3.3 Plenary Talks

Wednesday, Sep. 3, 2003, 10:15 – 11:00, Room: NU Aula

Chair: Wäscher, Gerhard

Cook, Thomas *(CALEB Technologies Corp.)*

Augmented Revenue Management

All revenue management systems make poor overbooking and discount allocation decisions due to errors in demand forecasts, errors in the data, and human errors. These errors result in revenue spilled to other airlines, spoilage, oversales, poor utilization of assets, and poor customer service.

This presentation presents a conceptual approach to addressing the problems of today's revenue management systems by systematically detecting opportunity flights and either smoothing the demand or dynamically changing the capacity.

Thursday, Sep. 4, 2003, 10:30 – 11:15, Room: NU Aula

Chair: Hofmann, Christian

Küpper, Hans-Ulrich *(Ludwig-Maximilians-Universität München)*

OR und Controlling - Der Beitrag quantitativer Theorie zur Selbstfindung und Akzeptanz einer praxisorientierten Disziplin

Controlling ist eine Disziplin, die sich aus der Praxis heraus entwickelt, im wissenschaftlichen Bereich aber erst langsam Anerkennung gefunden hat. Noch vor zwei Jahrzehnten konnte man dieses Fach nur an wenigen deutschen Universitäten studieren, Bücher und Aufsätze zu ihm waren stark von praktischen Instrumenten und Erfahrungen geprägt. Inzwischen ist Controlling an fast allen Universitäten sowie Fachhochschulen vertreten und gehört in den Kern betriebswirtschaftlicher Ausbildung, obwohl bis heute keine einheitliche Auffassung über seinen Gegenstand und genauere Abgrenzung besteht. Zudem findet es sich im internationalen Raum mehr unter anderen Bezeichnungen wie Management Accounting, obwohl seine Herkunft auf amerikanische Wurzeln zurückzuführen ist.

In dem Beitrag wird analysiert, welchen Einfluß die Entwicklung und Anwendung quantitativer Theorieansätze auf die Verankerung des Controlling im wissenschaftlichen Bereich hatte. Es wird nachgezeichnet, wie Modelle und Methoden insbesondere der quantitativen Planungstheorie sowie der normativen Agencytheorie zur Analyse und Lösung typischer Problemstellungen des Controlling herangezogen werden. Dabei wird herausgearbeitet, worin die spezifischen Merkmale dieser quantitativen Ansätze und der mit ihnen behandelten Controllingtatbestände liegen. Auf diesem Weg läßt sich erkennen, wie Instrumente des Operations Systems zur theoretischen Fundierung einer Disziplin beigetragen haben, durch die sie zu einem für die Forschung attraktiven Gebiet geworden ist und damit die wissenschaftliche Akzeptanz erreicht hat.

Diese Entwicklung liefert ein interessantes Beispiel für ein erfolgreiches Zusammenspiel zwischen Operations Research und einem wichtigen Bereich der Praxis. An ihr läßt sich zeigen, wo die Wurzeln für eine Synergie zwischen Wissenschaft und Praxis liegen, wie sie gerade für das Operations Research notwendig und charakteristisch ist.

Friday, Sep. 5, 2003, 10:30 – 11:15, Room: NU Aula

Chair: Reinelt, Gerhard

Nemhauser, George L. *(Industrial and Systems Engineering, Georgia Institute of Technology)*

Robust Airline Scheduling – Can Theory be Extended to Practice?

We begin by describing the goals of robust planning in airline plane and crew scheduling. We discuss why this problem is so difficult and our attempts at finding a practical approach to solving it. We then consider some simpler generic stochastic routing problems including a stochastic shortest path problem with random arc lengths and random arc failures. Here we show that the sample average approximation approach of stochastic programming together with a branch-and-cut algorithm is quite successful at obtaining provably good solutions and, surprisingly, the running time of the algorithm does not depend on the sample size.

3.4 Semiplenary Talks

Wednesday, Sep. 3, 2003, 11:30 – 12:15, Room: NU 04

Chair: Drexl, Andreas

Baptiste, Philippe *(CNRS LIX, Ecole Polytechnique)*

Recent Advances in Constraint Based Scheduling

In the recent years, researchers have integrated many specific and complex OR techniques in Constraint Programming (CP) tools. Because of the declarativity of CP, the tools are still easy to use and CP is a great industrial success.

In this talk, we describe two recent advances in constraint-based scheduling. First, we show how CP, Linear programming and column generation techniques can cooperate to compute very good lower and upper-bounds for a specific problem known as the "Resource-Constrained Project Scheduling Problem". Second, we show how CP can be used to solve scheduling problems with complex objective critria such as the minimization of the weighted number of late jobs.

Finally, we give an overview of the existing constraint-based scheduling engines and we try to identify the current limitations of these tools. We also highlight some promising research directions.

Wednesday, Sep. 3, 2003, 11:30 – 12:15, Room: NU 05

Chair: Günther, Hans-Otto

Piepenbrock, Georg *(Tecnomatix, Stuttgart)*

Integration von Simulation in die Prozessplanung

Im Rahmen der Prozessplanung werden die für die Produktion von Gütern notwendigen Arbeitsschritte und Arbeitsmittel geplant. In der bisherigen Organisation der Hersteller gibt es eine enge Einbindung von Produktdaten in diesen Planungsprozess. Diese Produktdaten liegen in der Regel als elektronische Daten (CAD, PDM, BOM) vor. Mit dem Begriff electronic Bill of Process (eBOP) wird die computergestützte Planung und Verwaltung von Fertigungsprozessen und Arbeitsschritten bezeichnet. Die Simulation von Materialfluss und Logistik hat sich in der Prozessplanung als wichtiges Werkzeug zur Entwicklung und Beurteilung von Planungsalternativen etabliert. In dem Tagungsbeitrag wird die werkzeuggestützte Integration der Simulation in die Prozessplanung beschrieben. Mit dieser Integration können deutlich kürzere Planungszyklen bei gleichzeitig hoher Datenkonsistenz erreicht werden. Besondere Anforderungen an die Ablaufsimulation werden im Bereich der Layoutplanung von Logistik und Transportsystemen gestellt. Formalisierungsansätze wie SDX (simulation data exchange) erlauben die Übernahme entsprechender Modelle von CAD-Systemen in Simulatoren. Die sorgfältige Definition, Verwaltung und Auswertung von Simulationsexperimenten ist eine wichtige Voraussetzung für stochastisch valide und aussagekräftige Simulationsstudien. Die gezeigten integrativen Ansätze berücksichtigen daher ebenfalls klare Schnittstellen zur Parametrierung und Einbindung von Modellen in Experimentläufe.

Wednesday, Sep. 3, 2003, 11:30 – 12:15, Room: NU 09

Chair: Rieder, Ulrich

Bäuerle, Nicole *(University of Hannover)*

New Control Problems in Insurance Mathematics

In the last years there emerged a number of interesting stochastic control problems in insurance mathematics. These problems are based on a simple model for the stochastic process of the risk reserve of an insurance company (so-called Cramér-Lundberg model). The optimization arises since the management is able to control the risk reserve dynamically by selecting

- a reinsurance strategy
- an investment strategy and
- a dividend pay-out policy.

Typical aims are to maximize the expected discounted dividend pay-out until ruin or to minimize the probability of ruin. In our talk we will first give a survey of these models and show how optimal or ε-optimal strategies can be found by solving the HJB equation of the problem or of the corresponding diffusion approximation. In a second part we will look at a special control problem where two different types of reinsurance are available: a traditional proportional reinsurance and a non-traditional reinsurance via CAT-Bonds. The probability of ruin has to be minimized by a suitable reinsurance mix. We will solve the diffusion approximation of this problem and discuss the results.

Wednesday, Sep. 3, 2003, 16:00 – 16:45, Room: NU 04

Chair: Fleischmann, Bernhard

Simchi-Levi, David *(Massachusetts Institute of Technology, Cambridge)*

Coordinating Inventory Control and Pricing Strategies with Random Demand and Fixed Ordering Cost

In this presentation we review recent research on single product, periodic review models in which pricing and production/inventory decisions are made simultaneously. Demands in different periods are random variables that are independent of each other and their distributions depend on the product price. Pricing and ordering decisions are made at the beginning of each period and all shortages are backlogged. Ordering cost includes both a fixed cost and a variable cost proportional to the amount ordered. We consider both the finite and infinite horizon models. In the finite horizon model the objective is to find an inventory policy and a pricing strategy maximizing expected discounted profit over the finite horizon. In the infinite horizon the objective is to maximize expected discounted, or expected average profit.

Finally, we discuss the implementation of coordinated pricing and inventory decisions in an industrial setting and suggest application areas and potential pitfalls.

Wednesday, Sep. 3, 2003, 16:00 – 16:45, Room: NU 05

Chair: Huschens, Stefan

Helbing, Dirk *(Institute for Economics and Traffic, Technical University Dresden)*

Models and Experiments of Dynamic Decision Behavior

We will present dynamical models for decision making with and without temporal constraints [1,2]. These models take into account the non-transitive and probabilistic aspects of decisions, i.e. they reflect the observation that not always the decision with the highest utility or payoff is taken. The theory is compared with recent results of experimental games relevant to the route choice behavior of drivers. The adaptivity ("group intelligence") with respect to changing environmental conditions and unreliable information is quite astonishing. Nevertheless, we find an intermittent dynamical reaction to aggregate information similar to volatility clustering in stock market data, which leads to considerable losses in the average payoffs. It turns out that the decision behavior is not just driven by the potential gains in payoffs. To understand these findings, one has to consider individual learning. Our results are highly significant for predicting decision behavior and reaching the optimal distribution of behaviors by means of decision support systems. These results are practically relevant for any information service provider, although the test persons were found to be more or less resistant against manipulation through biased information. Participants followed recommendations just as much as they helped them to reach their personal goals.

[1] D. Helbing: Quantitative Sociodynamics, Kluwer Academic, Dordrecht, 1995.

[2] D. Helbing: Dynamic decision behavior and optimal guidance through information services: Models and experiments. In M. Schreckenberg and R. Selten (eds.) Human Behaviour and Traffic Networks, Springer, Berlin, 2003, in print.

Wednesday, Sep. 3, 2003, 16:00 – 16:45, Room: NU 09

Chair: Rommelfanger, Heinrich

Slowinski, Roman *(Institute of Computing Science, Poznan University of Technology)*

Knowledge Discovery From Preference-Ordered Data Via Rough and Granular Computing

The paper is devoted to knowledge discovery from data, taking into account prior knowledge about preference semantics in classification patterns to be discovered. The data concern a set of situations (objects, states, examples) described by a set of attributes (properties, features, characteristics). The attributes are, in general, divided into condition and decision attributes, corresponding to input and output of a situation. The situations are partitioned by decision attributes into decision classes. A pattern discovered from the data has a symbolic form of decision rule or decision tree. In many practical problems, some condition attributes are defined on preference-ordered scales and the decision classes are also preference-ordered. The known methods of knowledge discovery ignore, unfortunately, this preference information, taking thus a risk of drawing wrong patterns. To deal with preference-ordered data we propose to use a new approach called Dominance-based Rough Set Approach (DRSA). Given a set of situations described by at least one condition attribute with preference-ordered scale and partitioned into preference-ordered classes, the new rough set approach is able to approximate this classification by means of dominance relations. The rough approximation of this classification is a starting point for induction of "if..., then..." decision rules. The syntax of these rules is adapted to represent preference orders. The DRSA analyses only facts present in data and possible inconsistencies are identified. It preserves the concept of granular computing, however, the granules are dominance cones in evaluation space, and not bounded sets. It is also concordant with the paradigm of computing with words, as it exploits ordinal, and not necessarily cardinal, character of data. We present the basic version of DRSA and its major extensions: DRSA for multiple-criteria choice and ranking, DRSA for decisions under risk and, finally, we characterize dominance-based decision rules as a preference model.

Thursday, Sep. 4, 2003, 11:30 – 12:15, Room: NU 04

Chair: Gaul, Wolfgang

DeSarbo, Wayne S. *(Pennsylvania State University)*
Fong, Duncan K. H. *(Pennsylvania State University)*
Liechty, John *(Pennsylvania State University)*
Chang, Jennifer *(Pennsylvania State University)*

Evolutionary Preference/Utility Functions: A Dynamic Perspective

The collection of repeated measures in psychological research is one of the most common techniques in all forms of survey and experimental research. As a popular example of such repeated measures, revealed preference analysis or conjoint measurement involves the collection of preferences or choices over a designated set of hypothetical stimulus profiles that are collected sequentially over the course of a survey. The behavioral decision theory literature documents the existence of the dynamic evolution of preferences that occur over time and experience that occurs due to learning, exposure to additional information, fatigue, cognitive storage limitations, etc. We introduce a Bayesian dynamic linear methodology that permits the detection and modeling of such potential changes to the underlying preference/utility structure of the respondent. A new empirical Bayes estimation framework is developed for the recursive estimation of model parameters. An illustration of revealed preference analysis is given involving students' preferences for apartments and their underlying attributes and features. Finally, directions for future research are discussed.

Thursday, Sep. 4, 2003, 11:30 – 12:15, Room: NU 05

Chair: Gritzmann, Peter

Weismantel, Robert *(University of Magdeburg)*

From Integral Bases to an Integer Programming Algorithm

This talk deals with the design of a new integer programming algorithm that is based on the theory of irreducible sets of points. We will explain the latter issue in detail and demonstrate on computational results that this approach is promising.

Thursday, Sep. 4, 2003, 11:30 – 12:15, Room: NU 09

Chair: Grünert, Tore

Crainic, Teodor Gabriel *(Département management et technologie, Université du Québec à Montréal)*

City Logistics, Issues, Models and Methods

City Logistics refers to the new approach of addressing the issues related to freight transportation within congested urban areas. The goal is a better management of freight flows to decrease congestion and pollution, while not penalizing the economic and social activities of the city. New approaches to transportation policies, planning, and operations are needed in order to achieve these goals. From a transportation point of view, one needs to stop considering each shipment as an individual entity. Rather, the entry and exit freight flows must be considered together into an integrated planning and operations where demands and shipments are consolidated such that vehicles are fully loaded and the number of trips is decreased. Operations Research may play an important role in the success of such approaches through the advanced models and methods for the planning and operational management of city logistics systems. In this talk, we will first describe the context and issues related to the city logistics concepts, pointing towards current experiments in a number of European cities. We will then describe a two-tier city-logistic system architecture and present a number of models for the design of the system and the planning and management of the corresponding operations. We will conclude with a number of challenges and possible research directions

Friday, Sep. 5, 2003, 11:30 – 12:15, Room: NU 04

Chair: Martin, Alexander

Mathar, Rudolf *(RWTH Aachen)*

On the Capacity and Optimization of UMTS Networks

The capacity of code division multiple access systems like UMTS, the upcoming universal mobile telecommunication system, is interference limited. Each user is assumed to request for a certain transmission rate combined with a maximum tolerable decoding error. By using a decentral power control algorithm the system aims at calibrating each user's transmission power to a minimum threshold such that all user demands can be satisfied.

In this presentation, the capacity region for n users is defined as the set of demand profiles in the n-dimensional Euclidean space which admit a feasible transmit power allocation. We investigate the geometry and topological

properties of the capacity region in the case of unlimited and limited power, respectively. In either case it turns out to be a convex set. Furthermore, minimax power allocation policies are determined for balancing contrary interests of users whenever a demand profile is infeasible.

Finally, we deal with the problem of maximizing network capacity by selecting an optimal antenna location and configuration pattern from a pool of candidates. Our approach leads to an integer program which is solved for moderate but realistic problem sizes by a specifically tailored branch-and-bound algorithm.

Friday, Sep. 5, 2003, 11:30 – 12:15, Room: NU 05

Chair: Lehmann-Waffenschmidt, Marco

Eichberger, Jürgen *(Universität Heidelberg)*

Game Theory with Non-Expected Utility Preferences

Since von Neumann-Morgenstern's (1948) seminal work, game theory has been closely connected with expected utility theory. Notions like the mixed extension of a game in pure strategies are inextricably linked to the expected utility decision criterion.

Recently axiomatic foundations for preferences represented by non-expected utility functionals, the Choquet integral and maximin expected utility, have been provided. These representations maintain the distinction between beliefs and evaluation of outcomes. If beliefs are not represented by probabilities, equilibrium concepts of game theory need to be reconsidered.

The lecture points out the main problems for game theoretic analysis entailed by a departure from expected utility theory. It reviews some of the solution concepts suggested in the literature. Examples illustrate how non-expected utility preferences can provide new game-theoretic results and account for some well-known puzzles.

Friday, Sep. 5, 2003, 16:00 – 16:45, Room: NU 04

Chair: Jahn, Johannes

Fliege, Jörg *(Universität Dortmund)*

Some Computational Issues in Multicriteria Optimization

Multicriteria optimization considers the problem of minimizing several objective functions simultaneously. The first question one has to tackle for this type of problem is "What is a solution?". This talk concentrates on *efficient* (Pareto-optimal) decisions, which can be characterized roughly by saying that for these decisions, there is no other decisions which is better for all objectives at hand.

In this talk, it will be argued that in stark contrast to classical optimization the knowledge of one efficient decision is seldom enough for a decision maker resp. a group of decision makers. Indeed, it is important to gain as much information about the structure of the set of efficient decisions as possible. This gives rise to the question of efficient —i. e. *fast*— and robust algorithms for approximating the *whole* set of efficient points in a certain well-defined way.

The talk analyzes several difficult problems encountered when designing and implementing algorithms for this problem and reviews several known and new approaches.

Friday, Sep. 5, 2003, 16:00 – 16:45, Room: NU 05

Chair: Trautmann, Siegfried

Korn, Ralf *(Universität Kaiserslautern)*

Recent Developments in Continuous-Time Portfolio Optimization

The optimal investment problem in continuous time is one of the classical tasks in modern financial mathematics. However, some simplyfying assumptions in the theory were yet preventing its results from a breakthrough in practical applications. In this talk, some recent developments in the area of continuous-time portfolio optimization are presented that will show that a lot of practical issues have been solved now making the results relevant for practical use. Among those are the trading of defaultable assets, crash models, interest rate products and the use of transaction cost models.
