8680, Suita, Osaka, nakai@iecs.kansai-u.ac.jp

Many game experiments show that considerably many players don't select their Nash equilibrium strategies. To explain it we had proposed a subjective game, but its expected payoff was assumed to be additive. In this paper we propose a fuzzy subjective game to treat non-additive feelings of players.

■ FB-17

Friday, 11:00am-12:30pm
Sea Pearl V

Fuzzy Sets in MCDM

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *Gwo-Hshiung Tzeng*, Institute of Management of Technology, National Chiao Tung University, 1001,Ta-Hsueh Rd., 300, Hsinchu, Taiwan, ghtzeng@cc.nctu.edu.tw

1 - Decision Making in Fuzzy Environment with Black-Scholes Option Pricing Model

Shin-Yun Wang, Department of International Trade, Chung Kuo Institute of Technology, 19F-5, No2, Section2 Chiao jiang raod, Banchiao city, Taipei state, Taiwan, 220, Banchiao, Taipei, Taiwan, grace.ms90g@nctu.edu.tw, *Gwo-Hshiung Tzeng*

This study adopts the fuzzy decision theory and Bayes' rule as a base for measuring fuzziness in the practice of option analysis. We employs "Fuzzy Decision Space to describe the decision of investors, which is used to derive a fuzzy B-S Pricing model under fuzzy environment.

2 - Using FAHP Gap Analysis and Sensitivity Analysis to Develop Effective Marketing Strategies

Mei-Fang Chen, Department of Business Management, Tatung University, 40, Chung-Shan North Road, Sec. 3, Taipei, Taiwan, 104, Taipei, mfchen@ttu.edu.tw

Marketers often encounter difficulties in understanding or changing the subjective perceptions of the consumer's evaluation, which in turn results in inappropriate marketing strategies. Fuzzy AHP is used to derive the evaluation weights for each criterion of the marketers and consumers in such a fuzzy MCDM environment. And gap analysis distinguishes the differences of the two parties. Moreover, sensitivity analysis can be used to determine the most critical criterion by computing the changing of the weight or evaluation of any criterion to bring about a switch in the ranking of different alternatives. The results help marketers formulate more effective marketing strategies.

3 - Fuzzy Ahp With Grey Relation Analysis For Evaluating The Performance Of R&d Consortia In Taiwan

Gwo-Hshiung Tzeng, Institute of Management of Technology, National Chiao Tung University, 1001,Ta-Hsueh Rd., 300, Hsinchu, Taiwan, ghtzeng@cc.nctu.edu.tw, *Chia-Chin Wan*, *Hua-Kai Chiou*

While entering WTO, Taiwan has become one of the members in the international community of globalization. The medium & small enterprises should aggressively develop technical capabilities and synergy form strategic R&D consortia to effectively consolidate resources. In this study we established a hierarchical frame for evaluating the performance of R&D Consortia with five aspects and twenty criteria for forming R&D consortia. AHP was applied to determine the weights of criteria. We also employed Grey Relation Analysis to evaluate the strategic synergy. Finally, we summarized four findings and some suggestions for development direction of M&S enterprise in near future.

■ FB-18

Friday, 11:00am-12:30pm
Sea Pearl VI

Production and Inventory Systems III

Cluster: Production and Inventory Systems
Contributed session

Chair: *Katsuhisa Ohno*, Management and Information, Aichi Institute of Technology, Yachikusa 1247, Yakusa-cho, 470-0392, Toyota, ohno@aitech.ac.jp

1 - A remark on a maintenance policy for production facilities

Chih-Hsiung Wang, Industrial Eengineering and Management, I-Shou University, Taiwan, I-Shou University, IE&M, Taiwan, 800, Kaohsiung County, Taiwan, chwang446@yahoo.com.tw

A joint optimization problem for the production run length and preventive maintenance policy is investigated. Based on the assumption that the conditions for the optimality of the equal-interval preventive maintenance schedule hold, we derive unique properties for the optimal production and maintenance policy.

2 - A Framework for Implementing Lean Production

Joseph Martinich, College of Business, Univ of Missouri - St. Louis, 8001 Natural Bridge Rd, 63121, St. Louis, Missouri, United States, joseph.martinich@umsl.edu

We present a framework for analyzing and evaluating the "leanness" of existing production systems, which can help prioritize lean production implementation efforts and guide in selection of appropriate lean production tools and techniques. This framework has been used to teach and implement lean production philosophy and tools.

3 - An Optimal Control of a Failure-prone Multi-stage Production and Distribution System by Neuro-Dynamic Programming and It's Numerical Comparison with Pull Systems

Katsuhisa Ohno, Management and Information, Aichi Institute of Technology, Yachikusa 1247, Yakusa-cho, 470-0392, Toyota, ohno@aitech.ac.jp

This paper deals with an optimal control problem for a stochastic multi-stage production and distribution system and proposes a new algorithm, called the SBMPIM, of neuro-dynamic programming. The expected costs per unit time of several pull production systems are numerically compared with that computed by the SBMPIM.

■ FB-19

Friday, 11:00am-12:30pm
Nautilus I

Resource Allocation

Cluster: Resource Allocation
Contributed session

Chair: *Vicky Mabin*, Victoria Management School, Victoria University of Wellington, PO Box 600, Wellington, 6004, Wellington, New Zealand, vicky.mabin@vuw.ac.nz

1 - Optimal Service Intensity of Freeway Service Patrols

Yafeng Yin, University of California, Berkeley, 1357 S.46th Street, Bldg.452, 94804, Richmond, CA, Afghanistan, yinyf@berkeley.edu, *Samer Madanat*

As one component of traffic incident management systems, freeway service patrols (FSP) facilitate the quick removal of incidents through fast response and reduced clearance times. This study is to investigate how to allocate tow trucks to each FSP beat such that the effectiveness of the FSP system can be maximized.

2 - Sensor Allocation Problem for Border Security

Kevin Saeger, Los Alamos National Laboratory, Los Alamos National Laboratory, Ms F604, 87544, Los Alamos, NM, saeger@lanl.gov

We develop an optimization model to allocate stationary and mobile radiation detectors to secure border and reduce the risk of nuclear smuggling across a border. In a variant of the model, we consider uncertain and biased information on risk of smuggling. We present some results in a real world application.

3 - An Algorithm for Buffer Allocation in Assembly-like Queueing Systems

Masayoshi Hasama, Wajirohigashi,Higashiku,Fukuoka,Japan, 811-0295, Fukuoka, bd03003@ws.ipc.fit.ac.jp

Here we consider a finite capacity assembly-like queueing model. Based on computer simulation results, we present some heuristic policies for effective resource allocation in such systems. Then we propose an algorithm to maximize the throughput of the system among all feasible allocations with a fixed total size of buffers.

4 - Reframing Trade-offs

Vicky Mabin, Victoria Management School, Victoria University of Wellington, PO Box 600, Wellington, 6004, Wellington, New Zealand, vicky.mabin@vuw.ac.nz, *John Davies*

Trade-offs are a central concern in ORMS, addressed by methods such as math programming, heuristics, MCDA and simulation. The Theory of Constraints 'Evaporating Cloud' method also addresses trade-offs, and is a valuable complement to ORMS methods. We explore some typical ORMS trade-offs using TOC's EC, with sometimes surprising results.

■ FB-20

Friday, 11:00am-12:30pm
Nautilus II

Decision Support Systems II

Cluster: Decision Support Systems
Contributed session

Chair: *Jaroslaw Nabrzyski*, Psnc, Institute of Bioorganic
Chemistry PAN, Noskowskiego 12/14, 61-704, Poznan, Poland,
Poland, naber@man.poznan.pl

1 - The Influence of the Data Multivariate Analysis in the Knowledge Discovery in Databases

Maria Teresinha Arns Steiner, Mathematics, Federal
University of Parana, Rua Padre Anchieta, 1231, ap. 31,
80730-000, Curitiba, Parana, tere@mat.ufpr.br, *Nei Yoshihiro
Soma, Tamio Shimizu, Julio Cesar Nievola, Pedro Steiner neto*

Knowledge Discovery in Databases is composed of several phases
starting with the data collection and ending with the evaluation of the
final results. This work aims in showing the data multivariate analysis
influence in Data Mining techniques performance for classification of
new patterns. The mentioned analysis brings important improvements.

2 - A Spreadsheet-based DSS for Demand Forecasting

Gerard Campbell, Charles F. Dolan School of Business,
Fairfield University, North Beson Road, 06824, Fairfield, CT,
gcampbell@mail.fairfield.edu

A decision support system has been developed for use in evaluating the
performances of alternative demand forecasting models. The models
contained within the DSS include various forms of exponential smooth-
ing, regression, and Croston's model. The structure of the DSS will be
presented, along with possibilities for future extensions.

3 - Multicriteria Optimization Methods for Solving Grid Scheduling Problems

Jaroslaw Nabrzyski, Psnc, Institute of Bioorganic Chemistry
PAN, Noskowskiego 12/14, 61-704, Poznan, Poland, Poland,
naber@man.poznan.pl, *Jan Weglarz*

The paper presents various possibilities of using multicriteria ap-
proaches to create generic strategies for solving scheduling problems in
Grids. Some preliminary results will be presented to proof the concept
of using a multi-criteria decision support to automate resource manage-
ment processes and minimize stakeholders' participation in the entire
scheduling process.

■ FB-24

Friday, 11:00am-12:30pm
Hibiscus I

Marketing II

Cluster: Marketing
Contributed session

Chair: *Makoto Abe*, Graduate School of Economics, University of
Tokyo, Hongo, 113-0033, Bunkyo-ku, Tokyo, Japan,
abe@e.u-tokyo.ac.jp

1 - Advertising and Pricing for National and Store Brands

Salma Karray, School of Business and IT, University of
Ontario Institute of Technology, 2000 Simcoe Street North,
L1h 7l7, Oshawa, ontario, Canada, skarray@hotmail.com,
Guiomar Martin-Herran

We study pricing and advertising decisions for national brands and
high-quality private labels. An infinite horizon differential game is
considered where manufacturers and retailers are decision-makers. The
obtained results provide answers on how manufacturers should moni-
tor their advertising expenditures and prices when facing competition
from strong private labels.

2 - Analysis of the Consumer Liking Utilizing Key Graph Method

Yuki Yokomichi, 966-5 Nishi-Aino, 6691341, Sanda, Hyogo,
Japan, yokomichi.yuki@jri.co.jp, *Kazuhiro Takeyasu, Gen
Suda, Satoshi Kojima*

Assumption is made that the liking of taste for wine or beer changes as
taste hazard holding people grow. A survey is done for many classes
including historical change of taste for each person. Key graph anal-
ysis method is introduced and combining the analysis of histogram,
interesting results are obtained.

3 - Diagnosing Websites and Analyzing Visitors' Navigation Patterns with Log files

Makoto Abe, Graduate School of Economics, University of
Tokyo, Hongo, 113-0033, Bunkyo-ku, Tokyo, Japan,
abe@e.u-tokyo.ac.jp

One objective of this research is to obtain an easy-to-interpret page
structure based on visitors' viewing patterns, which in turn can be used
to diagnose the website. Another is to infer visitors' goal and predict
their next page transition, accounting for their heterogeneity, with the
log file.

■ FB-25

Friday, 11:00am-12:30pm
Hibiscus II

Future Military Applications

Cluster: Military Applications
Invited session

Chair: *Dean S. Hartley III*, Hartley Consulting, 106 Windsong Ln,
37830, Oak Ridge, Tennessee, United States,
dshartley3@comcast.net

1 - Commonality Faults in Super Scaled Systems

Andrew Loebl, Computational Sciences and Engineering, Oak
Ridge National Laboratory, P.O. Box 2008 m/s 6085,
37831-6085, Oak Ridge, TN, United States, loeblas@ornl.gov

Work for a Federal agency exposed Super Scaled Systems' vulner-
abilities that would cause failures ranging up to full functionality
loss. Pathfinder research indicates a required paradigm shift in de-
sign/development to avoid this. The new paradigm requires full ex-
ploitation of common functionality determination at low level decom-
position and tight coupling.

2 - Semi-static Modeling of OOTWs

Dean S. Hartley III, Hartley Consulting, 106 Windsong Ln, 37830, Oak Ridge, Tennessee, United States, dshartley3@comcast.net

The ISSM System provides for semi-static modeling of OOTWs. It provides for measuring, tracking, projecting and understanding the status of an OOTW. It includes a generic set of factors for modeling Conflict, Economy, Govt, Misc, Movement, Needs, Security, Physical & Reversible/Variable factors. It also supports custom logic.

3 - An Analysis of Opportunities to Reduce Controlled Flight into Terrain Mishaps

John W. Lyons, Department of Operational Sciences, Air Force Institute of Technology, Wright Patterson AFB, OH, United States, lyons1994@msn.com, *Raymond Staats*

We present a Value Focused Thinking (VFT) based model that will help military decision makers determine the best way to 'buy down' risk with respect to operational mission effectiveness as well as personnel and aircraft safety.

Friday, 2:45-4:15pm

■ FD-01

Friday, 2:45-4:15pm
Honolulu I

Energy Policy and Planning

Cluster: Renewable and Natural Resources
Contributed session

Chair: *Maria Madalena Araújo*, Minho's University, Portugal, mmaraujo@dps.uminho.pt

1 - A Dynamic Programming Method for Economic Dispatch of Pumped Storage Power Plant

Pao-Long Chang, Department of Business Administration, Feng Chia University, 100, Wenhwa Road, Seatwen,Taichung, Taiwan, R.O.C, 407, Taichung, Taiwan, paolong_chang@yahoo.com.tw, *Shou-Fu Cheng*

Using daily load forecast, power supply reservation, and generator fuel cost data, this paper determines the pumping volume and generator cost function, and then constructs a dynamic programming model to find the number of pumping machines needed and the timing of pumping, so that the daily pumping cost is minimized.

2 - A System Of Models To Select Petrochemical Technologies

Carlos Escobar-Toledo, Faculty of Chemestry, Building D - 310, National University of Mexico (UNAM), Circuito Institutos, Ciudad Universitaria, 04510, Mexico,D.F., Mexico, D.F. (Mexico City), none, Mexico, carloset@servidor.unam.mx, *Claudia GarcÍa-aranda*, *Guadalupe Martínez-Martínez*

Models presented, select petrochemical technologies, using multicriteria methodologies and 0-1 programming. To build a petrochemical structure by chain of production, we use also a model based on networks, crossing alternatives up and downstream, going from final products to basic, showing, among other criteria, the value added through the production chains.

3 - Renewable Energy: The Key To Global Sustainable Development - A Strategic Vision

Nazar M. Hassan, Mechanical Engineering Department, University of Khartoum, Faculty of Engineering & Architecture, P.O. Box 471, Khartoum, Sudan, Khartoum, Sudan, nmhassan05@yahoo.com

Lack of activities for Renewable Energy technologies cannot be compensated by conferences and/or political declarations. The Renewable Energy Acquirement Program (REAP) is proposed as a strategically institutionalized measure to successfully deploy RE technologies. REAP makes use of the profit incentive, a vital stimulant to foreign investment within today's global economy.

4 - Wind Power Strategies in Portugal

Maria Madalena Araújo, Minho's University, Portugal, mmaraujo@dps.uminho.pt, *Paula Ferreira, M.e.j. O'Kelly*

There is an increasing interest in wind turbine electricity generation in Portugal. The present situation and expected evolution of wind power generation in Europe and Portugal is analysed. The promotion strategies followed by the Portuguese Authorities are evaluated and a comparison with the situation in the rest of Europe made.

■ FD-03

Friday, 2:45-4:15pm

Honolulu III

Linear Programming

Cluster: Linear Programming

Contributed session

Chair: *Nélio Pizzolato*, Departamento de Engenharia Industrial, Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil, ndp@ind.puc-rio.br

1 - A new initialization method for the Hitchcock transportation problem

François Dubeau, Mathématiques, Université de Sherbrooke, Faculté des sciences, 2500 Boul. Université, J1k2r1, Sherbrooke (Qc), Canada, francois.dubeau@usherbrooke.ca, *Oumar Mandione Gueye*

A new initialization method for the Hitchcock transportation problem is presented. It assigns a value only if necessary. It differs by this way to other traditional initialization methods. It gives excellent initial assignation results and often the optimal solution. It is also a suitable method for the bottleneck transportation problem.

2 - Fuzzy Linear Programming in a Coal-blending Problem

Nélio Pizzolato, Departamento de Engenharia Industrial, Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil, ndp@ind.puc-rio.br, *André Gandolpho*, *Ricardo Tanscheit*, *Marley Vellasco*

This work deals with the use of fuzzy linear programming in a coal-blending problem. Modelling involves vague and imprecise concepts that are translated into mathematical form through fuzzy numbers. The solution to the problem is described in terms of a region, with different possible degrees.

■ FD-06

Friday, 2:45-4:15pm

Iolani III

Aviation Applications

Cluster: Aviation Applications

Contributed session

Chair: *Anders Tavemark*, Division of Defence Analysis, Swedish Defence Research Agency, Foi, Se-172 90, Stockholm, tavemark@foi.se

1 - When is Selective Screening Effective for Aviation Security?

Sheldon Jacobson, Mech. and Ind. Eng., University of Illinois, 1206 West Green Street (MC-244), 618012906, Urbana, Illinois, United States, shj@uiuc.edu, *Laura McLay*, *John Kobza*

The TSA supports selective screening of passengers to achieve better airport security. A cost-benefit analysis of a selective baggage screening system is used to show that the screening system's accuracy in assessing risk is more critical the effectiveness of the baggage screening devices when few passengers are classified as higher-risk.

2 - Optimization Of Real-time Systems

Joseph Kreimer, Industrial Engineering and Management, Ben-Gurion University of the Negev, P.O.Box 653, 84105, Beer-Sheva, Israel, kremer@bgumail.bgu.ac.il, *Eduard Ianovsky*

We consider a real-time multiserver (e.g. unmanned air vehicles, over-hearing devices, machine controllers) and multichannel (e.g. surveillance areas, communication channels, assembly lines) system operating under maximum load. For RTS with exponentially distributed service and generally distributed maintenance times we obtain optimal values of assignment probabilities, system's availability and loss function .

3 - Operational Research in Support of Swedish Air Mobility Study

Anders Tavemark, Division of Defence Analysis, Swedish Defence Research Agency, Foi, Se-172 90, Stockholm, tavemark@foi.se

The Swedish military airlift fleet is ageing and in need for a mid-life-update. However, the operational requirements have changed since the first of eight C-130 was procured in 1965. This presentation deals with operational research methodologies and tools used in a study on future Swedish airlift and air-to-air refuelling capability.

■ FD-07

Friday, 2:45-4:15pm

Iolani V

Facilities Planning and Design

Cluster: Facilities Planning and Design

Contributed session

Chair: *Jaime Mora Vargas*, Industrial Engineering, Itesm-cem, Carr Lago de Guadalupe Km 3.5, 52926, Atizapan de Zaragoza, Estado de Mexico, Mexico, jmora@itesm.mx

1 - Location and sizing of kindergarten units using operations research methods

Mirian Buss Gonçalves, Engenharia de Produção, Universidade Federal de Santa Catarina, Rua Arlindo Penna, 27, 88037-260, Florianópolis, Santa Catarina, Brazil, mirianbuss@brturbo.com.br, *Débora da Silva Lobo*

This work presents an appropriate sizing to kindergarten units, placed in a model by numerical simulation. Then, for localization of these units, it's proposed an ideal spatial distribution using p-median and Voronoi diagram models. This work is applied for a medium-size Brazilian city.

2 - Meta-heuristics And The Facility Layout Problem

Carmen Flores-Mendoza, Industrial Engineering and Textile, Universidad de las Americas - Puebla, Ex Hacienda Santa Catarina Martir, Cholula, Puebla, 72820, Cholula, Puebla, Mexico, carmenx.flores@udlap.mx

The present research provides an overview of an ongoing comparison among the Ant Colony, Simulated Annealing, GRASP and Scatter Search meta-heuristics. This, in terms of how well (considering time and cost) each of them performs the search for a solution to the facilities layout problem (based on the QAP formulation).

3 - A genetic algorithm for optimal unequal-area block layout design

Jaime Mora Vargas, Industrial Engineering, Itesm-cem, Carr Lago de Guadalupe Km 3.5, 52926, Atizapan de Zaragoza, Estado de Mexico, Mexico, jmora@itesm.mx, *Eva Hernández*, *Eduardo Diaz-Santillan*

This work solves a mixed-integer linear programming model for the block layout design problem with unequal areas. The basic aspect of the model consists of a genetic algorithm that founds the binary variables of this model. The heuristic finds a set of feasible solutions for more than nine departments.

■ FD-08

Friday, 2:45-4:15pm
Iolani VI

Supply Chain Management VII

Cluster: Supply Chain Management
Contributed session

Chair: *Petr Fiala*, Econometrics, University of Economics, W.Churchill Sq. 4, 130 67, Prague 3, Czech Republic, pfiala@vse.cz

1 - Agent-Based Distributed Planning

Jean-Marc Frayret, Consortium de recherche FOR@C, Universite Laval, Département de Génie Mécanique, Pavillon Pouliot, G1k7p4, Québec, Québec, Canada, jean-marc.frayret@forac.ulaval.ca, *Sophie D'Amours*

This presentation proposes an analysis of recent advances in distributed planning in order to investigate the potential role of agent technology to integrate OR-based advanced planning tools. In particular, it analyzes how software agents could be exploited to complement and influence the development of Advanced Planning and Scheduling tools.

2 - (r, Q) Policies in an Inventory System with Limited Resource

Zhao Xiaobo, Department of Industrial Engineering, Tsinghua University, Qinghua Yuan, 100084, Beijing, xbzhao@tsinghua.edu.cn, *Fan Fan, Liu Xiaoliang, Xie Jinxing*

Single item (r, Q) policy inventory system with resource constraint is formulated for minimizing long-run-average cost. An algorithm with polynomial complexity is proposed for obtaining optimal solutions. Multiple item (r, Q) policies inventory system with resource constraint is formulated. An algorithm with polynomial complexity is proposed for obtaining undominated solutions.

3 - Analysis of supply chain networks

Petr Fiala, Econometrics, University of Economics, W.Churchill Sq. 4, 130 67, Prague 3, Czech Republic, pfiala@vse.cz

Supply chain networks are complex systems. Significant factors for supply chain models comprise network structure, dynamic environment, uncertainty environment, and multiple decision units with multiple goals. Network systems contain both positive and negative feedbacks. Supplier-customer relationships are changing to cooperative form. The paper proposes some approaches to analyze these systems.

■ FD-09

Friday, 2:45-4:15pm
Iolani VII

Operations Management

Cluster: Operations Management
Contributed session

Chair: *Jiyin Liu*, Business School, Loughborough University, Loughborough, Leicestershire, Le11 3tu, United Kingdom, j.y.liu@lboro.ac.uk

1 - Capacity Investment with Capacity Exchange Through a Marketplace

Jun Zhang, School of Business, Tulane University, 70118, New Orleans, LA, United States, jzhang4@tulane.edu

This paper studies the problem of capacity investment decisions with capacity exchange and demand forecast update. We demonstrate that the exchange market plays the role of a central planner in allocating capacities among firms and show that that capacity exchange effectively changes a firm's demand by reducing its variability.

2 - Evaluation and Assessment of Production and Operations Management Journals

George Hadjinicola, Public and Business Administration, University of Cyprus, 75 Kallipoleos, PO Box 20537, Cy1678, Nicosia, Cyprus, bageorge@ucy.ac.cy, *Vassilis Theoharakis, Andreas Soteriou, Chris Voss*

We provide evaluations for Production and Operations Management journals, based on a sampling frame that includes the majority of POM researchers worldwide. We develop hypotheses so test whether the perceived quality and relevance of a journal is affected by such factors as nature of research work, society membership, research productivity.

3 - Optimization of aggregate order release in workload control systems

Hubert Missbauer, Production and Logistics Management, University of Innsbruck, Universitätsstrasse 15, 6020, Innsbruck, Austria, hubert.missbauer@uibk.ac.at

Optimization of aggregate order release over time can replace the parameter setting of conventional order release mechanisms (time limit, target WIP) and allows adaptation to demand variations. The paper presents an optimization model for this purpose and outlines extensions focusing on models of the transient behaviour of production units.

4 - Single-job lot streaming in m-1 two-stage hybrid flowshops

Jiyin Liu, Business School, Loughborough University, Loughborough, Leicestershire, Le11 3tu, United Kingdom, j.y.liu@lboro.ac.uk

We study the single-job lot streaming problem in two-stage hybrid flowshops with a single machine at the second stage to minimise the makespan. We propose a simple method for sublot allocation and sequencing, and prove its optimality. With this allocation and sequencing, the optimal sublot sizes can be determined efficiently.

■ FD-13

Friday, 2:45-4:15pm
Sea Pearl I

Simulation in Health Applications

Cluster: Simulation
Invited session

Chair: *Andrew Ganti*, Healthcare Technologies, General Electric, 300 Winged Terr. Dr., 94582, San Ramon, CA, andy.ganti@med.ge.com

1 - Designing Adaptive Robust Healthcare Delivery Systems

Brian Dingman, Information and Decision Technology Group, GE Global Research, One Research Circle, 12309, Niskayuna, NY, dingman@crd.ge.com

Healthcare systems experience large variations in demand mix, processing requirements, and financial effects. Simulation can be combined with other analytical tools to improve system capability as covered in the Peri-Op application. Other topics include: System dynamics, demand mix management through scheduling and clustering based on processing needs and financial impact.

2 - Simulation of Hospital Bar-Coded Medication Administration Process

Dave LaCourse, HealthCare Management Engineering, Inc., 13505 Marquette Blvd, 33905, Fort Myers, Florida, United States, davelacourse@earthlink.net

Simulation of bar-coded medication distribution and administration process to dramatically improve medication safety in hospitals. Engineer-led team of nurses and pharmacists explored and evaluated alternatives for a system that didn't yet exist. Physical and analytical simulation tools uncovered AND SOLVED the nursing-versus-pharmacy dilemma with the breakthrough, lowest-cost optimum design!

3 - Behavioural healthcare modelling

Jennifer Sykes, Mathematics, University of Southampton, 24 Broadlands Road, So17 3ar, Southampton, United Kingdom, js@maths.soton.ac.uk, *Paul Harper*, *Sally Brailsford*, *Derek Rutter*

The effectiveness of breast cancer screening programmes is dependent upon the attendance behaviour of targeted individuals. However, most models for evaluating screening strategies do not incorporate human behaviour at an individual level. In this talk we present a simulation that includes psychological models of patient behaviour when analysing mammography policies.

■ FD-14

Friday, 2:45-4:15pm
Sea Pearl II

Artificial Intelligence

Cluster: Artificial Intelligence
Contributed session

Chair: *Riaan Oberholzer*, Computer Science, North-West University, Hoffman Street, Potchefstroom, 2531, Potchefstroom, South Africa, rkwjao@puknet.puk.ac.za

1 - Weblogs as Dynamic Value Models for Information

Robin Burk, Department of Systems Engineering, United States Military Academy, Mahan Hall 412, 10996, West Point, NY, United States, robin.burk@usma.edu

Weblogs constitute a rich example of the way in which humans apply various measures of value to information from remote, possibly anonymous and unreliable sources. Multiple attribute utility theory only partially describes this valuation activity. Agent-based simulation offers additional insights towards design of intelligent software for information evaluation.

2 - Artificial Intelligence - Techniques for Search Results in Programming Projects

Maria Pereira, Gepro, Geiasc, Caixa Postal 606, 88010-970, Florianopolis, SC, mariagpereira@uol.com.br

The problem of scheduling projects is dealt with in this study with the aim of comparing tools in order to find the optimum or near-optimum solution. There is an infinite number of tools that serve this purpose, both the traditional ones based on more sophisticated mathematical formulations.

3 - Effective heuristic function selection for the modified Wang-type algorithms for cutting stock problems

Riaan Oberholzer, Computer Science, North-West University, Hoffman Street, Potchefstroom, 2531, Potchefstroom, South Africa, rkwjao@puknet.puk.ac.za, *Giel Hattingh*

The determination of optimal cutting patterns for two-dimensional applications using guillotine cuts have been considered by various authors like Wang (Operations Research, 31(3):573-586, May-June) and others. Oliveira and Ferreira (EJOR, 44:256-266) use heuristic functions to underestimate wastage. Alternative heuristics are considered in this paper and comparative empirical results are presented.

■ FD-16

Friday, 2:45-4:15pm
Sea Pearl IV

Forecasting

Cluster: Forecasting
Contributed session

Chair: *Elliot H. Levy*, US Department of Commerce, 11011 Saffold Way, 20190, Reston, VA, United States

1 - Combined Method to Upraise Forecasting Accuracy

Yuki Higuchi, College of Economics, Osaka Prefecture university, 1-1 Gakuen-cho, Sakai, Osaka Japan, 599-8531, Sakai, Osaka, Japan, h_snow1901@yahoo.co.jp, *Kazuhiro Takeyasu*

In order to upraise forecasting accuracy, new method is introduced. Minimum variance smoothing constant of exponential smoothing method is derived. Combining Moving Average Ratio Method which calculate monthly ratio with above method, forecasting accuracy improved a great deal. Variance of forecasting error is compared with new method and ordinary method.

2 - On the significance of currency VaR estimation with regime switching models

Koji Inui, Graduate School of Global Business, Meiji University, 1-1 Surugadai Kanda, Chiyoda-ku, 101-8301, Tokyo, Japan, inui@kisc.meiji.ac.jp

I examine some different types of non-stational time series models on the significance of currency VaR estimation accuracy. One of the regime switching models whose transition probability depends on interest rates with respect to the currencies shows better performance that the others.

3 - Regression Analysis, Monte Carlo simluation and Schedule Data

Diane Williams, CPA, Acquisition Management Department, Defense Acquisition University - South, 6767 Madison Pike, Bldg #7, 35806, Huntsville, AL, United States, Diane.williams@dau.mil

Army's THAAD program ($1.5B) had a management challenge of accurately forecasting program schedules. Using regression analysis to find relationships between planned and actual activity durations, a more accurate schedule (and budget) was determined. This technique was coupled with a statistical Monte Carlo analysis to provide projected dates for major milestones.

4 - Aberration Control in Time Tend Forecasting

Elliot H. Levy, US Department of Commerce, 11011 Saffold Way, 20190, Reston, VA, United States

Tolerance bounds were applied to forecast errors to avoid an input logjam. They follow a loss function in order to reduce the spread between prediction and realization. Two-way forecast adjustements were used to control this distance between them in future trials; their traking costs were presented too.

■ FD-17

Friday, 2:45-4:15pm
Sea Pearl V

New developments in Outranking Methods

Cluster: Multi-Criteria Decision Analysis
Invited session

Chair: *José Figueira*, School of Economics, University of Coimbra, Av. Dias da Silva, 165, Coimbra, Portugal, figueira@fe.uc.pt

1 - The Robustness Analysis: A powerful tool in the Multiple Criteria Decision Making Field

Gabriela Fernández Barberis, Métodos Cuantitativos para Economía, Universidad San Pablo-CEU. Fac. CC. Económicas y Empresariales, Julián Romea 23, 28003, Madrid, Madrid, Spain, ferbar@ceu.es, *María del Carmen Escribano Ródenas*

The Robustness Analysis of a Multicriteria Decision problem has became an additional step of the Decision Process. The paper tries to make clear which has been the development of the uncertanties consideration in the Multicriteria Decision-Aid field and which is the current situation.

2 - An inverse analysis of ELECTRE III

José Figueira, School of Economics, University of Coimbra, Av. Dias da Silva, 165, Coimbra, Portugal, figueira@fe.uc.pt, *Tommi Tervonen*, *Risto Lahdelma*, *Pekka Salminen*

ELECTRE III is a well-known multiple criteria decision aiding (MCDA) method. In this paper, we introduce an inverse weight-space analysis for the ELECTRE III. The inverse analysis is based on a modified version of the Stochastic Multicriteria Acceptability Analysis (SMAA). We also derive robust conclusions of an existing ELECTRE III application by applying the inverse approach.

3 - PROMETHEE CLUSTER and TRI: A new method for classification like problems

Yves De Smet, Service Mathématiques de la Gestion, Université Libre de Bruxelles, Boulevard du Triompe, Cp 210/01, Bruxelles, Bruxelles, Belgium, ydesmet@smg.ulb.ac.be, *José Figueira*, *Jean-Pierre Brans*, *Bertrand Mareschal*

In this paper we introduced a new methodology for classification (nominal and ordinal) and clustering problems. This methodology is mainly based on PROMETHEE method.

4 - Multicriteria Clustering: a Hierarchical Approach

Claude Lamboray, Service de Mathématiques de la Gestion SMG, bvd du Triopmphe, Cp 210-01, 1050, Bruxelles, Belgium, clambora@ulb.ac.be, *Yves De Smet*

We present an extension of the hierarchical clustering algorithm to the multicriteria framework. First, we present an approach based on the Pareto dominance relation. Then, it is extended to an algorithm based on the decision maker's preference structure. Finally, the context of multiattribute auctions will be used to illustrate their applicability.

■ FD-18

Friday, 2:45-4:15pm
Sea Pearl VI

Production and Inventory Systems IV

Cluster: Production and Inventory Systems
Contributed session

Chair: *Pär Brander*, Division of Industrial Logistics, Luleå University of Technology, 97187, Luleå, Sweden, par.brander@ltu.se

1 - Product configuration based on dynamic document structures

Tobias Teich, Economics, University of Applied Sciences Zwickau, Scheffelstr. 39, Psf 201037, 08012, Zwickau, Germany, tobias.teich@fh-zwickau.de, *Erik Oestreich*

The individualization of vehicles needs complex and particular descriptions of spezial peripheres. On the basis of a specification of a standard product and the customer wishes an electronic configuration can be developed with the help of a generic documental model. It can be transferred in a BOM by applicative algorithms.

2 - Three-Stage Production-Distribution Planning with Capacity Expansion

Bülent Çatay, Faculty of Eng. & Natural Sciences, Sabanci University, Tuzla, 34956, Istanbul, Turkey, catay@sabanciuniv.edu, *Pinar Yilmaz*

We address strategic level single-item, multi-supplier, multi-producer, multi-distributor production-distribution problem with deterministic demand. The objective is minimizing the costs associated with production, transportation, and inventory as well as capacity expansion costs subject to production and transportation capacities. The problem is formulated as 0-1 mixed integer program. Relaxation-based heuristics are proposed.

3 - A Double Threshold Accepting Algorithm for Order Assignment and Product Distribution Problems in a Multi-Plant System

Chi-Yang Tsai, Industrial Engineering and Management, Yuan Ze University, 135 Yuan-Tung Rd., 320, Chung-Li, Tao Yuan, Taiwan, iecytsai@saturn.yzu.edu.tw

This research considers order assignment and product distribution problems in a multi-plant system and proposes a double threshold accepting algorithm that minimizes total cost. The algorithm applies a feedback mechanism and an iterative approach to take into account the interrelation between the assignment phase and the distribution of the problem.

4 - Cyclic Lot Scheduling with Sequence-dependent Setups

Pär Brander, Division of Industrial Logistics, Luleå University of Technology, 97187, Luleå, Sweden, par.brander@ltu.se

We consider the problem of scheduling the production of multiple items on a single facility with constrained capacity. Only one item can be produced at a time, i.e. the Economic Lot Scheduling Problem. We assume sequence-dependent setups and present a heuristic for determination of cyclic schedules for this problem.

■ FD-19

Friday, 2:45-4:15pm
Nautilus I

Data Mining and Data Base Modeling

Cluster: Data Mining and Data Base Modeling
Contributed session

Chair: *Mahesh Kumar*, Msis, Rutgers Business School, 180 University Avenue, 200E, Ackerson Hall, 07102, Newark, NJ, maheshk@rutgers.edu

1 - Optimal boundary finding method for the bumpy regions

Hideo Hirose, Systems Innovation & Informatics, Kyushu Institute of Technology, Iizuka 680-4, 820-8502, Fukuoka, Japan, hirose@ces.kyutech.ac.jp

Assuming that the points having response 0 and the points response 1 are very similarly distributed except some regions, we want to find the boundary for the bumpy regions in which the points with response 1 are much more frequently observed than in the whole support region.

2 - Using Adaptive Learning in Credit Scoring to Estimate Take-Up Probability Distribution

Hsin-Vonn Seow, School of Management, University of Southampton, Building 2, Highfield, So17 1bj, Southampton, United Kingdom, hvs@soton.ac.uk, *Lyn Thomas*

Current in consumer lending, there is an increasing need to assess whether the customer will accept that lending product or similar products with some variation in the features. The adaptive dynamic programming model developed assesses and updates the probability of customers accepting the various versions of the product.

3 - Clustering of Statistical Model Parameters Using Error-based Clustering

Mahesh Kumar, Msis, Rutgers Business School, 180 University Avenue, 200E, Ackerson Hall, 07102, Newark, NJ, maheshk@rutgers.edu

We show that for clustering of statistical model parameters error-based clustering performs significantly better than traditional clustering methods, such as k-means and hierarchical clustering. In particular, we present theory and empirical study results on clustering of four statistical models: sample averaging, linear regression, time series and Markov chain models.

■ FD-21

Friday, 2:45-4:15pm
Lehua Suite

Expert Systems / Neural Networks

Cluster: Expert Systems / Neural Networks
Contributed session

Chair: *Zuhaimy Ismail*, Mathematics, Universiti Teknologi Malaysia, Fakulti Sains, UTM, Skudai JOHOR, 81300, Johor bahru, Johor, Afghanistan, zuhaimyi@yahoo.com

1 - Failure Time Series Prediction in Industrial Maintenence Using Neural Networks

Rubião Torres, Ibmec - Br, Rua Moura Brasil, 74 - 801, Laranjeiras, 22231200, Rio de Janeiro, Rio de janeiro, Brazil, rubtor@attglobal.net, *Maria Augusta Machado*, *Reinaldo Souza*

A daily times series is modeled based on dada from a five years period of maintenence interventions pauses.The purpose is to introduce these models and verify its system's pauses prediction capacity aiming the extension of operational periods. The results demonstrate the applicability of Neural Networks in failure predictions.

2 - An Application of Genetic Simulation Approach to Layout Problem in Robot Arm Assembly Factory

Zih-Ping Ho, Industrial Engineering and Enterprise Information, Tunghai University, No.181, 3Sec., Zhong-Gang Rd., 40704, Tai-Zhong, Taiwan, c8880@ms21.hinet.net, *Chyuan Perng*

The space of the assembly room in robot arm factory is the limited resource. This research aim at dynamic layout strategies by genetic algorithm (GA) simulation approach and database technique. It is validated that we try to solve the 4-Dimensions question of layout problem in one information system efficiently.

3 - Forecasting of Malaysian Electricity Load Profile Using Rule-Based Approach

Zuhaimy Ismail, Mathematics, Universiti Teknologi Malaysia, Fakulti Sains, UTM, Skudai JOHOR, 81300, Johor bahru, Johor, Afghanistan, zuhaimyi@yahoo.com

Increase in energy cost and uncertainty over the availability and sources of energy call for improve optimization and accurate forecasting of energy demand. Current practices of forecasting in Malaysia are studied and rule-based forecasting procedures are developed to produce half hourly forecasts of Malaysian Electricity load profile.

■ FD-23

Friday, 2:45-4:15pm
Kahili II

Strategic Planning and Management
Cluster: Strategic Planning and Management
Contributed session

Chair: *Tae Hee Moon*, Ise, Yonsei University, Shinchon-dong, 134 Sudaemoon-gu, Seoul, Korea, Republic Of, mthstat@yonsei.ac.kr

1 - Building a Balanced Scorecard the OR way

Mik Wisniewski, Management Science, Strathclyde Business School, Glasgow, G1 1qe, Glasgow, mik@mansci.strath.ac.uk, *Fran Ackermann*, *Valerie Belton*, *Farhad Shafti*

The Scorecard is an increasingly common approach in performance measurement. The process of building a Scorecard is complex, messy and subjective - characteristics that typify OR modelling. This paper examines how OR can contribute to the effective development of a Scorecard.

2 - Establishing the Use of Holons as an Enquiry Method

Jon Warwick, Faculty of BCIM, London South Bank University, Borough Road, Se1 0aa, London, United Kingdom, warwick@lsbu.ac.uk, *Gary Bell*

The need for utilising holons as part of 'systems intervention' is argued and demonstrated through an investigation within a UK Higher Education Institution. The case study approach is used to evaluate the use of holons against traditional management enquiry, and we suggest connections with mathematical techniques linked with project management.

3 - A multimethodology approach for analysing complex problems - a case study

Stein Malerud, Norewgian Defence Research Establishment, P.O.Box 25, N-2027 Kjeller, Norway, 2007, Kjeller, sma@ffi.no, *Martin Gilljam*

We present a case study addressing the trade-off between scientific recognition and applied science. The objective is to learn more about problem structuring methods used prior to a more comprehensive model development and analysis. Soft system methodology is utilised in combination with other OR-methods in a multimethodology.

4 - Positioning of IT Growth Engines using Multidimensional Scaling Method

Tae Hee Moon, Ise, Yonsei University, Shinchon-dong, 134 Sudaemoon-gu, Seoul, Korea, Republic Of, mthstat@yonsei.ac.kr, *So Young Sohn*

Understanding the value chain among 9 growth engines is essential to successfully promote the IT 839 Strategy proposed by Korean government. In this paper, MDS is used to analyze the relationship among the engines. It is expected that our approach can give direction for the effective implementation of the Strategy.

■ FD-24

Friday, 2:45-4:15pm
Hibiscus I

Marketing III
Cluster: Marketing
Contributed session

Chair: *Pedro Steiner neto*, Business, Federal University at Paraná, R. Pe. Anchieta, 1231, 80730-000, Curitiba, Pr., Brazil, pedrosteiner@ufpr.br

1 - Marketing/inventory interactions in the characterization of retailer response to manufacturer trade deals

Francisco Arcelus, Faculty Of Administration, University Of New Brunswick, P.o. Box 4400, Fredericton, new brunswick, Canada, arcelus@unb.ca, *Gopalan Srinivasan*

This paper discusses possible strategies of a profit-maximizing retailer, in the presence of forward-buying opportunities and anti-hoarding strategies on the part of the manufacturer. The analysis establishes a direct and positive link between the incidence of forward buying and the incidence of more-than-100% price pass-through policies.

2 - Partitioned Fuzzy Integral Nested Logit Model for Taiwan's Internet Telephony Market

Fang-Mei Tseng, Department of International Business, 135 Yuan-Tung RD., Chung-Li, 320, Taoyuan, fmtseng@ms73.hinet.net

The multinomial logit model is the widely used discrete choice model. However, it has the property that independence of irrelevant alternatives and the attributes are additive. This study proposes the partitioned fuzzy integral nested logit to solve these problems and Taiwan's Internet Telephony market is used to illustrate this model.

3 - The measurement of the influence by family members on purchasing decisions: a multivariate analysis study

Pedro Steiner neto, Business, Federal University at Paraná, R. Pe. Anchieta, 1231, 80730-000, Curitiba, Pr., Brazil, pedrosteiner@ufpr.br, *Roberto Cunha*, *Maria Teresinha Arns Steiner*

This paper adopts the father-mother-child triad as the key to understanding how selected socio-demographic variables affect the level of influence of every family member on purchasing decisions. A multivariate analysis is performed to address the perceived influence on each purchase process step.

4 - Optimal Service Policy with Negative Network Externality Under Finite Capacity

David Ching-I Teng, Department of Business Administration, Chang Gung University, 14, Ally10, Lane167, Sec 4, Cheng-Kung Rd, 114, Taipei, Taiwan, chingit@mail.cgu.edu.tw, *David Ming-Huang Chiang*

When meeting the preference of particular group of consumers hurts the interests of another group, the intuition to meet the preference of the majority is shown not optimal in all cases. Managers shall balance consumption amount with/without met preference and the size of each group to reach the optimal profit.

■ FD-25

Friday, 2:45-4:15pm
Hibiscus II

Military Applications II

Cluster: Military Applications
Contributed session

Chair: *Yoon Kyung Bok*, Informaiton and Industrial Systems Engineering, Yonsei University, Dept. of Informaiton and Industrial Systems Engineering, Yonsei University Shichondong 134 Seoul, Korea, 120-749, Seoul, Korea, Republic Of, ykb@yonsei.ac.kr

1 - Comparison of Multiple Modeling Methods for Stryker Brigade Deployment

Alan Johnson, Dept of Operational Sciences, Air Force Institute of Technology, 2950 Hobson Way, Bldg 41, 45433-7765, Wright-Patterson AFB, OH, United States, alan.johnson@afit.edu

We compare methods of modeling military deployments, to quantify relationships between simplified, deterministic spreadsheet based models and more robust higher-fidelity stochastic simulation models. Our goal was to develop functions that would enable a transportation analyst to combine the speed of quicklook spreadsheet tools with the fidelity of higher-fidelity modeling methods.

2 - Analysis Issues with Agent-Based Military Simulations

Raymond Hill, Biomedical, Industrial & Human Factors, Wright State University, 207 Russ Eng. Center, 3640 Col Glenn Hwy, 45435, Dayton, OH, ray.hill@wright.edu

Multi-agent simulations are of great interest to military analysis. An intriguing aspect, "emergent behavior," arises due to the interactions among the agents within the model. We summarize some recent military-based agent-based simulation models examining its emergent behavior and discuss validation issues with agent models associated and the emergent behavior.

3 - Enabling A Transforming Army at War: A Supply Chain Approach

Greg Parlier, Office for Economic Development, University of Alabama in Huntsville, Vbrh B-20, 35749, Huntsville, AL, United States, parlieg@email.uah.edu

Major analytical challenges confronting US Army Logistics Transformation are presented. A systems approach, combining classical inventory theory, recent developments in large-scale supply chain design/management theory, and innovative approaches pioneered in the corporate sector, culminates in the development of an "analytical architecture" to guide Logistics Transformation. Emerging results will be presented.

4 - Forecasting both time varying MTBF of fighter aircraft module and expected demand of minor parts

Yoon Kyung Bok, Informaiton and Industrial Systems Engineering, Yonsei University, Dept. of Informaiton and Industrial Systems Engineering, Yonsei University Shichondong 134 Seoul, Korea, 120-749, Seoul, Korea, Republic Of, ykb@yonsei.ac.kr, *So Young Sohn*

A fundamental aspect of logistics management of fighter aircraft is proper inventory control of minor parts in main module. In this paper, we use a random effects model to forecast optimal inventory level of minor parts in the module of fighter aircrafts based on varying characteristics of modules over time.

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