Abstracts

On On-line systems for short-term forecasting for energy systems

Henrik Aalborg Nielsen We 9:00 - 9:30, Room HS 6
Torben Skov Nielsen, Henrik Madsen

The paper describes experiences with developing on-line systems for short-term forecasting of wind power production and heat consumption in district heating networks. Furthermore, we discuss how the forecasts and uncertainty can be used as input to formal OR-models.

The paper is based on the authors participation in the development of two on-line systems called WPPT and PRESS. WPPT (Wind Power Prediction Tool) is a system for forecasting the total wind power produced on wind turbines in large geographical areas for up to 39 hours with a resolution of 30 minutes. PRESS (In Danish: PRognose og Energi Styrings System) is a system for forecasting the heat consumption in district heating networks and for controlling the supply temperature in order to reduce heat loss. In the paper we focus on forecasting, the horizon is 39 hours with a resolution of 1 hour. Both systems run at a number of locations.

The systems use on-line meteorological forecasts together with on-line measurements of the response in order to continuously update the underlying models. General aspects which have been identified as being important includes; (a) combination of statistical methods and knowledge about physical characteristics of the specific system, (b) uncertainty on meteorological forecasts, (c) dedicated models for each individual forecast horizon. These aspects will be explained and exemplified. Up-scaling of wind power forecasts from individual farms to geographical areas will be described.

In-formal use includes presenting the forecasts and uncertainty graphically and letting the user take appropriate action upon it. Formal approaches include the use of the forecasts as inputs to stochastic programming models. However, since individual models are used for each individual forecast horizon it is required to develop a stochastic model for the correlation structure of the prediction errors. An example considering wind power is briefly addressed.

Multi-agent scheduling models

Alessandro Agnetis Th 9:00 - 9:30, Room HS 4
Pitu B. Mirchandani, Dario Pacciarelli, Andrea Pacifici

We consider scheduling situations arising when two agents, each owning a set of nonpreemptive jobs, compete to perform their respective jobs on a common processing resource. Each agent wants to minimize a certain objective function, which depends on the completion times of his/her jobs only. This situation has been analyzed by means of game-theoretic models (sequencing games), economic models (market-oriented programming), probabilistic sequencing models. After reviewing the existing literature, we propose and illustrate a novel combinatorial optimization approach, focusing on the computation of nondominated schedules, i.e., such that a better schedule for one of the two agents necessarily results in a worse schedule for the other agent. We consider several objective functions (maximum of regular functions, number of tardy jobs, total weighted completion time), as well as several system structures (single-machine, flow shop, open shop). For each scenario, we address the complexity of the problem of finding single nondominated schedules, and we investigate the problem of determining their overall number. Open problems and hints for future research will be also presented.

New Heuristics and Lower Bounds for the Min-Max k-Chinese Postman Problem

Dino Ahr We 11:30 - 12:00, Room HS B
Gerhard Reinelt

Given an undirected edge-weighted graph and a depot node, postman problems are generally concerned with traversing the edges of the graph (starting and ending at the depot node) while minimizing the distance traveled. For the Min-Max k-Chinese Postman Problem (MM k-CPP) we have $k > 1$ postmen and want to minimize the longest of the k tours. We present two new heuristics and improvement procedures for the MM k-CPP. Furthermore, we give three new lower bounds in order to assess the quality of the heuristics. Extensive computational results show that our algorithms outperform the heuristic of Frederickson et al. (1978).

Operatives Konfliktmanagement im Projekt

André Ahuja We 9:00 - 9:30, Room HS 4

Ablaufkonflikte bedeuten die Unmöglichkeit der Realisierung und geben im Projekt bei Erkennung Anlass zur Planüberarbeitung. Ein operatives Projektkonfliktmanagement soll ein Ablaufreferenzsystem bereitstellen, Regeln zur Erkennung operativer Konflikte definieren und, in Abhängigkeit von der Erheblichkeit eines Konflikts, eine (bestenfalls optimale)

Behandlungsmöglichkeit vorschlagen. Im Idealfall besteht jenes Ablaufreferenzsystem aus einem mathematischen Totalmodell, welches eine Projektnutzenfunktion, also die Aggregation geeignet messbarer Teilziele, maximiert. In der Phase der Projektdefinition gestalten sich die Modellrestriktionen aus beschränkenden Rahmenbedingungen wie Budget oder Terminziel und sachlich-logischen Ablaufbedingungen. Mit dem Projektauftrag werden ein angestrebter Projektnutzen sowie Teilzielerreichungen festgeschrieben und bilden damit zusätzliche Restriktionen des hiermit abgeleiteten Durchführungsmodells. Dieser beschriebene Idealfall ist in der Praxis jedoch nicht anzutreffen. Statt dessen unterstützen im Regelfall Partialmodelle letztlich eine lexikografische Abarbeitung der auf der Stufe einer Mehrzielentscheidung verbliebenen Teilziele. So schließt sich an eine terminoptimierende Vorgangsplanung etwa eine nivellierende Ressourcenplanung an. In dieser Arbeit wird zunächst das projektphasenbezogene Konfliktmanagement auf Basis eines mathematischen Totalmodells aufgebaut. Anschließend wird der iterative Prozess der Optimierung, Konflikterkennung und -behandlung in Partialmodellen formalisiert. Insbesondere lässt sich hiermit ein Vorgehensschema für ein operatives Konfliktmanagement innerhalb dieser verbreiteten Modellwelt angeben. Schließlich werden beide Modellansätze bzw. Vorgehensweisen verglichen. Die hierdurch erkennbaren restriktiven Konsequenzen eines Konfliktmanagements auf Grundlage von Partialmodellen werden prinzipiell einer quantitativen Bewertung zugeführt.

Literatur:

MADAUSS, B.-J. (1984): Projektmanagement, C.E. Poeschel, Stuttgart.

RÖDDER, W., AHUJA, A (erscheint): Projektmanagement: Konzept, Aufgaben, Techniken, Kohlhammer, Stuttgart.

Project Risk Management by a Probabilistic Expert System

André Ahuja
Wilhelm Rödder

Tu 9:30 - 10:00, Room E1.05

Efficient applications of expert systems to problems of project risk management are seldom. In this paper we overcome this lack by using the probabilistic expert system shell SPIRIT. The rule-based shell's power in conditioning, inference and reasoning under incomplete information will work well on risk estimation, classification, and treatment. A SPIRIT's key characteristic is the possibility to integrate projects' objectives into the risk management method. So, one may not only implement known dependencies between risk variables but can also detect such dependencies, even if hidden. Furthermore, the method recommends adequate measures to risk treatment. Because of the novelty of projects they suffer from incomplete information which is explicitly handable by this type of expert systems. As the system models variables and structures in an undirected graph, undirected inference is possible. So, in an early-state risk management situation – where the definite model is not yet available – preliminary risk analyses are possible making SPIRIT a powerful tool. In other words, it enables szenario-analyses, even if certain variables and/or their respective dependencies are still unknown. An example shows project risk management using SPIRIT providing interesting results, e.g. expected cost reduction by imployment of external resources as a measure for risk reduction.

References:

RAFTERY, J. (1994): Risk analysis in project management, E.& F.N. Spon, London.

RÖDDER, W. (2000): Conditional Logic and the Principle of Entropy, Artificial Intelligence, 117, p. 83-106.

RÖDDER, W., AHUJA, A (forthcoming): Projektmanagement: Konzept, Aufgaben, Techniken, Kohlhammer, Stuttgart.

SCHÖN, D. / DIEDERICHS M. / BUSCH V. (2001): Chancen- und Risikomanagement im Projektgeschäft, in: Controlling, (2001) 7, p. 379-387.

Sensitivity Analysis by a Strategy Network Method

André Ahuja

We 15:00 - 15:30, Room HS 10

An optimal sequence of decisions under risk or strategy, respectively, for discrete problems can be determined by using decision trees. Under certain circumstances decision trees can be transformed into decision networks. In this paper such a transformation will be generalized considering a strategy network, which especially is able to handle continuous ranges of actions and states. First, the new presented strategy network method will provide optimal strategies by means of maximizing expected utility, and second it will calculate the 'cost buffer' of each suboptimal strategy. The respective calculus reminds of time scheduling by the critical path network method and motivated the name of this new method. Cost buffers serve as a basis for different types of analyses. On the one hand they show the expected disadvantage when selecting a suboptimal strategy. On the other hand they detect, which measures should be taken in order to improve an inferior strategy. The strategy network method is developed within the following steps:

1. Definition of structural elements for a strategy network
2. Assignment of subsets of strategies to structural elements
3. Valuation of input structural elements (arcs) by input data of strategies

4. Valuation of remaining structural elements (nodes) by means of respective rules

5. Deriving the optimal solution

6. Sensitivity analysis on the strategies' space.

An interesting example shows the strategy network method as a whole followed by its comparison with stochastic networks and decision networks.

References

AHUJA, A. (1999): Optimale Entscheidungsstrategien unter dem Aspekt der Nutzenmaximierung, thesis, Institute of Operations Research, FernUniversität in Hagen.

SALIGER, E. (1998): Betriebswirtschaftliche Entscheidungstheorie, 4th ed., Munich.

Multi-stage dynamic production stock planning which performed in West Machine Company

H. Ahmet Akdeniz
Mehmet Aksarayli

Tu 14:30 - 15:00, Room HS 9

In today's world, production of goods and service is an important indicator of a country's development and competitiveness. A company which wants to sell its products in world market has to use production resources effectively.

Unnecessary stock holding increases costs and it is not good for a company which dedicated itself to effectiveness and profit. Production stock planning is a way that helps the company to meet its demands and to have minimum costs. This study is about production stock planning which has a dynamic structure and then multi-stage dynamic production stock planning which performed in West Machine Company is presented.

Selecting the Best Stochastic System when the Number of Alternatives is Large

Ameen Alawneh
Mahmoud Alrefaei

Tu 17:30 - 18:00, Room HS 9

Selecting the system with the best expected performance measure with a pre specified significance level is an important and not easy task, particularly, when the number of alternatives is large. When the number of alternatives is small, say less than 20, then methods of ranking and selection can be used. However, in this paper we consider the problem of selecting the system that has the best performance when the number of alternative systems is large. We introduce a method that consists of two phases. In the first phase, we screen out non-competent alternatives and construct a confidence set that contains the best alternative with a pre specified precision. The second phase uses ranking and selection statistical procedure to select the best expected alternative among the survivals of the first stage. To improve the computational efficiency, we use the standard clock simulation which is a technique that can simulate multiple points using only a single sample path. We also present numerical example which shows that the algorithm converges to an optimal solution quickly.

On some extensions of the Cramer-Lundberg model in risk theory

Hansjörg Albrecher

Tu 17:30 - 18:00, Room E1.05

The classical Cramer-Lundberg model in collective risk theory for the surplus process of an insurance portfolio is characterized by a Poisson claim number process, independent and identically distributed claims and a constant premium density. Several generalizations of this model are considered. In a ruin model allowing for a constant force of inflation and interest on the free reserve, we investigate when it is suitable to represent the finite-time survival probability as a gamma series and derive some exact analytical solutions for exponentially distributed claim sizes. In a model with dividend payments according to a non-linear dividend barrier strategy, integro-differential equations for the survival probability and the expected discounted dividend payments are derived and, using integral operators, efficient number-theoretic solution methods are developed. Moreover we investigate the behavior of the Lundberg exponent when dependence structures among consecutive claims are considered.

Roadway Grades Modeled by A Polynomial That Minimizes Earthwork Cost

Mohammed Aljohani Th 11:30 - 12:00, Room HS 3
Ahmad A. Moreb

The roadway grade selection usually involves earthwork (transportation) that can be solved using linear programming. Previous work in dealing with roadway grade selection considered the road profile as series of interconnected linear segments. Constraints are included in the linear programming formulation to insure continuity of the road. The sharp connectivity points along the road are usually ignored. Disregarding the sharp connectivity points issue was not justified. In this paper, the issue of sharp connectivity points is resolved by representing the road profile by a high order polynomial. Although a high order polynomial is used to represent the road profile, the mathematical model representing the transportation of earthwork is purely linear in nature. Linearity had facilitated the use of the linear simplex method and at the same time guaranteed global optimality. Besides the sharp connectivity smoothing, this method gives a minimum cost less than that of all previous methods.

Keywords: Linear programming; Transportation; Earthwork allocation; Roadway grades

---

Age-dependent Optimal Prevention Program for Marijuana Use in Australia

Christian Almeder Tu 9:30 - 10:00, Room HS 7
C.Y. Kaya, G. Tragler, G. Feichtinger

Often models of drug initiation and drug use are based on the same principles as epidemiological models. Drug use can be observed to be contagious in the sense that use by some individuals affects the probability that others will start using the drug through several mechanisms. At a reputational level, experiences of others can be instrumental in shaping perceptions of the riskiness of drugs, and those perceptions in turn influence initiation. Indeed, the very fact that the mechanism of transmission does not require physical contact or interaction makes the dynamics of contagion more complex and more interesting.

In Australia the so-called National Drug Strategy Household Surveys (NDSHS) are conducted regularly, where a large number of people chosen at random are interviewed about their experiences with drugs. The NDSHS conducted in 1998 involved more than 10000 people, where more than half reported to have used marijuana. Based on this NDSHS, an optimal control model has been developed. The model explores the age-dependency of a prevention program. The system dynamics are described by an extended version of the McKendrick equation, a hyperbolic partial differential equation of first order. This extended version includes an integral term which reflects the influence between different age groups and the society-wide reputation of a drug. The objective to be minimized is the total social cost, which consists of the cost due to drug consumption and the cost of prevention programs.

Necessary optimality conditions can be derived for this system, however the problem can only be solved numerically. Under the assumption that the effect of prevention programs is seen immediately, the main result is given as that the age distribution for prevention programs should be similar to that of initiation. This kind of a model is a good starting point to explore different types of prevention programs and their interaction with treatment.

The Medical Formation in the Spanish Health System. Dynamic Analysis

Isabel Alonso Magdaleno We 12:00 - 12:30, Room HS 7

During the second half of the seventies and eighties, the Spanish Health System lived a strong expansion. This generated a great demand of physicians; which overcame, amply, the readiness of doctors. Equally, in the nineties, the supply of MIR “house physician (intern)” vacancies has been increased gradually; even when the necessities of physicians have diminished. That is to say, the coverage rate “MIR vacancies allocated on new graduated” initially was very reduced. Although, at the present time the number MIR vacancies allocated overcomes the number of recently graduated. The specific sequence followed in the supply of MIR vacancies, along the eighties and nineties, has generated an important imbalance between supply and demand of specialized doctors in the Spanish Health System. The objective of this work is the elaboration of a model, using system dynamics, whose purpose is to identify the causes or origins of those imbalances. Its purpose is to learn of the system behavior rather the realization of future forecasts.

The Number of Physicians in the Spanish Health System

Isabel Alonso Magdaleno Mo 17:30 - 18:00, Room HS 8

The supply of MIR “house physician (intern)” vacancies constitutes the main instrument of planning human resources in the Spanish Health System. Nevertheless, this supply has been carried out by the immediate necessities of physicians and for the short-term orientation in solving problems. Nowadays, Spain has one of the biggest amounts of physicians per capita. This situation is worrying in comparison with other countries in our environment. As a result of that, in our

country there is an imbalance between demand and supply of physicians, a fact which is bringing the system up to an untenable situation that risks the future of physicians profession and increases the sanitary costs. This paper argues about the rationality of present planning policies and simulates the evolution of number of physicians for the next twenty years, based on the formation process carried for a long time and on the politic trends.

Simulated Annealing Type Algorithm for Continuous Stochastic Optimization

Mahmoud Alrefaei Tu 17:00 - 17:30, Room HS 9

We consider the problem of optimizing an objective function over a continuous set of feasible solutions; in situations where the objective function value cannot be evaluated exactly and instead have to be estimated using simulation and when the objective function is multimodal. We use some simulation techniques for estimating the gradient of a function with respect to continuous input parameters. Then we use the direction in which the function decreases most rapidly (in case of minimization problems) to select a new candidate then apply the stochastic annealing (SA) scheme to compare the estimated objective function value of the candidate state with that of the current state in order to accept or reject the new candidate. In an earlier work (see Alrefaei and Andradottir [1]), we have shown that the SA works very well for solving discreet stochastic optimization problems. In this paper, we show that SA is indeed works well for solving continuous stochastic optimization problems. We apply this method for solving practical problem involving queuing model, The results show that this method works well for this example.

[1] Alrefaei, M.H. and Andradottir, S. A. Simulated Anealing Algorithm with Constant Temperature for Discrete Stochastic Optimization. Management Sci., 45, 748-764. (1999).

Extraproximal methods for equilibrium and game problems with coupled constraints

Anatoly Antipin Tu 17:00 - 17:30, Room HS 8

We consider the problem of computing a fixed point v^* of the extreme coupled constrained mapping

$$v^* \in \mathrm{Argmin}\{\Phi(v^*, w) + \varphi(w) \mid \ g(v^*, w) \leq 0,\ w \in \Omega\},$$

where functions $\Phi(v, w) : R^n \times R^n \to R^1, \varphi(w) : R^n \to R^1, g(v, w) : R^n \times R^n \to R^m$ are convex in w for any $v \in \Omega$, $\Omega \in R^n$ is a convex closed set.

If the objective and constrained functions have get the form of $\Phi(v, w) + \varphi(w) = f_1(z_1, x_2) + \varphi_1(z_1) + f_2(x_1, z_2) + \varphi_2(z_2)$, $g(v, w) = g_1(z_1, x_2) + g_1(x_1, z_2)$, where $w = (z_1, z_2), v = (x_1, x_2)$, then the equilibrium problem take the configuration of two-person game with Nash equilibria

$$x_1^* \in \mathrm{Argmin}\{f_1(z_1, x_2^*) + \varphi_1(z_1) \mid \ g_1(z_1, x_2^*) \leq 0,\ z_1 \in X_1\},$$

$$x_2^* \in \mathrm{Argmin}\{f_2(x_1^*, z_2) + \varphi_2(z_2) \mid \ g_1(x_1^*, z_2) \leq 0,\ z_2 \in X_2\}.$$

To solve a equilibrium and game problems it is proposed and justified extraproximal methods. The convergence of these are proved, estimates of convergece rate are obtained.

A hybrid constraint propagation-cutting plane procedure for the RCPSP

Christian Artigues Mo 13:30 - 14:00, Room HS 4
Sophie Demassey, Philippe Michelon

We present a new destructive lower bound for the Resource-Constrained Project Scheduling Problem based on Constraint Programming (CP) and Linear Programming (LP). The scheme of the method is close to the work of Brucker and Knust (2000), with the objective to propose a deeper cooperation between CP and LP. The LP relaxation of the classical Integer Linear Programming formulation of the RCPSP is considered. The algorithm tests the validity of a given lower bound T by proving the unfeasibility of the linear program if the makespan is not greater than $T-1$. To strengthen the linear relaxation, efficient constraint propagation techniques are performed with additional shaving. Constraint programming based cutting planes are generated using the information provided by the shaving algorithm. Despite high computational times, the bound obtains competitive results compared to the best bound proposed so far on a well-known set of instances.

Reference

P. Brucker, S. Knust. (2000) A linear programming and constraint propagation-based lower bound for the RCPSP. European Journal of Operational Research, 127, 335-262.

Is Conditional Value at Risk (TailVaR) a good multiperiod risk measure?

Philippe Artzner Tu 14:00 - 14:30, Room E1.05

Conditional value at risk has become popular in risk measurement (e.g. credit risk, energy risk) because of its coherence and its sensitivity to extreme values.

We investigate its extension to the multiperiod risk case and notice its lack of recursivity: connections between current and future C-VaR values are difficult to make.

It is interesting to examine this feature in the specific multiperiod risk measurement for income streams proposed by Pflug and Ruszczynski.

Geometric Methods of Solving Partition Problems

Alexey Baburin We 17:30 - 18:00, Room HS C

Assume a partition problem of division a set of given k-dimensional vectors into 2 subsets subject to minimize a norm of the difference of the subsets sums.

For the given set of n vectors $v_1, v_2, \ldots, v_n$ in R^k the function $S(x) = ||v_1 * x_1 + \ldots + v_n * x_n||$ of x (where $x_i \in \{-1, 1\}$ and $||f||$ is one of standard norms of a vector f in R^k) is minimized.

It is known that for $k = 1$ the problem is NP-hard and is well studied. In the report a motivation for the specified generalization ($k > 1$) is given. The same generalization was considered by Sevastyanov in his works.

For the well known approximation algorithms for $k = 1$ analogical algorithms are built and studied for the case $k > 1$. When the considered norm is Euclidian two geometric methods of solving the problem for $k > 1$ are proposed.

The first method, having small complexity $O(n)$, gives a solution for which $S(x)$ is at most $b * \{\max(||v_i||, i = 1..n)\}$,where b is a constant depending on the dimension k of space. It is shown that the bound is achieved for optimal solutions on some inputs.

The second method gives an approximation reduction of the problem to the case $k = 1$ using the first algorithm. Using the method for a well known algorithm for $k = 1$ an algorithm is constracted that in the case of uniform distribution of vectors achieves the following results.

For any $\varepsilon > 0$ $P\{S(x) < \varepsilon\} \to 1$ as n approaches infinity, where P is the probability of the respective event.

Zuflussvorhersage für den Kraftwerkseinsatz als Grundlage des EPV-Energiewirtschaftliches Planungssystem Verbund

Martin Bachhiesl Mo 17:00 - 17:30, Room HS 6

Am Beispiel des Verbund (Österreichische Elektritzitätswirtschafts-Aktiengesellschaft) wird die Bedeutung und der praktische Einsatz eines hydrologischern Vohersagesystems für ein wasserkraftdominiertes Elektrizitätsversorgungsunternehmen dargestellt. Der Verbund, Österreichs größter Stromproduzent, verfügt über insgesamt 108 Wasserkraftanlagen und 17 kalorische Kraftwerke. Die Wasserkrafterzeugung unterliegt kurzfristigen sowie saisonalen Schwankungen, daher ist der Einsatz hydrologischer Vorhersagemodelle für das Unternehmen eine Notwendigkeit. Durch das neue Umfeld der Strommarktliberalisierung ist die Online-Verfügbarkeit zuverlässiger, operationeller Vorhersagen sogar gestiegen. Das Zuflussvorhersagesystem setzt sich aus verschiedenen Modelltypen zusammen, Wellenablauf- und Niederschlag-Abfluss-Modell mit laufender Schätzung der Systemparameter mittels Kalmanfilter, einem konzeptuellen Niederschlag-Abflussmodell mit einer physikalisch basierten Struktur und einer Kombination eines Schnee- und Bodenfeuchtemodells mit einem multiplen linearen Regressinsmodell. Diese Modelle berechnen für ausgewählte Kraftwerkstandorte mehrere Vorhersagevarianten mit unterschiedlicher Diskretisierung und Vorhersagefrist. Damit stehen dem Anwender optimale Vorhersagen zur Verfügung. Diese bilden auch die Grundlage für die energiewirtschaftliche Planung und Kraftwerkseinsatzoptimierung. Anhand einiger Bsp. wird der praktische Einsatz des Zuflussvorhersagesystems für den Kraftwerksbetrieb bei ansteigender Hochwasserwelle und bei der übergeordneten energiewirtschaftlichen Planung/Kraftwerkseinsatzoptimierung dargestellt.

Cost Optimized Layout of Fibre Optic Networks in the Access Net Domain

Peter Bachhiesl
G. Paulus, M. Prossegger, J. Werner, H. Stögner Tu 14:30 - 15:00, Room HS 6

During the last two years European network-carriers have invested 7.5 billions EUR in the expansion of the core- and the distribution net domain (backbones, city backbones and metropolitan area networks). However, investigations have shown that about 95% of the total costs for the implementation may be expected for the area-wide realization of the last mile (access networks). In order to achieve a return of investment, carriers will be forced to link access net nodes, like corporate clients, private customers or communication nodes for modern mobile services (e.g. UMTS) to their city

backbones. We present the two stage planning tool NETQUEST as a full digital workflow for the computation of cost optimized, real world layouts for fibre optic access networks. NETQUEST-LINK valuates all relevant geo-information data for the considered access net domain, e.g. land classes, geographic positions, existing (network-) infrastructures, preferences of network carriers and others. The result of this stage is a penalty grid which measures the specific costs of one meter of underground work with respect to the underlying land classes with a resolution of one meter in square. NETQUEST-OPT computes an optimized implementation layout for the intended access network based on the penalty grid of NETQUEST-LINK. Cluster strategies, exact and approximation algorithms of graph theory and combinatorial optimization and ring closure heuristics form the optimization kernel of NETQUEST-OPT. Beside the methodology and several scenarios of application, we accordingly present results for two computed projects. The first one is a fictive access net domain in Klagenfurt. The latter concerns a real network designing problem which was processed with our industrial partner in Berlin.

Scheduling jobs with values dependent on their completion times

Aleksander Bachman Mo 14:00 - 14:30, Room HS C
Adam Janiak, Tomasz Krysiak, Costas Pappis, Theodore Voutsinas

The paper deals with a single machine scheduling problem where job values are dependent on the completion times of their execution. Each job is characterized by its processing time, its initial value and a lost function. The job value calculated at some moment is given as a difference between its initial value and its lost function calculated at this moment. The problem is to find a schedule for which the sum of job values calculated at their completion times is maximal. We reformulate the problem so that the sum of the lost functions should be minimized. We prove that the general version of the reformulated problem is NP-hard. The proof is done from the well known Partition Problem. For the special cases of the general problem, we prove some properties. Based on these properties, we construct some optimal algorithms which solve the problems in polynomial time. The problem considered in the paper describes the utilization process of some used up products (e.g. computers or cars). These products cannot be used any more because of the one of the following reasons: the risk of their utilization is relatively big, they do not satisfy some requirements (e.g. computers are too slow) or simply some of their component parts are already broken. It means that these products cannot be used as a whole device, however some of their components can be utilized as spare parts in some new products (e.g. computers of a new generation). Thus, in this situation, the problem of disassembling products into the components appears. The order in which the products are disassembled depends on the demand for some particular components. However, demand for the components is directly connected with their values. Finally, the component values depend on the moment when they are available for utilization. Our objective is to find an order of disassembling the products so that the sum of the values of the obtained components is maximized.

The Capacitated m-Ring-Star Problem

Roberto Baldacci Tu 11:30 - 12:00, Room HS 6
M. Dell'Amico, Juan Jose Salazar Gonzalez

The Capacitated m-Ring-Star Problem (CmRSP) is the problem of designing a set of rings passing through a central depot and through some transit nodes and/or users, and to assign each non-visited user to a visited node. The number of users visited and assigned to a ring is bounded by an upper limit: the capacity of the ring. The objective is to minimize the total routing cost plus assignment costs.

The problem has practical applications in the design of urban optic fibres telecommunication networks.

In this paper we describe new integer programming formulations for the CmRSP, we present lower bounds derived from the LP-relaxation of the new formulations which are improved by adding valid inequalities in a cutting plane fashion. A new branch and cut algorithm for the optimal solution of the CmRSP is described and computational results are also reported.

A Generic Methodology for Emulation and Performance Evaluation of Scheduling Algorithm of Computer Networks

Marta Barria Tu 12:00 - 12:30, Room HS 6
Reinaldo Vallejos, Isabel Martín, Marco Aravena.

In this paper a generic methodology is proposed for emulating and mathematically evaluating the performance of various scheduling algorithms in ATM networks. To emulate the operation of a given algorithm, a meta-algorithm named LDS (Load Dependent Scheduling) is proposed. The emulation of various algorithms using LDS is simple, and is achieved by

specifying the appropriate LDS operating parameters. To evaluate the performance of a given algorithm X, the performance of LDS using the parameters that enable it to emulate that algorithm is evaluated. Thus, the performance measures obtained for LDS will correspond to those of algorithm X.

Is the Recurrence of Delinquent Behavior Optimal?

Doris Behrens Tu 9:00 - 9:30, Room HS 7

This paper sets up an optimal control model of epidemics of delinquent be-havior based on a descriptive three state model [D.A. Behrens, J.P. Caulkins, G. Tragler, G. Feichtinger: "Memory, contagion, and capture rates: Character-izing the types of addictive behavior that are prone to repeated epidemics". Discussion Paper No. 251 of the Institute of Econometrics, OR, and Systems Theory, Vienna University of Technology: Vienna, December 2000.] which differentiates between two levels of delinquency ("light" and "heavy"), and includes a state representing memory of past years of the heavy form of delinquency. As hypothesized by David Musto [D.F. Musto: The American Disease. Yale University Press: New Haven, CT, 1987.] this memory of past experiences dampens initiation and, hence, potential future offences in a subtle and plausible way. Optimal control enlightens how an epidemic of delinquent behavior is spread as offenders "infect" non-offenders, and how these epidemics might (periodically) recur when a new generation forgets the odd effects of the heavy form of delinquency experienced by their forbears (or is lacking farsighted-ness). Among the findings with respect to control are that it is always useful to apply prevention programs, but that this is particularly so at the onset of an epidemic of delinquent behavior. For epidemics with a low forgetting rate it is always useful to help "heavy offenders" to desist, e.g., through "treatment". However for epidemics with high forgetting rates, intensive treatment can in-duce cycling in the system behavior. For epidemics with a high probability of offenders escalating to a "heavy" stage of delinquency, it may be useful to pursue measures that discourage escalation, but such measures should be carefully planned, because a low probability of escalation from a light to a heavy form of delinquency might cause cycling behavior (especially when appearing together with a fast forgetting process).

The Ability of Artificial Neural Networks to Exploit Non-Linearities by Data Mining Models Compared to Statistical Methods

Lutz Beinsen
Bernd Brandl We 15:00 - 15:30, Room E0.05

This paper discusses the question whether Artificial Neural Networks have the capacity to exploit additional non-linear information on the basis of exchange rate forecast models selected on linear criteria. This includes a com- parison of exchange rate forecasts between Artificial Neural Networks (ANN) and linear statistical methods and it is asked whether linear relationships serve as an approximation. The focused forecast models are selected by a data mining approach which combines fundamentals from economic theory, respectively building blocks from economic theory, with "fundamentals"derived solely by statistical criteria. This combination of theoretical and statistical relationships in data mining takes care that both long run determinants on exchange rate behaviour as well as current influences are integrated in the forecast models. The results are evaluated for five exchange rates on a monthly frequency. The results favour the use of ANNs as they slightly improve the out-of-sample performance of the forecast models. It is still more interesting that linear as well as nonlinear methods can be applied and the advantages from both methods can be used, which means that statistical methods allow a more detailed analysis of the results whereas ANNs offer a slightly better forecast performance.

Algorithm of constructing of stability regions for local Hoffman's constant

Evgeny Belousov Tu 9:30 - 10:00, Room HS 8

We consider a mapping given by a finite system of linear inequalities

$$M(b) = \{x \in E_n \mid Ax \leq b\}, \qquad b \in B \equiv \{b \in E_m \mid M(b) \neq \emptyset\}.$$

We study the properties of Hoffman's function $h(b)$, i.e. dependence of the sharp local Hoffman's constant upon the right-hand sides of given inequalities, using the wide classes of monotonic norms. It turns out that function $h(b)$ is lower semicontinuous, i.e. it has a closed epigraph. The function $h(b)$ can take only finite many ($\leq 2^m$) values. Level sets $\{b \in B \mid h(b) = const\}$ of the function $h(b)$, as well as the whole feasible set B are the union of the finite number ($\leq 2^{(2^m)}$) nonintersecting, convex, relatively open cones B_i with origin as vertex. Besides that all cones B_i have the same recession space coinciding with linear hull of the columns of the matrix A. In this work we give the algorithm of constructing of all cones B_i, i.e. their representation by the mixed system of linear equalities and strict inequalities. This algorithm reduces in the end to solving of the finite system of linear algebraic equations.

Reference:
1. E.G.Belousov and V.G.Andronov. On sharp Lipschitz and Hoffman constants for a system of linear inequalities Computational Mathematics and Cybernetics, No.4, pp.35-41, 1999.

Die Eignung des Earnings Yield Gap zur Vorhersage von Aktienmarktkorrekturen

Klaus Berge
Hermann Locarek-Junge

We 14:00 - 14:30, Room E1.05

Das Arbeitspapier untersucht die Vorhersagefähigkeiten des Spreads zwischen der Rendite langfristiger Staatsanleihen und der Gewinnrendite des korrespondierenden Aktienmarktes für Aktienmarktkorrekturen. Betrachtet werden die USA (1985 - 2000) sowie Deutschland (1988 - 2000). Eine frühere Untersuchung basierte auf dem aktuellen Gewinnniveau des Aktienmarktes und nicht den theoretisch zu verwendenden geschätzten Gewinnen. Der Fokus des vorliegenden Papiers liegt auf der empirischen Betrachtung des theoretisch richtigen Ansatzes. Es wird festgestellt, dass der Indikator zu ungenaue Signale gibt, als dass auf diesem Indikator basierende Strategien eine buy-and-hold-Strategie auf dem Aktienmarkt deutlich schlagen können. Allerdings erreicht der Indikator vor Korrekturen stets Extremwerte. Bei Berücksichtigung weiterer Einflussfaktoren sind demnach vielversprechende Ergebnisse zu erwarten.

Scheduling and project management on CPM and PERT with simulation

Vikas Bhumireddy Lakshmi
R. Venkatesh

Tu 9:30 - 10:00, Room HS 4

The complexity of the present day management problem and the business competition has added to the already existing pressure on the brains of decisions makers. In a large and complex projects involving a number of interrelated activities, requiring a number of men machines and materials. It is not possible for the management to make and execute optimum schedule just by invitation based on the organizational capabilities and work experience.

Management are thus always on the look out for the methods and technologies, which may help in planning, scheduling the project. A project may be defined as a combination of interrelated activities, which must be executed in a certain order before the entire task can be completed.

The aim of the planning is to develop a sequence of activities of the project, so that the project completion time and cost are properly balanced and that the excessive demand of key resources are avoided. To meet the object of systematic planning , the management has evolved a number of techniques applying network strategy.

Program evaluation review technique [PERT] and the critical path method [CPM] are two of the many network techniques which have been widely used for planning , scheduling and controlling the large and complex project] are two of the many network techniques which have been widely used for planning, scheduling and controlling the large and complex project. The technique that we have followed for drawing the network is Activity on Node diagram [AON] which is more simplified than the older Activity on Arrow diagram[AOA]. The project manager for managing a project has to manually draw the network and apply network strategy to arrive at the critical and minimum completion time.

To make his job easier and accurate, the purpose of devising software becomes apparent. For this purpose, visual basic-6 and MS-ACCESS have been used. Also to determine the optimum project schedule, crashing program is also included as cost of completion of the project is also important in completing the projects.

As the day to day activities are uncertain, one has to complete for the uncertainties that may take place in the industry. For which we have added the SIMULATION PACKAGE Which makes use of Monte Carlo technique. This makes the package more complete providing the project manager a foresight of what might happen and let him take decision accordingly to counter or contain risks.

The specialty of our project is that we have used AON diagram technique to determine/calculate Total float, Free float, and Independent float, which does not exist in other similar packages

---

On Multiprocessor Scheduling under Multiple Objectives

Vittorio Bilò
Michele Flammini

Th 9:30 - 10:00, Room HS 4

In this paper we consider the multicriteria version of the classical scheduling problem in which jobs are characterized by a d-dimensional vector of non negative rational costs. Every job must be scheduled on one of the m machines so as to simultaneously minimize, for each dimension, the maximum cost per machine. In such a setting an online algorithm is said to be $(c_1, \ldots, c_d)$-competitive if it is c_i-competitive with respect to the i-th cost measure, $1 \leq i \leq d$. We first consider the bicriteria case and present a parametric family of online algorithms $F_m = A_k | 1 \leq k \leq m$ such that, for each k, A_k is a $((2m-k)/(m-k+1), (m+k-1)/k)$-competitive algorithm. Then we prove that for each possible

tradeoff on the competitive ratios, that is for each value of k, there exists a suitable lower bound comparing favorably with the ones returned by A_k. Namely, we show that each algorithm in F_m is optimal for $m = 2$ and in general r times far from optimality, with $r = 9/7$ for $m = 3$ and r increasing in m and approaching 2 as m goes to infinity. Moreover, if we are interested in the minimization of the maximum competitive ratio, algorithm A_k with $k = m/2$ if m is even and $k = (m + 1)/2$ if m is odd achieves a maximum ratio which is, in the worst case, strictly less than $3/2$ times the optimal one. Finally, we extend our family of algorithms to the general d-dimensional case and prove that, in the case of minimizing the maximum competitive ratio, there exists a suitable algorithm in each family which achieves a maximum ratio of value $d+1-d/m$, in spite of an order of a $\log d/\log\log d$ lower bound. The minimization of the maximum competitive ratio is a stronger form of the classical Vector Scheduling. Therefore, as a consequence of our results, a $(d+1-d/m)$-competitive online algorithm is obtained also for this problem.

Strategien zur Rüstzeitvermeidung in der Elektronikfertigung

Claus-Burkard Boehnlein Mo 14:00 - 14:30, Room HS 1

Mit der Einführung der Surface Mount Technology wurde die Grundlage für eine hochautomatisierte Fertigungsabwicklung in der Elektronikindustrie geschaffen. Durch die Normierung und Miniaturisierung oberflächenmontierter Bauelemente (Surface Mounted Device, SMD) kann mit gängigen SMD-Bestückungssystemen eine Vielzahl unterschiedlicher SMD-Gehäuseformen verarbeitet werden. Dies führte zu einem Wechsel von der werkstatt- zur linienorientierten Fertigungssteuerung. In den vergangenen Jahren konzentrierte sich die Massenproduktion elektronischer Güter in Asien. In den Hochlohnregionen Westeuropas wird dagegen zunehmend in Kleinserien bzw. kundenauftragsorientiert gefertigt. Die damit verbundenen kleinen Losgrößen und häufigen Auftragswechsel führen dazu, dass SMD-Bestückungen wegen Umrüstung zu 30-40 % der Betriebszeit stillstehen und meist einen Engpass in der Elektronikfertigung darstellen. Mit den heute verfügbaren Planungssystemen kann dieses Problem nicht befriedigend gelöst werden. Der Beitrag faßt die wesentlichen Forschungs- und Entwicklungsarbeiten im Rahmen meiner Dissertation zusammen. Detaillierte Untersuchungen der Fertigungstechnologie, Produktionsprozesse und verfügbaren Planungskonzepte sowie Marktanalysen und Beobachtungen in realen Fertigungsumgebungen führten im Rahmen des mehrjährigen Forschungsprojekts zu einem eigenständigen Planungsansatz und einer Software-Lösung. Erfahrungen aus einem 18-monatigen Produktiveinsatz in einem Industriebetrieb zeigen, dass die mit dem Planungsansatz erzeugten Rüstungen mehrere Monate in der Fertigung eingesetzt werden können und allen Anforderungen in typischen Fertigungsumgebungen gerecht werden. Die Rüstzeiten konnten im Untersuchungszeitraum gegenüber den Werten der Referenzperioden um bis zu 60 % gesenkt werden. Im 3-Schichtbetrieb des Kooperationsunternehmens wurde somit eine Reduzierung der Stillstandszeiten um bis zu fünf Stunden pro Linie und Tag erreicht.

Standards fuer Modellierung und Simulation

Claus-Burkard Boehnlein Tu 14:30 - 15:00, Room HS 8

Bei der Analyse betrieblicher Abläufe spielt die Simulation eine wichtige Rolle, da sie Aussagen über die Ablaufausführung unter verschiedenen Bedingungen und bezüglich verschiedener Aspekte, etwa Kosten, Durchlaufzeiten, Ressourcenverbrauch oder Maschinenauslastung, erlaubt. Die Simulation leistete daher in der Vergangenheit eine wichtige Unterstützung bei der Ablaufplanung, der Ablaufverbesserung sowie bei der Gestaltung von Informationssystemen zur Ablaufausführung. Im Rahmen der Konzentration auf Kernkompetenzen reduzieren vielen Unternehmen ihre Wertschöpfungstiefe und gehen strategische Kooperationen mit ihren Zulieferern ein, wodurch sich weit verzweigte, mehrstufige Beschaffungsnetze entwickeln. Für die Abstimmung und Koordination in derartigen unternehmensübergreifenden Netzwerken werden Funktionen zur Durchführung von What-If-Analysen und Simulationsmöglichkeiten benötigt, die nicht nur auf strategischer Ebene, sondern zunehmend auch auf taktischer und operativer Ebene eine Entscheidungsunterstützung bieten. Somit ergeben sich neue Herausforderungen für die Modellierung und Simulation, denn kurzfristige Aussagen sind nur dann möglich, wenn die operativen Systeme mit Simulationskomponenten gekoppelt sind. Damit gewinnen Aspekte der Standardisierung von Modellierungstechniken, Schnittstellen und Austauschformaten zukünftig sowohl für die Anwender, als auch für Anbieter von Simulationsumgebungen eine zentrale Bedeutung, wenn kurzfristige Aussagen getroffen werden sollen. In dem Beitrag werden aktuelle Techniken und Standards zur Modellierung und Datenstrukturierung im Hinblick auf eine strukturierte und effiziente Modellerstellung und Simulation untersucht.

Sensitivity Analysis of Fuzzy Set Approach to Logistics Chains

Ludvik Bogataj
Janez Usenik, Marija Bogataj Tu 14:00 - 14:30, Room HS 1

Input output analysis, MRP and Laplace transforms methodology, developed in Linköping school (R.W.Grubbström) were used to explain the activities of the supply chain on multi - sequential levels. The results of the sensitivity analysis

of authors Ludvik Bogataj, Liljana Horvat and Marija Bogataj, especially the results of the paper of Marija Bogataj: »Inventory allocation and customer travelling problem in spatial duopoly«. (Int. j. prod. econ.1999, vol. 59, no. 1/3, p.p. 271-279) based on some results of H.J.von Girlich are compared with the results obtained by fuzzy logic. Due to the complexity of given problem, fuzzy reasoning gives excellent results also for sensitivity of robust systems estimation.

Keywords: Sensitivity analysis, logistics, supply chain, inventory, Laplace transforms, shortage of goods, fuzzy logic.

The Risk of Pension Plans in Central Europe

David Bogataj
Robert Vodopivec

Tu 17:30 - 18:00, Room HS 5

Central European enterprises and their local economies wish to become a part of the global supply networks. One of conditions to success is that their alliances are reliable. Logistics reliability is to be achieved by the reliable equipment and reliable human resources. The reliability of human resources depends on aging. This is probably the reason why the idea of providing social security for industrial workers by establishing pension plans was born in the field of transportation activities and communication. How this idea could be used in the social partnership between management and labor unions in central European countries is analyzed. The modeling of the influence of pension plan on central European economies, their advantages and their disadvantages are analyzed.

All over the Europe the retirement age is rising due to longer life expectancy. The problem is that Accession Countries of EU have empty pension found. The model, determine minimal contributions in a new sector-wide pension arrangement are suggested, using the actuarial annuity stream approach.

KEYWORDS: pension plan, systems reliability, actuarial mathematics,

---

Masters Logistics Courses in the USA: Lessons for Europe

Marija Bogataj

We 9:30 - 10:00, Room HS 5

In the new millennium supply networks management emerges as one of the most important management paradigm and as one of the last unexplored frontiers of management science. In a global marketplace, getting the right goods at the right time at the right place is as important as low costs. It is essential for enterprises to develop the visibility of flows in the network and to understand management tools needed for supply network logistics. OR community got the opportunity to develop the network of European education on this field. Some universities and some individual professors, joined to the first academic network trying to develop this area, when SOLE recommendation has been consider too.

The present project will offer the students a one-year MSc Programme in Logistics and Supply Chain Management as well as the possibility to continue the study on doctoral level. The Programme comprises of core modules undertaken by all MSc students and a large number of electives for the student to study.

The programme will be designed to equip students with a depth of technical knowledge and understanding of management skills that will enable them to apply this knowledge in their chosen career, whether this is in planning or operational management in supply chain systems.

In addition, students will be exposed to the problems of working in a multi-disciplinary field with multi-countries environment including both group and individual tasks. Some conclusions of these activities are presented.

Keywords: logistics, education SOLE, master program

Capacity planning system for container terminals

Carsten Boll

Mo 16:30 - 17:00, Room HS 8

Report on the development of a simulation system with the aid of which the capacity determinant values of seaborne container terminals can be analysed. The capacity is dependent on length and geometry of quay, number and performance of ship to shore cranes, time graphs of transhipment volume, arrival time distributions of vessels, trucks and trains as well as stacking and handling areas. As a decision support system the user is advised a.o. about occupancy of berths over a year, vessel service times, usage of storage areas and handling equipment.

Metadata Search: A New Approach to Natural Language Database Interface

Veera Boonjing
Cheng Hsu

We 11:30 - 12:00, Room HS 10

Metadata search is a new approach to process text natural language database queries. Its objective is to support any style of text inputs. To accomplish the objective, it builds a metadata reference dictionary containing information models,

database values, user-words, and query cases. The reference dictionary accommodates any possible interpretations of a natural language query concerning enterprise databases. The branch-and-bound search method makes it possible and efficient to search all possible interpretations of a natural language query in order to determine the best solution. The approach also incorporates a case-based learning and case-based reasoning to assure successful closure to a query and to improve performance. A laboratory testing of a prototype shows the feasibility of the approach.

Integrating Stochastic Programming and Decision Tree Techniques in Land Conversion Problems

Valentina Bosetti
Enza Messina

Tu 14:00 - 14:30, Room HS 9

Land management is typically concerned with the key roles of uncertainty and irreversibility in valuing conversion and development of large areas. An important issue arising is related with the presence of environmental uncertainty that, if not included in the decision process, may lead to a miscalculation of the land allocation pattern. Within this context we address the general problem of what is the optimal land conversion policy. In particular, we will determine the optimal land portfolio in time, considering future market uncertainty through the formulation of a scenario-based stochastic programming problem. For what concerns environmental uncertainty traditional financial approaches may fail in capturing this specific source of uncertainty, hence we take it into account developing a model that integrates a decision tree approach and different stochastic programming problems. Indeed, this methodology allows us to consider the value of flexibility of different options, thus maximizing the Arrow-Fisher quasi-option value. Finally, we apply the methodology developed to a case study involving a semi-degraded natural area located in the north of Italy.

Empirical test of the consumer behavior theory of price valuation using a semiparametric approach, reference prices and accounting for heterogeneity

Yasemin Boztug
Lutz Hildebrandt

Mo 13:30 - 14:00, Room HS 2

To describe price response at the individual level most existing studies are based on the prospect theory framework modeled in a parametric manner. In general prospect theory is used without any empirical validation although alternative response functions exist. One alternative approach to describe consumer behavior is the assimilation contrast theory. In an empirical study Kalyanaram & Winer (1995) considered situations where this model might be more valid. Again, the validation of the theory was not tested and the model was estimated in a full parametric manner.

In our approach to discover the underlying structure of the brand choice process, we use a semiparametric methodology based on a Generalized Partial Linear Model (GPLM). Feature, display, loyalty (as in Guadagni & Little, 1983), and brand dummy parameters are estimated in a parametric manner following the standard Multinomial Logit Model. The price gap (reference price minus actual price) is modeled with a nonparametric estimator. Due to this special modeling form, we are able to discover empirically the underlying process of the consumer behavior regarding the influence of reference prices. Several reference price types are used for internal and external reference price modeling. Heterogeneity is captured by an a priori segmentation of the consumers based on the concept of loyals and switchers, which is a common approach.

In a simulation study we examine data that follow a model based on the assimilation contrast theory but the estimation is based on an approach regarding to the prospect theory. The results lead to parameters, which are highly significant, but far away from the true values. In an application to a real data set, we find that the behavior of loyal consumers is in line with the assimilation contrast theory, while the switchers behave according to prospect theory.

Strategische Unternehmensplanung mit System Dynamics (SD)

Peter Bradl

Mo 14:30 - 15:00, Room HS 7

Strategische Planung ist heute weitest gehend als Kernbereich von Managementaktivitäten akzeptiert. Dies steht allerdings im Widerspruch zu der nach wie vor eingeschränkten Unterstützung derartiger Tätigkeiten und Prozesse durch Methoden und Software der IV. Zur Reduzierung von Unsicherheit bei der Planung künftiger Entwicklungen von Unternehmen bedient man sich derzeit zwar verschiedener Verfahren und Ansätze, welche i. d. R. jedoch nur in bedingtem Maße Simulation oder Plan-/Ist-Vergleiche ermöglichen. Insbesondere ist es mit den verfügbaren Methoden und Programmen derzeit nicht möglich, dynamische Aspekte im Planungsverlauf zu simulieren. System Dynamics bietet die Grundlage, solche Zusammenhänge über Rückkopplungsschleifen zu erfassen, in Modellen abzubilden und in diesen künftige Auswirkungen von Unternehmensentscheidungen mit quantitativen und qualitativen Größen zu simulieren. Im Mittelpunkt der aktuellen Forschung steht eine Methode zur Modellierung von Wirkungszusammenhängen. Positive Auswirkungen eines “systemischen Ansatzes” sowie der Nutzen von System Dynamics werden erarbeitet und die Umsetzung von beschriebenen Abhängigkeiten und Interdependenzen in lauf- und simulationsfähige Modelle vorgestellt. Als Software gelangt

exemplarisch Powersim zum Einsatz, da es die Verknüpfung der Modelle mit externen Datenquellen (bspw. Excel oder SAP SEM) ermöglicht. Die Anwendbarkeit und der praktische Nutzen der erarbeiteten Vorgehensweise und Modelle wird anhand expliziter Fragestellungen aus dem Bereich zur Personalplanung (Akquise, Einarbeitung und Schulung) in einem Softwarehaus und den Auswirkungen von Entscheidungen im Bereich Personal auf den Finanzsektor abgeschlossen. Langfristiges Ziel der gemeinsam mit der SAP AG durchgeführten Forschung ist die Bereitstellung von Referenzmodellen als Ausgangsbasis für Simulationen in Unternehmen verschiedener Branchen.

Integrating Exchange Rate Theory in Data Mining

Bernd Brandl We 14:30 - 15:00, Room E0.05

This talk focuses on an integration of exchange rate theory in a data mining process for the purpose of forecasting. The applied approach consists of a Genetic Algorithm and Artificial Neural Networks, which allows the identification of relationships that are not describable by economic theory, and therefore go beyond economic theory. As experience showed, relationships derived by data mining are often not convincing as regards their correctness and effectiveness. Most data mining approaches do not contribute much to persuade otherwise. In this work, it is tried to remove part of this limitation by combining economic theory and theoretical building blocks with data mining. Usually the role of economic theory in exchange rate forecasting is to identify a list of relevant variables to be included in the analysis, with possible and plausible signs of their coefficients. Previous research documents the failure of this approach in forecasting exchange rates at frequencies up to one month. Consistent with these results, in this work the role of economic theory is extended and implemented in data mining as a framework in which the possibilities of data mining are exploited not only to identify further sources of influence, but also to find alternative variables to improve fundamental forecasts and outperform the benchmark of the naive forecast. Other findings include: (i) During the years 2000 and 2001 the countries relative economic growth is most significant in forecasting exchange rates one period ahead, (ii) the financial market is of major concern when explaining exchange rate movements as it may be used to proxy real economic activity. Also, financial markets map international capital flows which in turn affect exchange rates and (iii) fundamental forecasting is more effective over longer horizons. The approach is illustrated in some detail for five exchange rates at a daily, weekly and monthly frequency.

On the Moments of the Overflow and Freed Carried Traffic for the GI/M/C/0 System

Manfred Brandt Tu 14:00 - 14:30, Room HS 6

In circuit-switched networks call streams are characterized by their mean and peakedness (two-moment method). The GI/M/C/0 system is used to model a single link, where the GI-stream is determined by fitting moments appropriately. For the moments of the overflow traffic of a GI/M/C/0 system there are efficient numerical algorithms available. However, for the moments of the freed carried traffic, defined as the moments of a virtual link of infinite capacity to which the process of calls accepted by the link (carried arrival process) is virtually directed and where the virtual calls get fresh exponential i.i.d. holding times, only complex numerical algorithms are available. This is the reason why the concept of the freed carried traffic is not used. The main result of this paper is a numerically stable and efficient algorithm for computing the moments of freed carried traffic, in particular an explicit formula for its peakedness. This result offers a unified handling of both overflow and carried traffics in networks. Furthermore, some refined characteristics for the overflow and freed carried streams are derived.

Pricing Derivative Securities Using Cross-Entropy: An Economic Analysis

Nicole Branger Mo 17:30 - 18:00, Room E1.05

This paper analyses two implied methods to determine the pricing function for derivatives when the market is incomplete. First, we consider the choice of the equivalent martingale measure exhibiting minimal cross-entropy with respect to a given benchmark measure. We show that the choice of the numeraire has an impact on the resulting pricing function, but that there is no sound economic answer to the question which numeraire to choose. The ad-hoc choice of the numeraire introduces an element of arbitrariness into the pricing function, thus contradicting the motivation of this method as being the least-prejudiced way to choose the pricing operator. Second, we propose two new methods to select a pricing function: the choice of the stochastic discount factor (SDF) having minimal extended cross-entropy with respect to a given benchmark SDF, and the choice of the Arrow-Debreu (AD) prices having minimal extended cross-entropy with respect to some set of benchmark AD prices. We show that these two methods are equivalent. They avoid the dependence on the numeraire and replace it by the dependence on the benchmark pricing function. This benchmark pricing function, however, can be chosen based on economic considerations.

Selecting Key Risk Factors of Worst Case Scenarios

Thomas Breuer
Dietmar Maringer, Filip Pistovcak

Tu 17:00 - 17:30, Room E1.05

Maximum Loss has frequently been suggested as a risk measure superior to Value at Risk. Worst case scenarios producing the maximum loss provide important information for risk managers. In this contribution we present a way to report worst case scenarios. The reports are based on the key risk factors of the worst case scenario. Selecting these key risk factors is discrete optimisation problem. We investigate the performance of Memetic Algorithms and of Simulated Annealing on this optimisation problem.

Decision models with ordinal information

Helena Brozova

Mo 14:00 - 14:30, Room HS 10

This paper deals with special type of decision models and their solution. The model definition is rather simple. Payoffs are usually estimated values using expert estimation. Probabilities of states of nature are often estimated, too. Suppose now, that both estimations needn't be particular numbers and the decision-maker knows only preference information either for payoffs or for probabilities. That means, ordinal information for both data sets can be known. Generally there are six possible types of decision model definitions according to the kind of information available. The possibilities are: ordinal or cardinal information for payoffs and no information, ordinal or cardinal information for possibilities of states of nature. Decision under uncertainty can be characterised as no information about state of nature and cardinal information about payoffs. Decision under risk includes cardinal information about states of nature as well as about payoffs. These types of decision model are widely used and there are many methods for their solution. Decision situation with ordinal information about states of nature and cardinal information about payoffs lies between decision making under uncertainty and decision making under risk. Last three types of decision model are remarkably different. Decision situations with ordinal information about payoffs and nominal, ordinal or cardinal information about states of nature could not be solved using classical decision models. Multiple attribute decision making methods can be used for selection the best alternatives in these cases. For instance, ordinal information about states of nature can be transformed to cardinal information using Fouler's or Saaty's methods and ORESTE method can be used for models with ordinal information about states of nature and payoffs.

Complex job-shop scheduling problems

Peter Brucker
Mikhail Kovalyov

Tu 15:00 - 15:30, Room HS C

The job-shop problem is one of the most important basic scheduling problems with many applications. However, in most applications extensions of the job-shop problem are relevant. Features which lead to such extensions are time lags, parallel machines at stages, transportation, limited buffers, and periodic constraints.

The disjunctive graph model for the job shop problem is the basis for the devellopment of algorithms. We discuss how the disjunctive graph model can be generalized to cover the different extensions.

Local search methods are the main tools to solve extended problems. In this connection we investigate how neighborhoods for the job-shop problem can be adjusted to handle the extensions.

Bidding System for task Allocation in a Shopfloor

Dan Burkolter
Eleni Pratsini, Jens Henoch

Tu 11:30 - 12:00, Room HS 1

A market based approach in task assignment within a shop-floor consisting of several work-cells is considered. As orders arrive at the shop-floor, they are announced and agents representing the appropriate work-cells bid for the tasks. Each work-cell calculates its bid based on its marginal cost of performing the order and the lowest bid is awarded the order. The costs consist of fixed and variable components as well as costs of deviating from certain operational goals. The risk attitude of the agents as well as various bidding strategies can be applied to the cost model in order to enhance a bid. The bidding system has been implemented in a multi-agent framework. Operational results of the task allocation by bidding were compared to those of reference assignment rules. Simulations showed that the bidding rules fared better both in smooth settings as well as in setups including machine breakdowns.

Berücksichtigung knapper Lagerkapazitäten bei der Simultanplanung von Produktions- und Transportlosgrößen in mehrstufigen Fertigungssystemen

Udo Buscher
Gerd Lindner

Th 11:30 - 12:00, Room HS 1

Traditionelle Modelle zur Planung von Fertigungslosgrößen unterscheiden bisher nahezu ausschließlich die Alternativen der Weiterleitung ganzer Lose oder der Beförderung individueller Erzeugniseinheiten, wenn es darum geht, im Rahmen eines mehrstufigen Produktionsprozesses die auf einer Stufe hergestellten Mengeneinheiten zu einer nachgelagerten Stelle zu transportieren. Weiter wird idealisierend zumeist angenommen, daß die zwischen benachbarten Stufen auftretenden Lager eine unbeschränkte Kapazität aufweisen. In diesem Beitrag wird hingegen ein Modell für ein serielles mehrstufiges Fertigungssystem vorgestellt, welches es gestattet, gleich große Transportlose zwischen aufeinanderfolgenden Stufen zu befördern. Bei der stufenindividuellen Festlegung der Transportvorgänge gilt es allerdings zu beachten, daß die Zwischenlager nur begrenzt aufnahmefähig sind. Das Entscheidungsproblem besteht darin, neben der Fertigungslosgröße die optimalen ganzahligen Ausprägungen der stufenbezogen Transporthäufigkeiten so zu bestimmen, daß die im betrachteten System anfallenden, sich aus Rüst-, Lagerhaltungs- und Transportkosten zusammensetzenden Gesamtkosten minimiert werden. Zur Lösung der vorliegenden Planungsaufgabe wird ein iterativer Algorithmus vorgestellt, der es aufgrund einer effizienten Gestaltung des Suchprozesses ermöglicht, auch für Problemstellungen realistischer Größenordnung sehr schnell die Optimallösung zu ermitteln.

Design of Genetic Algorithms for on-line sale

Pasquale Carotenuto
Marco Augugliaro

We 17:00 - 17:30, Room HS 1

The diffusion of internet to more and more capillary level in the daily activities associated to less expensive and more fast accesses, has allowed this tool to insert in the traditional commercial activities, innovating them in order to open new markets. The innovative opportunities coming from the electronic commerce (e-commerce) have however determined the necessity to design new decisions support tools to face with success the problems tied to the processes of acquisition and sale of products and services, through public or private digital nets. The faced problem concerns the retail sale of a multi-product stock in a warehouse with an established number of units for every product, selecting between the bids of the potential buyers the subset of orders more profitable for the seller firm. The bids concern the acquisition of a subset of the products put on sale and only of a part of the amount of the unities of every product. The selection is effected assuring the completeness of the approved orders, verifying real availability, in the stock in sale, of the general quantity of each product of the selected orders, trying to maximize the profit for the seller firm. Moreover, the problem has been faced both under the hypothesis of a sale to catalogue, and therefore to fixed prices, both under the hypothesis of a sale through offer to the rise, to unique turn, beginning from a general price not inferior to the sum of the catalogue prices of the total quantities of the in demand good. The described problem has been faced making use of a metaheuristics based on genetic algorithms. The experiments have been conducted on different data arrangement of different dimensions, and with distribution functions of the orders composition as suggested by the literature.

A computer tomography based approach to optimal log cutting

Eranda Cela
Adnand Dragoti, Alexander Petutschnigg, Ulrich Pferschy, Alfred Rinnhofer

Th 10:00 - 10:30, Room HS 2

We consider the problem of cutting logs in a saw mill, where computer tomography is being used to recognize deffect areas inside the log such as knots, cracks, resin pockets etc. In general, different sortiments can be cut out of a log and each of them has to fulfill certain quality criteria with respect to the kind of deffect areas it may contain and their mutual positions. Different sortiment types are sold at different prices (per cubic meter) and in general, there is a considerable discrepancy between these prices. A cutting plan for a log specifies the sortiment types to be cut out of the input log, the sortiment sizes and their positions with respect to the log. Clearly, for each log different cutting plans could result in quite different revenues, in general. In this contribution we deal with the following question: How to make use of computer-tomographical information about the position and size of deffect areas inside the log in order to determine a profitable cutting plan for the log?

In the application we consider, the log break down is realized by so-called guillotine cuts. A first series of parallel cuts is performed in a certain fixed direction (specified by the so-called opening angle). The following series of parallel cuts runs orthogonal to the previous series, their direction being determined by rotating the log by $\pi/2$. There may also be additional cuts where each series is again orthogonal to the previous series obtained by rotating the log by $\pi/2$.

We develop a 2-phase heuristic approach to compute a profitable cutting plan. The first phase is in principle an implicit enumeration approach which computes the opening angle for the cuts. This angle specifies the position of the very first cut

to be performed and has a strong impact on the total profit generated by the cutting plan. In a second phase we compute the positions of the remaining cuts. To find an efficient arrangement of these cuts an appropriate digraph model is employed.

An Algorithm for Optimizing a Linear Function Over the Integer Efficient Set

Djamal Chaabane
Moncef Abbas

We 14:00 - 14:30, Room HS C

In this communication a new method for optimizing a linear function over the efficient set of Multiple Objective Integer Linear Programming Problems is developed. Let $w = dX$ be the objective function and Eff be the efficient set of a Multiple Objective Integer Linear Programming problem MOILP as defined by Teghem and Kunsch. A technique for finding the first efficient solution is given within the theoretical tools section. Then a test is introduced to find the better efficient solution lying on the edge Ej yielding an increase in W. The feasible region S is being reduced at each step until infeasibility. With this procedure one does not have to calculate all the efficient solutions but only those give a better value of W.

References :

[1] Teghem Jr. and Kunsh P.L., *A Survey Of Techniques For Finding Efficient Solutions To Multi-Objective Integer Linear Programming*, Asia-Pacific Journal of Operational Research 3 (1986) 95-108

[2] Ecker J.G. and Song J.H., *Optimizing a Linear Function over an Efficient Set*, Journal of Optimization Theory and Applications, vol 53, No.3, pp. 541-563, Dec. 1994.

[3] Klein, D., *An Algorithm for the Multiple Objective Integer Linear Programming Problem*, European Journal of Operational Research 9,pp.378-385, 1982.

[4] Steuer, R. E., *Multiple Criteria Optimization theory*, Computation and Applications, Wiley, New York , 1985.

No-wait scheduling in supply chain environment

Satyaveer Singh Chauhan
Jean-Marie Proth

Tu 9:00 - 9:30, Room HS 1

This paper presents an approach to schedule a project online in a supply chain without rescheduling or disturbing the previous schedules. We consider a production system consisting of several resources. Some or all of these resources are partially busy with other projects and we know the busy periods of these resources when a new project arrives in the system. The new project may utilize some or all of these resources in a specific given order. The problem is to find, in real time, the schedule that leads to the lowest possible completion time of the project. The schedule we are looking for is a no-wait schedule, i.e. a schedule in which the next operation must start as soon as the previous operation is completed. Some of the operations of the project are assembly operations; this means that lot of operations should be completed simultaneously to start an assembly operation. No-wait constraint is crucial and imposes the biggest difficulty in case of several assembly operations. The operation times vary between the minimum and the maximum permitted operation time. The possibility to extend the processing time gives little flexibility to the system.

Three algorithms are proposed. The first algorithm schedules the jobs online optimally for production processes that do not include assembly operations. The second algorithm utilizes the functionality of first algorithm for scheduling the ordinary assembly processes (single assembly operation at the end of the processes). The third algorithm extends the approach of ordinary assembly process to schedule the complex assembly processes. A complex assembly process contains one assembly operation (if it is not the last one) or more than one assembly operations.

Key words: No-wait scheduling, Assembly, Supply chain, Online scheduling

---

Solver in function of solving linear programming problems

Marina Cicin-Sain
Marija Marinovic

Tu 9:00 - 9:30, Room HS 5

The aim of this paper is to approach to managers and other users a tool, which is very useful, but insufficiently used in solving linear programming problems by applying spreadsheets. That approach can make manager feel like he's the master of situation, because the process is constantly under control. It is important to emphasize that such a process can be developed on the software, which every average company has, and it is relatively familiar to user. Usage of Solver application in mathematical programming and limitation programming technology requires ability to create a linear programming problem- solving model. It is necessary to integrate high-specialized knowledge about computer supported optimization methods such as matrix generating, data preparing for solver, mathematical programming. Continuos development and increase in quality of computer tools and programs for optimization and algorithm technology creates ground for creation of faster and more complex software problems that appear in solving of linear programming problems. New software

generation lessens the complexity and shortens the time of applications creation as for example, generation of software components that surpass the gap between linear programming and limitation programming with the help of automatic code generating. Solver application is a part of software generation mentioned above, and is developing by creating of newer, advanced version in accordance to the newest development in the field of computer supported mathematical programming. Formal mathematical models are understandable to mathematicians but complicated for non-mathematicians. Solving a linear programming model manually is not very agreeable and sometime, when working with hundred of variables almost impossible. Using linear programming software is better solution but still could be convoluted. Is there a possibility to solve the linear programming problems without big additional expenses and without to much hassle? This paper shows there is an easier way in solving linear programming problems. The method is cheap, because it does not require additional investments for all those companies that already have computer and installed Excel program, which is the standard equipment in offices today. Examples given in this papers show that is relatively easy to teach the staff to use Solver application, especially if they know how to use Excel already.

A New Exact Implicit Enumeration Procedure for the Resource Constrained Project Scheduling Problem with Discounted Cash Flows

György Csébfalvi Mo 14:00 - 14:30, Room HS 4

In this paper we present a new implicit enumeration procedure with effective pruning rules to solve the resource constrained project scheduling problem with discounted cash flows. We will prove by counterexample, that the traditional "minimal delaying alternatives" concept not necessarily results resource feasible optimal solution because a "hidden" resource conflict may remain "invisible" in the searching process. Our procedure is based on the "minimal resource violating sets" concept with appropriate new pruning rules. Our procedure repairs every feasible resource usage conflict regardless of whether it is "visible" or "hidden". In our model the bounds are computed by solving well-solvable totally unimodular zero-one linear programming problems. To solve the problems a state-of-the-art primal-dual interior point algorithm was applied. The computational experience on a wide variety of problems shows that the proposed new approach is very fast and efficient. Replacing the exact searching algorithm with a "beam search" algorithm we can solve large-size problems heuristically within acceptable time.

Innovative Lösungen im bimodalen Transport Straße / Binnenwasserstraße

Joachim R. Daduna
Johannes Schröter We 17:30 - 18:00, Room HS 3

Der zunehmenden Belastung der Straßenverkehrsinfrastuktur durch den Güterverkehr soll durch Verlagerung auf andere Verkehrsträger entgegen gewirkt werden. Ein Ansatz ist hierbei die Bildung bi- bzw. multimodaler Transportketten im Kombinierten Ladungsverkehr. Dieser erfordert allerdings in den Schnittstellen geeignete Umschlagsysteme, die zeit- und kostenaufwendige Umsetzvorgänge der Ladungseinheiten verursachen, wodurch eine Wirtschaftlichkeit nur unter bestimmten Randbedingungen gegeben ist. Allerdings existieren bei einem Einsatz geeigneter Binnenschifftypen sowohl für den Güterfern- als auch für den -nahverkehr effiziente Lösungen für bimodale Transporte auf der Basis von Ro/Ro-Konzepten, die mit geringen Infrastrukturanforderungen verbunden sind. Im Fernverkehr, bei dem sich die Grundstrukturen auf Hub-Location-Ansätze zurückführen lassen, ergeben sich ablaufbezogene und wirtschaftliche Vorteile, da Restriktionen des Straßenverkehrs (u.a. zeitliche Nutzungsbeschränkungen) sowie bestimmte Kostenfaktoren (u.a. nutzungsabhängige Mautzahlungen) nicht auftreten. Beim Nahverkehr bietet sich, insbesondere in Ballungsräumen, ein solcher Ansatz an, um Verkehre zwischen peripher gelegenen Güterverkehrszentren und den Kernbereichen effizient zu gestalten. Auch wenn durch eine begrenzte Verfügbarkeit von Binnenwasserstraßen eine solche Lösung nicht auf jeder Relation zur Anwendung kommen kann, sind dennoch ausreichende Potentiale vorhanden, um diese Technik einzusetzen und ökonomisch sinnvoll zu nutzen. Zusätzlich müssen die ökologischen Aspekte gesehen werden, die mit dem Verkehrsträger Binnenschiff verbunden sind, so daß, insgesamt gesehen, bimodale Lösungen dieser Art mit erheblichen Vorteilen verbunden sind.

Solving stochastic programming problems by successive regression approximations

Istvan Deak Mo 14:00 - 14:30, Room HS 9

Successively applying regression approximations we can solve two-stage, probabilistic constrained, and a combination of the two previous stochastic programming problems. The algorithms are discussed and results from the last two years are summarized. Numerical examples for the different model types are given and optimization results are also presented.

On a polynomially solvable case of traveling salesman problem: extension of Lawler's conditions

Vitali Demidenko Tu 9:30 - 10:00, Room HS B
Valery Gordon, Jean-Marie Proth

Conditions as a system of linear inequalities for the elements of real-valued matrix are considered which guarantee that optimum of the assignment problem (AP) with one fixed assignment gives an upper bound to the optimum of the traveling salesman problem (TSP). These conditions allow to generalize Lawler's result (Math. Programming 1, 1971) which guarantees polynomial solvability of the TSP for upper-triangular matrices.

Let $A = [a_{ij}]$ be a real-valued $n \times n$ matrix and S_{1n} be a subset of symmetric group formed by permutations σ with $\sigma(n) = 1$. Let σ_0 be a permutation that yields a minimum to $f_A(\sigma) = \sum_{i=1}^{n} a_{i\sigma(i)}$ over S_{1n} (the AP with fixed assignment), let τ_0 be a cycle that yields a minimum to f_A over all cycles of length n (the TSP). Then the following is valid.

Theorem. *If the elements of matrix $A = [a_{ij}]$ satisfy to the system of inequalities*

$$\begin{aligned} a_{j+1\,1} + a_{j\,i} - a_{j\,1} + a_{j+1\,i} \geqslant 0, \quad j = 3, \ldots, n-1,\ i = 2, \ldots, j-1, \\ a_{k+1\,1} + a_{k\,k} - a_{k\,1} - a_{k+1\,k} \geqslant 0, \quad k = 2, \ldots, n-1, \end{aligned} \tag{1}$$

then $f_A(\sigma_0) \geqslant f_A(\tau_0)$.

This system of inequalities defines a cone $\mathbf{K}$ in a matrix space. It is proved that linear subspace of this cone (a maximum subspace contained in $\mathbf{K}$) includes as a subset all upper-triangular matrices for which the TSP can be solved in $O(n^3)$ time.

The same time is needed to find an upper bound of the optimum of the TSP with matrices (1) which can be used in branch and bound methods for eliminating unpromising branches as well as in evaluating of heuristic and approximate methods for the TSP.

The authors were partly supported by INTAS (Project INTAS 00-217).

Metaheuristics for Tracking Error Minimization in Portfolio Management

Ulrich Derigs Th 10:00 - 10:30, Room E1.05
Nils Nickel, Ralf Schnickmann

In passive portfolio management index-tracking is a common approach for portfolio optimization. Here the funds manager tries to construct from a given universe of assets a portfolio which fulfills all funds-specific guidelines (restrictions) and which has a "similar" performance as a given benchmark portfolio (objective). With respect to overall efficiency over time, this tracking has to take transaction cost into account.

In general, due to rather complex guidelines, this problem leads to nonlinear optimization models for which only heuristic approaches are practical. In this talk we present a new multi-level meta-heuristic and we report on results on real world tracking problems.

FUZZY LOGIC Optimisation of Budget Planning of a Municipality

Srecko Devjak We 9:30 - 10:00, Room HS 10
Jože Benčina

The budget manifests the allocation of political power and financial possibilities of a municipality. This is the result of appropriately selected investment projects and of the assessment of the funds required for continuous performance of tasks falling within the competence of municipalities. A successful budgetary process is closely related to the phase of contents preparation and budget adoption. The most important factor in relation to this is the support given by the representatives of political parties in the municipal council to the investment projects of a municipality. We will present the use of fuzzy logic in searching for optimum strategy in the selection of investment variants with regard to the standpoints and influence of political parties in the municipal council. The example will take into account the Slovene political situation.

A review of Neighborhood Structures for the Job-shop scheduling problem

Luca Di Gaspero We 14:00 - 14:30, Room HS 4
Igor Vian, Andrea Schaerf

Over many years, several Local Search techniques have been successfully applied to the Job-Shop scheduling problem. The success of these techniques relies both on the metaheuristic employed and on the neighborhood definition.

In this presentation, we review some neighborhood structures defined for Job-Shop scheduling and we compare several Tabu Search algorithms built upon these structures in a common experimentation setting. The algorithms were developed in C++ using the EasyLocal++ framework and were compared on a set of benchmarks recently employed in a survey of Vaessens and co-workers.

Furthermore, we propose an Iterated Local Search algorithm which makes use of one of the simplest neighborhood structures, and we show that its use increseas the performance and the robustness of the underlying tabu search algorithm. Finally, we show that the resulting Iterated Local Search algorithm outperforms the plain ones on all the instances.

On Flows Saturating an Edge in Undirected Networks

Madiagne Diallo Tu 17:00 - 17:30, Room HS B
Dominique Barth, Pascal Berthome

This paper is a contribution to the network flows theory. More precisely, we focus on properties making an edge to be or not saturated by a or any maximum flow between two selected vertices in the network.

Given an undirected network, we provide a way to identify exactly in polynomial time the set ASF of all vertex pairs for which any maximum flow between the two elements of a pair of vertices in the set saturates the given edge.

For an undirected network where all vertices can serve as sources and terminals when some flow has to be sent from one vertex to a nother in the network, Gomory and Hu showed how to obtain the all pairs maximal flows with just (n-1) maximal flows computations instead of n(n-1)/2 flows computations in the obvious case.

Elmaghraby on one side and recently Diallo and Hamacher on the other, delivered procedures to compute Gomory and Hu cut trees when a single arc capacity is function of a parameter. They provided analyses of the parametric multi-terminal flows. This consists of determining the maximum flows between any two vertices in the network for each value of the parameter.

In this paper, we show that exploring the non parameterized GH cut trees delivers partially the set ASF and the parametric GH cut trees deliver exactly the ASF.

This problem has applications in the transports, energy and telecommunications fields.

Parametric Capacity and Multi-Terminal Networks Flows

Madiagne Diallo Tu 17:30 - 18:00, Room HS B
Horst W. Hamacher

In this paper, we analyze the parametric multi-terminal network flows problem. We propose an efficient way to do a sensitivity analysis on a single parametric edge capacity in undirected networks. This consists of analyzing the variation of the all pairs maximal flows in the network induced by a decrease on this parametric capacity.

This sensitivity analysis was first tackled by Elmaghraby. In this paper, we propose a more efficient way to perform such a sensitivity analysis. This intends also some algorithmic improvements on the Elmaghraby's procedure.

In proposing our procedure, we even go further by solving the following problem:

Given an edge of the network, does there exists a minimal cut between two vertices (not necessarily the end vertices of the edge) that contains this edge?

The multi-terminal network flows problem has many applications as mentioned. The parametric multi-terminal network flows analysis problem may be of relevant utility in some real world problems in many sectors such as transports, telecommunications, energy.

In telecommunications, we may think, between others, about some very recent applications such as: multicasting (a priori one needs to know the maximal flow that each user — of a group in communication — can send to any of his pairs in the group), ad-hoc network (network where no end point is fixed). In the energy sector, we may restrict the citations to electricity, water and oil distribution networks.

In these contexts it may happen that some capacity of a single edge in the networks suffers some variations. Between many such perturbations, we may cite:

Reservation of a determined quantity of bandwidth, loss of a link in telecommunications; Partial or complete breakdown of some link in a energy network; Close of some route in a transport network. Sensitivity analysis on multi-terminal network flows may even have some ramifications in the financial sector for evaluating proposals for capital investments.

Hybridization of a GA based heuristic for the set covering problem with a network based heuristic

Farhad Djannaty We 17:00 - 17:30, Room HS 2

Genetic algorithms have attracted attention of many researchers for the past 20-30 years. Starting with a good population will lead to better solutions. A network based heuristic called Residual Cost Procedure, developed by the author, generates the initial population and it is hybridized with a GA based heristic. A slight increase in the execution time is rewarded by finding good quality solutions. A number of strong cost allocation strategies for the shortest route relaxation of the SCP problem are developed. Computational results are presented.

An Algorithm for LC1 Optimization

Nada Djuranovic-Milicic We 15:00 - 15:30, Room HS 8

In this paper an algorithm for LC1 unconstrained optimization problems, which uses the second order Dini upper directional derivative is considered. The purpose of the paper is to establish for this algorithm general hypotheses under which convergence occurs to optimal points. A convergence proof, estimates of the convergence rates are presented.

A Progress Report on Research in the Field of Tour Planning in Municipal Waste Disposal

Lothar Dohmen Mo 16:30 - 17:00, Room HS 5

This paper presents the current state of a research project on route planning in municipal waste disposal. It proposes an approach to route planning in municipal waste disposal by combining the multiple capacitated routing problem with the one-step multiple location problem. Pick-up sequences will be simulated, and routes, districts, locations of transfer stations, and the heterogeneous vehicle fleet will be optimized. The total cost for collection, transfer, and transportation of the municipal waste is the criteria for the optimization. Due to the complexity of this problem, a mathematical model and a simulation method will be developed that employ iterative methods of artificial intelligence. The mathematical model will structure the given problem set in greater detail. It comprises the resemblance of basic elements in a graph theoretic manner, the classification and structure of the mathematical problem set, and it describes the target function as well as the side constraints. The geographic area in which the households reside that produce the waste, can be resembled as nodes (intersections, company premises, target location, transfer stations) and arcs (street sections). Herein, the different types of waste are considered with their respective quantities in the different arcs, and the different vehicle types are attributed to these waste fractions. The mathematical model then is constrained by the loading capacities of the vehicles and their operating time. Based on these findings, the optimal tours and districts can be found. The mathematical model can be classified as a multiple assignment problem which combines routing problems and capacity restrictions with a multiple location problem under the consideration of multiple waste fractions. It therefore is an exact problem which will be solved with heuristic methods of artificial intelligence. Thereby, the total costs for collection, transfer, and transportation in municipal waste disposal can be reduced.

Transformation of Attributes in Multiple Attribute Decision-Making Models

Ludmila Domeova
Milan Houška Tu 9:30 - 10:00, Room HS 10

The multiple criteria decision-making methods evaluate the managerial decisions with aspect to more than one predermined criteria. After having defined finite set of feasible solutions (decision variants), finite set of criteria a criteria importance (criteria weights), the quantification of criteria matrix as evaluation of all variants under all criteria should be made. Than, the method of solution is to be chosen respecting the goal of solution, quality of the input information and the level of knowledge of the problem, impact of input data change and another model experiments and finally own decisions on some variant preference. Than there are two general assumption which should be fulfilled before the multiple attribute decision making method (MADM) itself is applied:

1. The same scale in all criteria

2. All maximal (minimal) criteria

Not all MADM methods require these assumptions but it may be essential for some methods like maximin, simple additive weighting method, TOPSIS, etc. The criteria transfer to all maximizing (minimizing) and to the same scale is usually made at once in the framework of one procedure (normalization) using different variants for cost and benefit criteria. There are several methods of normalization, i.e. vector normalization, linear scale transformation etc., but there is not exact definite assignment of normalization method to particular MADM. Our experience is, in contradiction with some literature, that these methods should be used with attention because they can sometime cause a remarkable difference in the final solution, i.e. finally chosen decision variant. We have paid special attention to the TOPSIS method. We demonstrate on this method the possible change in final solution caused by exploitation of unsuitable criteria transfer method.

A heuristic multi-criteria approach for the capacitated vehicle routing problem with fuzzy demand

Michael Drawe
Brigitte Werners

Mo 16:30 - 17:00, Room HS 10

In case that the demand of each customer is not precisely known when planning delivery, the classical capacitated vehicle routing problem (CVRP) has to be extended. Fuzzy sets are appropriate to model uncertain and vague demand, but then several goals have to be considered to find a good solution: The possibility to satisfy demand completely has to be high; the total vehicle travel distance has to be low. Additionally, the possible quantity of satisfied demand has to be high to maximize total sales. A fuzzy multi-criteria approach, based on a crisp equivalent mixed integer linear mathematical programming model, has been suggested to find this desirable solution. In order to solve even larger problems, heuristic approaches for the classical vehicle routing problem are modified accordingly with regard to fuzzy demand and multi-criteria optimization. A compromise solution is determined interactively with the decision maker, who adjusts the degree of satisfaction with the different goals. The influence of the applied heuristics on the quality of the compromise solution is discussed.

Strategies and Relative Skill in Poker

Marcel Dreef
Peter Borm, Ben van der Genugten

Th 9:30 - 10:00, Room HS 5

This talk will treat the poker model with two players and alternate bidding that was first discussed in the book of Von Neumann and Morgenstern (1944). In the original model, the cards (hands) the players receive, are independently distributed according to a uniform distribution on the interval $[0, 1]$. It will be shown that the equilibrium results of Von Neumann and Morgenstern can be extended to a game with more general distributions. With this extended result, one can approximate the strategies that are optimal for the players if this poker game is played with a real deck of cards. Apart from the equilibrium analysis, the relative level of skill of this game will be discussed, following the model that was developed by Borm and Van der Genugten (2001).

Scheduling Austrian and German Professional Soccer Leagues

Andreas Drexl
Thomas Bartsch, Stefan Kröger

Tu 11:30 - 12:00, Room HS C

Generating a regular season schedule is a demanding task for any sports league. In Europe, the creation of a suitable schedule for every national top soccer league not only has to address numerous conflicting inner-league requirements and preferences. Additionally, the games of the European Cup matches (Champions League, UEFA Cup, National Cup Winners) have to be taken into account. In this paper we consider the case of Austria and Germany, that is the planning problem the Deutsche Fußball-Bund (DFB) and the Österreichische Fußball-Bund (ÖFB) are confronted with.

For both leagues we develop models and algorithms which yield reasonable schedules quickly. The models borrow their expressive power from so-called partially renewable resources. Partially renewable resources are obtained by assuming for each resource a capacity on subsets of periods.

For the solution of the models three algorithms are presented. A semi-greedy algorithm which constructs a couple of (feasible) solutions quickly. A truncated branch-and-bound algorithm, which searches the solution space more completely and, finally, an exact branch-and-bound algorithm, which searches the solution space exhaustively. The algorithms are evaluated experimentally.

The algorithms have been embedded in an interactive decision suppport system based on Paradox. Our approach generates schedules which have been accepted for play by the DFB once and five times by the ÖFB. In these applications, partially renewable resources are a core tool for defining requirements in terms of constraints. It is strongly conjectured that soccer scheduling problems of other (European) countries can be solved adopting the approach presented in this paper.

A survey on the potential approach in cooperative game theory

Theodorus S. H. Driessen

Th 10:00 - 10:30, Room HS 5

The discrete potential approach to the solution theory for cooperative TU-games was introduced by Hart and Mas-Colell in 1989 resulting in the characterization of the known Shapley value as the unique efficient value that admits a potential representation (prescribed by the discrete gradient of a so-called potential function). In 1997, Calvo and Santos established that the Shapley value is the very best representative of the family of (not necessarily efficient) values that admit a (standard) potential representation. Our main goal is to survey the main recent results in the next two different extensions of the standard potential approach: (1) The revised representation of the value by incorporating, besides a fraction of the the discrete gradient, a fraction of the underlying pseudo-potential function itself, as well as a fraction of the average of all

the components of the gradient. Appealing examples of such values are put forward and moreover, a characterization of the full class of such values is stated (e.g., by linearity). (2) No change of the (several) equivalence theorem(s) happen(s) if the addition (or multiplication) operator is replaced by any an arbitrary binary group operator on the set of real numbers (which guarantees the existence of the inverse of any real number). In the setting of the group structure, a counterpart of the standard Shapley value arises as the very best representative of the family of (not necessarily group-efficient) values that admit the potential representation (with reference to the underlying group structure).

Nonconvex Duality: Theory and Applications

Mirjam Duer We 11:30 - 12:00, Room HS 8

This talk discusses the concept of Lagrange duality for nonconvex optimization problems both from a theoretical and an applications-oriented point of view. On the theoretical side, estimates of the duality gap will be specified and the properties of the dual problem in case of primal infeasibility will be investigated. Further, bounds obtained by duality will be compared to those obtained by a-priori bounds for the primal objective function. Algorithmic implications of these findings are of particular interest: Branch-and-Bound procedures using dual bounds can be shown to converge. As an important problem class which can be solved by this means, we briefly discuss sum-of-ratios fractional problems.

VRP with interdependent Time Windows - A Case study for the Austrian Red Cross blood programme

Karl Dörner Tu 14:00 - 14:30, Room HS 3
M. Gronalt, R.F. Hartl, M. Reimann, K. Zisser

In this paper we propose a new approach for vehicle scheduling in connection with the blood donation activities of the Austrian Red Cross blood programme. In order to collect the donations for each period (weekend) a number of districts is selected for the blood donation campaigns. Usually the locations contain a number of small villages spreaded in the area of Eastern Austria. To each of the locations a team is assigned for organizing the blood donation during a specific daily duration. They collect the donations and provide for a proper storage of these. Collected blood must be transported from the campaign locations to a central blood processing facility, where it has to be further processed within about 300 minutes. A number of vehicles is scheduled for picking up the stored blood donations and delivering it to the processing facility within the given time window. Obviously, several pickups can be combined to one tour. Time windows for each location show a dynamic behaviour as they depend on previous pickup times. We develop a savings-based constructive solution procedure for the VRP with interdependent time window constraints. In the initialization phase the minimum number of pickups and the current slack time are determined for each location. This leads to a multiplication of locations and their respective time windows in the used construction graph. In the construction phase locations are added to a tour according to the savings values and the current slack times. In the next step of our constructive heuristic tours are assigned to vehicles. Preliminary results show that we can easily decrease the overall tour length and the number of used vehicles. Future work will deal with dynamic orders also, as hospitals are ordering blood conserves during the course of a day. The available vehicles must consider these new orders in their tours.

Winner Determination in Combinatorial Auctions: An Application to Decentralized Production Planning

Thomas Elendner Mo 17:30 - 18:00, Room HS 2

Consider an auction, where multiple non-identical objects are auctioned simultaneously. If bidders are allowed to place bids on single items or combinations of items, this kind of auction is called a “combinational” or “combinatorial auction”. Whenever there exist - from the side of the auctioneer - no restrictions on placing bids, the winner determination is proven to be NP-hard in the general case. Combinatorial auctions were identified to be efficient coordination mechanisms in the environment of decentralized production planning; m jobs are auctioned to n self interested agents possessing private information. Every agent can submit bids on an arbitrary number of bundles of jobs but can be assigned only one bundle (bid). We present exact algorithms for the winner determination for the case of identical jobs.

SCIL - Symbolic Constraints in Integer Linear Programming

Matthias Elf We 9:00 - 9:30, Room HS B

We describe the software system SCIL that introduces symbolic constraints into branch-and-cut-and-price (BCP) algorithms for integer linear programs (ILP). Symbolic constraints are known from constraint programming and contribute significantly to the expressive power, ease of use, and efficiency of constraint programs. The BCP paradigm for solving

ILPs is one of the most effective approaches to find exact or provably good solutions of hard combinatorial optimization problems. But the implementation of a BCP algorithm requires significant expert knowledge. SCIL simplifies the implementation by supporting high-level specifications of combinatorial optimization problems with linear objective functions. It provides a library of symbolic constraints and can convert high-level specifications into efficient BCP-algorithms. Symbolic constraints encode structural knowledge that can be utilized during computation by generating problem specific cutting planes or using decomposition strategies like Lagrangean relaxation. A user may extend SCIL by defining new symbolic constraints or by changing the standard behaviour of the algorithms. This talk is based on joint work with Ernst Althaus, Alexander Bockmeyer, Michael Jünger, Thomas Kasper and Kurt Mehlhorn.

Demand allocation in Multiple-Product, Multiple-Facility Make-to-Stock Systems

Mohsen Elhafsi
Saif Benjaafar

Mo 16:30 - 17:00, Room HS 1

We consider the problem of allocating demand arising from N products to M production facilities with finite capacity and load-dependent manufacturing lead times. Production facilities can choose to make items either to-stock or to-order. If items are stocked, demand is satisfied immediately if there is on-hand inventory. Otherwise, demand is backlogged with the production facility to which it is assigned. Products vary in their demand rates, holding and backordering costs, and service level requirements. We develop models and solution procedures to determine the optimal allocation of demand to facilities and the optimal inventory level for each product at each facility. We consider two types of demand allocation, one in which we allow the demand for a product to be split among multiple facilities and the other in which demand from each product must be entirely satisfied by a single facility. We refer to the former as the demand allocation problem and to the latter as the demand partitioning problem. For each case, we offer a solution procedure to obtain optimal demand allocations and optimal inventory base-stock levels for each product at each facility. We use the models to characterize analytically several properties of the optimal solution. In particular, we highlight six principles that relate the effects of cost, congestion, inventory pooling, customer segmentation, and process/demand variability.

Integrating stochstic delays into multicriterial time-table optimization

Ophelia Engelhardt-Funke
Michael Kolonko

Mo 14:30 - 15:00, Room HS 3

The weighted sum of passenger waiting times over all transfer connections is often used as an objective function in time-table optimization. Though waiting times are annoying for passengers they also serve as time buffers for delayed trains. So reducing these slack times may result in less reliable transfer connections.

In a multicriterial optimization environment it is therefore interesting to consider both (conflicting) goals: minimize scheduled waiting time and minimize actual waiting time in the presence of random delays.

As the distributions of arrival and departure delays are subject to multiple dependencies the cost function “expected real waiting cost” can be calculated analytically only for trivial networks. In realistic networks it has to be estimated using stochastic simulation. Suitable heuristic optimization methods like evolutionary algorithms require many cost function evaluations each of which needs several (expensive) simulation runs.

We present first structural observations obtained withour optimization tool: a) the less slack time a time-table has, the more simulation runs are necessary to obtain stable estimators for the expected real waiting cost, b) during the optimization process the two cost functions “expected real” and “scheduled waiting cost” are almost identical for time-tables with large slack time. For small slack times they differ significantly, and eventually, reducing scheduled waiting times does not improve the expected real waiting cost any more.

This justifies our adaptive approach in which the costly simulation is only invoked in later stages of the evolutionary algorithm where expected real waiting time different from the scheduled waiting time can be expected.

Sorting with Line Storage Systems

Thomas Epping
Winfried Hochstättler

Tu 12:00 - 12:30, Room HS 4

We consider a problem that arises in the car production. In particular, we focus on the sorting of car bodies with respect to their designated enamel colors for a paint shop. Our objective is to sort a given car body sequence so that the number of color changes within the sorted sequence is minimized. Current technology is to perform the realignment of a sequence by the use of a line storage system.

First, we consider a simplified version of the problem where a snapshot of the line storage system is given and an optimal retrieval of the colors on the storage belts is searched. We show that this problem is in a certain sense equivalent to

the multiple sequence alignment (MSA) problem known from molecular biology, which can be solved fast by a dynamic programming (A^*)-algorithm. We describe our modifications of the dynamic program and show that an optimal MSA yields an optimal retrieval sequence for the colors on the storage belts.

Next, we consider not only the retrieval, but also the storage of colors on the storage belts. We give a dynamic program for the solution of this problem and show how the huge theoretical complexity of the dynamic program can be reduced in a suitable implementation.

We present preliminary computational results and discuss the applicability of our solution approaches in practice.

Opinions on Internet and Book Buying Behavior Among Faculty

Orhan Erdem Tu 11:30 - 12:00, Room HS 2
Nilly Al-Abdulsalam, Zakia Al-Adawi

Faculty members can be considered as a market segment when they purchase products and services through Internet. Determining what they buy and why they buy through Internet might have implications for the local businesses. This study examines the opinions of SQU faculty on Internet use and attempts to differentiate book buyers on Internet from non-buyers based on demographic characteristics and the opinions of faculty.

The study was conducted online through an e-mail survey. A cover letter was e-mailed to 200 faculty members directing them to the website of the questionnaire. After a week a reminder was e-mailed. At the end of second week, 42 responses were obtained, resulting in a 21 percent response rate. Given the fact that this was the first online survey in the country, this response rate was considered acceptable. Faculty opinions on Internet use were obtained by using Likert-type statements, ranging from 5 = strongly agree to 1 = strongly disagree.

T-tests were utilized to see whether opinions on Internet use differed significantly by demographic characteristics of the faculty. A discriminant analysis was conducted to differentiate between book buyers/non-buyers on Internet. The discriminant function was significant at .01 level and the hit ratio was 76 percent. The significance of this hit ratio was also tested based on three different criteria.

Intensity Splitting Revisited: Hamilton-Hopf Bifurcations and DNS-Curves

Gustav Feichtinger Tu 15:00 - 15:30, Room HS 7
Alois Steindl

In this paper we present an application of the Hamilton-Hopf bifurcation to an inventory/production model. Among other results, our analysis provides a new proof of the result that persistent oscillations may be optimal for arbitrary small discount rates. For a vanishing discount rate a “Hamiltonian Hopf bifurcation” occurs, leading to a family of periodic solutions bifurcating from a steady state. If the discount rate is assumed small, but different from zero, almost all periodic solutions vanish; only an unique branch of periodic solutions is obtained. The second main result of the paper refers to the existence of DNS-curves which is numerically proven. In particular, for certain parameter ranges a ‘3-fold’ Skiba-point in the state-space is found. There are three trajectories emanating from this point and exhibiting the same minimal value of the cost functional. Two of these paths lead to the stable limit cycle, while the remaining path converges to the inner long-run equilibrium.

The Management Game SINTO-Market

Tanja Feit Tu 14:00 - 14:30, Room HS 5
Susanne Lind, Ulrike Leopold

The management game SINTO-Market which was developed and programmed by Otwin Becker and Reinhard Selten was performed at University of Kalmar and University of Graz several times. The electronic management game SINTO-Market puts the players in a competitive situation of the branded food product sector. SINTO is a synthetic protein product which does not exist in reality, although it may be developed at some time in the future.

Each firm must decide how many brands to bring onto the market. Brand characteristics, production, price and advertising expenditure have to be fixed for each brand. All brands are competitive with each other so that the sales of one brand are also dependent on the decisions made for all other brands. The goal of each firm is the maximization of final owned capital.

Our aim is to model a realistic market situation and to have survival strategies for the oligopolists at hand.

Pricing of Multidimensional Resources in Revenue Management (Multidimensional Dynamic Stochastic Knapsack Problem)

Jens Feller Tu 12:00 - 12:30, Room HS 9

Revenue management deals with selling a limited amount of a perishable resource. This resource becomes valueless at a known point of time (deadline). First used to assign problems in airline industries (e. g. selling of seats) revenue management has become more and more important in account of further research results, its practical successes and itswide fields of applications. There are many papers dealing with one-dimensional resources (e. g. seats or hotel rooms) using different approaches as linear programming or Markov decision processes which consider the problem as a dynamic stochastic knapsack problem (DSKP).

In this talk we address the question of choosing an optimal price of these resources in consideration of the remaining time, the resources left and the expected demands. Obviously a bad choice may result in being out of stock when getting lucrative requests or in denying requests and keeping unsold resources at the deadline. We focus on the characteristics of multidimensional resources which often have to be taken into account, e. g. when transporting freight with limitations to volume and weight or when pricing package holidays as a simultaneous selling of seats and rooms.

We present a model using the DSKP-approach for maximizing the expected revenue with a given deadline and resource when the distribution functions of the demands and of the offered revenue are known. We show that there is a threshold policy optimizing this expected revenue by giving a price threshold and accepting all requests with a better price and denying all other requests. In the special case of discrete time periods we give an algorithm for calculating such policies and present some examples showing interdependencies between different types of demands and the strong influence of requests for more than one unit of some resource dimensions.

Asymmetrische Informationsverteilung und optimale Kontraktgestaltung

Claudia Fink We 11:30 - 12:00, Room E1.05

Hauptproblem: Im Rahmen dieses Beitrags wird die Agency-Problematik bei langfristiger Projektfinanzieung (Stop-Go Entscheidung) aufgegriffen. Kernproblem dabei ist eine asymmetrische Informationsverteilung zwischen kapitalanbietendem Kreditinstitut und kapitalnachfragender Unternehmung.

Lösung: Mit traditionellen Finanztiteln bzw. mit traditionellen Finanzkontrakten kann keine first best solution (= Lösung bei symmetrischer Informationsverteilung) erreicht werden; erst durch Konstruktion hybrider Finanzkontrakte kann das Problem der asymmetrischen Information gemindert bzw. gelöst werden.

Technik und Anwendung: Modelliert wird die Wertentwicklung des zu realisierenden Projektes in diskreter Zeit. Ziel ist es, dass beide Vertragsparteien - trotz asymmetrischer Informationsverteilung - zu jedem Zeitpunkt und in jedem Zustand zur selben (optimalen) Entscheidung bezüglich Weiterführung (= zusätzlicher Finanzmittelbedarf) oder Einstellung des Projektes kommen. Diese Problemstruktur findet man in der Praxis beispielsweise bei der Arzneimittelentwicklung in der Pharmaindustrie als auch bei der Entscheidung bezüglich Folgeinvestitionen im Rahmen der Ausbeutung von Bodenschätzen (Metalle, Erdöl etc.) wieder.

On minimizing average weighted completion time: A PTAS for job-shop scheduling with release dates

Aleksei Fishkin
Klaus Jansen, Monaldo Mastrolilli We 14:30 - 15:00, Room HS 4

In this paper we present a polynomial time approximation scheme (PTAS) for the job-shop scheduling problem with release dates, fixed number of machines, fixed number of operations per job and the average weighted completion time objective. This improves on the previous best $(5.78 + \varepsilon)$-approximation algorithm by Chakrabarti et al.

Strategische Planung von Produktionsnetzwerken in der Automobilindutrie

Bernhard Fleischmann
Peter Henrich We 9:30 - 10:00, Room HS 1

Die strategische Planung der Produktion hat in der Automobilindustrie eine sehr grosse Bedeutung. Entscheidungen bezüglich des Produktionsnetzes benötigen für die Umsetzung mehrere Jahre und binden das Unternehmen wegen der langen Produktlebenszyklen über einen langen Zeitraum. Wesentliche Entscheidungen bei festgelegtem Produktprogramm betreffen die Fragen: Wieviel Kapazität ist für welche Produkte an welchen Standorten aufzubauen? Dabei ist die gesamte Supply Chain von der Materialanlieferung zu den Werken bis zu den weltweiten Absatzmärkten zu betrachten. Solche Fragen lassen sich je nach Zielsetzung durch LP- oder MIP-Modelle erfassen. Für deren Einsatz in der Praxis ist jedoch die Einbettung der strategischen Produktionsplanung in den strategische Entscheidungsprozess und in die Gesamt-Unternehmensstrategie zu beachten, aus der auch wichtige nicht-quantitative Ziele und Vorgaben resultieren. Der Vortrag

stellt ein Konzept zum Einsatz von quantitativen Modellen vor, erläutert die Datensammlung, die Modellierung und Lösung mithilfe der Software 'Strategic Network Optimization' (SNO) von J. D. Edwards und berichtet über Erfahrungen aus der Praxis.

CrewOpt: A Column Generation Method for Transit Crew Scheduling

Charles Fleurent
Lise Séguin

We 12:00 - 12:30, Room HS 3

The transit crew scheduling problem consists of identifying an optimal set of duties to completely cover a given vehicle schedule, while respecting several constraints. In recent years, column generation has emerged as the most effective approach for solving general crew scheduling problems, as evidenced by its wide use in many fields. However, because of the long execution times, its application was often limited to problems of moderate size and alternative methods had to be used to solve large examples. For instance, with the HASTUS product from GIRO Inc., a heuristic approach was in the past required to solve problems having more than 1000 driving tasks. The newer CrewOpt product based on column generation was recommended for smaller problems. In the recent years, significant progress has been made, and CrewOpt can now effectively tackle problems of all sizes. First, the availability of more powerful computers and improvements to the core algorithm have increased the maximum size of problems that can be solved directly by CrewOpt. Secondly, a multi phase approach has been developed so that very large problems can be divided into smaller ones, and then solved by column generation. This approach also includes post-optimization phases in which the solutions of the smaller problems are combined and optimized locally for further improvements. These advances have led GIRO Inc. to identify CrewOpt as their standard crew scheduling algorithm, for all new HASTUS installations or upgrades. In the final version of this paper, we will discuss important issues to consider for the effective use of column generation techniques on large problems. Test results will also be presented for large problems from different transit companies. These results show that recent CrewOpt versions can now generate excellent results for large scale crew scheduling problems.

Environmental Coordination of Supply Chain Networks Based on Fuzzy Sets

Jürgen Friedl
Baptiste Lebreton, Axel Tuma

Th 10:00 - 10:30, Room HS 6

Following the actual discussion concerning modern production concepts, an increasing trend to network organizations can be identified. In interconnected production systems materials and different forms of energy are provided, converted, stored and transported. Environmental impacts can be identified at any production unit. Due to this fact it is of special interest to implement coordination mechanisms to control the energy and material streams. In this way it is possible to use available resources more efficiently and to reduce emissions and by-products caused by the production process. Achieving this goal in a first step the structure of a production system, including the input and output streams, has to be modeled. This can be done with input-output models (e.g. unit-operation models) or with simulation systems. Due to the modeling requirements of supply chain networks (modeling of production and storage units, dynamic behavior) a petri net approach seems to be adequate. In a second approach control strategies concerning economic and ecological goals have to be integrated. In order to address the multi-criteria structure of such a decision problem, a scoring-model based on fuzzy sets is discussed.

Indirect Expenditure Functions and Shephard's Lemma

Susanne Fuchs-Seliger

Mo 17:30 - 18:00, Room E0.05

Instead of basing a model of consumer behaviour on preferences on the commodity space, by duality, one can also develop such a model assuming hypotheses on the individual's preferences on the price space. For instance, it is appropiate to assume that an individual prefers lower prices to higher ones. The basic hypotheses on consumer's behaviour will be the following ones:

(P1) R is a relation on the strictly positive n-dimensional real space. Every p in this space will be interpreted as a normalized price vector. pRp' means, the consumer appreciates the price system p to be at least as good as p'.

(P2) R is reflexive.

(P3) R is lower semicontinuous.

(P4) R is decreasing.

Note that it is not assumed that the individual's preferences are transitive or complete. Nevertheless, one can show that the indirect expenditure function and the inverse demand function have the main properties usually required in the theory of consumer behaviour. Even one can show that Shephard's lemma holds within the theory.

Computing intervals of eigenvectors in max-min algebra

Martin Gavalec Th 9:30 - 10:00, Room HS C

For a given $n \times n$ matrix A over a max-min algebra, the structure of the eigenspace $F(A)$ is completely described. $F(A)$ can be expressed as a union of $n!$ subspaces of the form $F(p, A)$, for all permutations p on the set $\{1, 2, \ldots, n\}$. Every subspace $F(p, A)$ contains exactly the inversely p-permuted vectors from the set $Fleq(App)$, consisting of all non-strictly increasing eigenvectors of the matrix App with simultaneously permuted rows and columns.

Further, the structure of $Fleq(A)$ is described as a union of at most 2^{n-1} intervals containing monotonous eigenvectors of a fixed type (monotonicity intervals), and an explicit formula for the intervals is given. It is shown that the endpoints of the intervals can be computed in $O(n^2)$ time, or in $O(n)$ time, if an auxiliary $n \times n$ matrix $C(A)$ has previously been computed.

In the third part of the lecture, the following question is considered: how many of the possible 2^{n-1} monotonicity intervals in the eigenspace $Fleq(A)$ can really be non-empty and have mutually distinct endpoints? It is shown that the answers to the question have a wide scope from 1 to the maximum value 2^{n-1}.

Bifurcation Analysis of Optimal Methadone Maintenance Treatment

Caius Gavrila
G. Tragler, G. Feichtinger, J. P. Caulkins Tu 12:00 - 12:30, Room HS 7

We consider an optimal control model of the methadone maintenance treatment for a population of injection drug users (IDUs). The treatment has a positive effect on the incidence of certain diseases (HIV and hepatitis C) related to injection drug use. The equation of motion that describes the dynamics of the number I of infected IDUs depends on the state variable I and the control variable M, i.e. the amount of methadone treatment. A crucial parameter in the equation of motion is the infectivity κ of the disease. Our aim is to minimize the cost functional, which is the sum of the cost of the treatment and the social cost νI, where ν is the social cost per infected user. Depending on the values of κ and ν the model has either an extreme solution (minimal or maximal treatment) or a solution that presents a DNS-threshold. Using numerical and analytical methods we characterize the domain in the ν–κ plane where the model has a DNS-threshold.

Dynamic Theory of Industrial Service Management

Heiko Gebauer Mo 13:30 - 14:00, Room HS 7

Despite the demonstrated benefits of industrial services in driving competitive advantages, most companies found it extremely difficult to manage the transition from product manufacturer to service provider successfully. In fact, companies have found it difficult to sustain the transition. The transition has often led to declining business because of increasing costs for additional services, which could not be recovered with corresponding returns. That has led to decreasing margins and has weakened company's competitive position. We employed the system dynamics method to identify multiple feedback mechanism and major managerial challenges affecting the transition process. By using this method, we developed a dynamic theory of service management. This dynamic theory explains why do some companies struggle to sustain the transition successfully. Our theory integrates the characteristics of service management, the structures of service improvement programs and the behavior of managers. Further on we identified the key factors for managing the transition. The key factors span both strategic and operational level. In order to employ a sustainable transition process the key factors are implemented into a framework for the strategic positioning of product manufactures, an integrated model for service management and guidelines for managing the transition process. The key factors are integrated into a decision support system by which managers can control the transition from product manufacturer to service provider. The decision support system helps to find a consistent, complementary and mutual reinforcing configuration of key factors. The dynamic theory has evidence from literature and from qualitative research. The main tool for theory development are intensive case studies. We have conducted several case studies among companies which either managed the transition process already successfully or are still in process of transition.

Introducing Path Relinking to Multi Objective Combinatorial Optimization

Martin Josef Geiger We 17:00 - 17:30, Room HS 3

A huge variety of metaheuristic approaches like genetic algorithms, simulated annealing and tabu search, has successfully been proposed to solve $\mathcal{NP}$-hard combinatorial optimization problems. For problems with multiple objectives, extensions of the basic ideas were developed to obtain a set of Pareto efficient solutions instead of a single global optimum. An early approach by Glover is the *path relinking* strategy, involving a set of solutions to perform a local search along the path of two solutions via a finite number of transitions (moves).

In this paper, we present an application of the path relinking approach to multiple objective combinatorial optimization problems (MOCO). An example for the flow shop scheduling problem under multiple objectives is studied and an idea of an interactive optimization procedure incorporating preferences from a decision maker is discussed.

Entscheidungsunterstützung für die nationale Umsetzung von Emissionsminderungsmaßnahmen mittels des Stoffflussmodells ARGUS

Jutta Geldermann Th 11:00 - 11:30, Room HS 6
Nurten Avci, Stefan Wenzel, Otto Rentz

Das Göteborg-Protokoll der UN/ECE ('Multi-Pollutant- und Multi-Effects-Protokoll' von 1999) wird in der EU durch die Richtlinie 2001/81/EG über nationale Emissionshöchstgrenzen für bestimmte Luftschadstoffe ('NEC-Richtlinie') für SO2, NOx, NH3 und VOC (flüchtige organische Verbindungen) umgesetzt. Vor allem die geforderte Reduktion der VOC-Emissionen um 80% bis zum Jahr 2010 (Bezug 1990) stellt Anforderungen an kleine und mittlere Unternehmen in den verschiedensten industriellen Sektoren. In diesem Beitrag wird das Stoffflussmodell ARGUS, ein techno-ökonomisches Optimierungsmodell zur Ermittlung wirtschaftlich optimaler Emissionsminderungsstrategien, vorgestellt. Damit können ökonomische und ökologische Auswirkungen von umweltpolitischen Maßnahmen für Industriesektoren, Länder oder Regionen abgebildet und analysiert werden. Bisher wurde ARGUS verwendet, um die Auswirkungen des Göteborg-Protokolls und der EU-Lösemittelverordnung in Deutschland und in Frankreich zu analysieren. Derzeit wird es für die Erarbeitung eines Maßnahmenplans zur Umsetzung der NEC-RL in Österreich eingesetzt. Im Rahmen der Optimierung beschreibt die Zielfunktion die Minimierung der Ausgaben (Betriebsausgaben und Investitionen für Produktionsprozesse / Abscheidetechnologien) in den betrachteten Teilperioden auf Basis der Kapitalwertmethode. Als Nebenbedingungen können verschiedene Schwellenwerte und Übergangsfristen für die Emissionsreduktion sowie Annahmen über die Entwicklung der Nachfrage nach Produkten bzw. Produktionskapazitäten berücksichtigt werden. Ein an das Stoffflussmodell gekoppeltes Lebensdauermodell gewährleistet, dass in zukünftigen Perioden Spielräume für den strukturellen Wandel von Technologien adäquat dargestellt werden, die sich aus den Technologielebensdauer- und den Reinvestitionszyklen der berücksichtigten Anlagen ergeben. Weiterer Forschungsbedarf ergibt sich durch die Anforderungen an umfassende Sensitivitätsanalysen, die bereits durch die NEC-RL gefordert sind.

Weiterentwicklungen der MADM-Verfahren in China und in Deutschland

Jutta Geldermann Tu 9:00 - 9:30, Room HS 10
Kejing Zhang, Otto Rentz

Ziel des Beitrags ist eine Untersuchung der am häufigsten angewendeten Verfahren zur multikriteriellen Entscheidungsunterstützung sowie der vorgeschlagenen Sensitivitätsanalysen in China und in Deutschland. Der Schwerpunkt liegt dabei auf den MADM-Verfahren (Multi Attribute Decision Making) zur Auswertung einer vorliegenden Anzahl diskreter Alternativen. Beispiele sind Multi Attribute Utility Theory (MAUT), Analytischer Hierarchie Prozess (AHP) und die Outranking Verfahren ELECTRE, PROMETHEE, ARGUS und MACBETH.

Diese Verfahren finden Anwendung bei der strategischen Produktionsplanung, der Lieferantenauswahl, Standortwahl oder bei Fragen der Technikbewertung unter ökonomischen, ökologischen und technischen Kriterien.

In China werden vorwiegend MAUT und vor allem AHP eingesetzt. So fanden in den Jahren 1988 und 1992 internationale Symposien über AHP statt. Schwerpunkt der Forschungsarbeiten ist die Weiterentwicklung von AHP hinsichtlich der Consistency Ratio (R.I.) und der Ursachen für "Rank Reversals". Anwendungsbeispiele, die in der chinesischen Literatur diskutiert werden, sind etwa Autokauf oder Investitionsstrategien.

Als Weiterentwicklung wird die Integration von Fuzzy Logik und Neuronalen Netzen in multikriterielle Entscheidungsunterstützungssysteme in beiden Ländern diskutiert, um ungenaue oder unscharfe Information berücksichtigen zu können.

Locating Sensors on Traffic Networks

Monica Gentili We 15:00 - 15:30, Room HS 3
P.B. Mirchandani

Sensors on a traffic network monitor traffic flows. Information on traffic flows has significant use in estimating origin-destination volumes, traffic volumes on truck routes and, in general, for traffic management and planning. However, there has been limited attention paid to the optimal location of these sensors, some of which can be quite costly to buy, install and maintain. This paper focuses on the development of two generic locational decision models: (1) "How many and where should sensors be located to obtain sufficient information on flow volumes on routes?" and (2) "Given that the traffic operators have already located flow detectors on some network arcs (e.g., induction loop counters), how many and where

should additional sensors be located to get the maximum information on flow volumes on routes?" Two different types of sensor types are addressed: (i) those that can provide turning ratios at each node (the node location problem) or (ii) and those that get information on route flows (the arc location problem). We formulate these problems, which are related to the set covering problem, and study their computational properties. We also provide some polynomial instances.

Multiprocessor Task Scheduling Systems with Machine Saturation Property

Monica Gentili
Paolo Dell'Olmo

Tu 14:00 - 14:30, Room HS C

Let $T = \{T_1, T_2, \ldots, T_n\}$ be a set of n unit time independent tasks and $P = \{P_1, P_2, \ldots, P_m\}$ a set of m processors. During each time instant, each processor can be used by a single task at most. The processing of each task T_i requires the simultaneously availability of a pre-specified set of processors $P(i)$ for one time unit. A schedule is an assignment of a start time for each task T_i such that no two of which use the same processor in the same interval time. A schedule is said to be optimal if it minimises the maximum completion time. It is well known that, this problem can be formulated as the problem of finding an optimal vertex coloring of a graph, that is a partition of the vertices of the graph into a minimum number of stable sets. Graph models have been used extensively to design algorithms and study properties for the multiprocessor tasks scheduling problem. In particular, we study saturated graphs to model scheduling systems with Machine Saturation Property, that is systems admitting schedules without idle times where all processors are kept busy in every time instant. This is an interesting property of the system as it guarantees, not only the optimality of the solution with respect to the makespan criterion, but also the best possible utilisation of the whole processor set as no processor is ever idle. We give a characterisation of saturated graphs and polynomial time recognition algorithms for some graph classes.

The Max TSP: asymptotically optimal algorithms in Euclidean space

Edward Gimadi
Alexey Y. Baburin

Tu 9:00 - 9:30, Room HS B

The maximum weight TSP in Euclidean space R^k is considered. An asymptotically optimal algorithm for the problem is known (Serdyukov, 1987). The time complexity of the algorithm is $O(n^3)$, dominated by the complexity of constructing a maximum weight matching M. The multigraph constructed by the algorithm is covered by four Hamiltonian cycles (depending on the parity of $m = |M|$). Each cycle consists of all intervals of the matching M. The longest cycle asymptotically achieves the optimal length. A performance ratio of the solution is $1 - b(k) * n^{-2/(k+1)} \to 1$, as n grows to infinity, where a constant $b(k)$ depends only on k.

The same complexity and performance ratio is maintained by more simple version of asymptotically optimal algorithm (Gimadi, 2001), where a single cycle is constructed (independently on the parity of m), and this cycle achieves the asymptotically optimal solution. Moreover, the solution contains at most two edges of M.

We suggest another asymptotically optimal algorithm for the case of distance matrix which entries guarantee limited fractions of the maximum and minimum weights of edges in maximum weight matching. For instance, this class contains the Euclidean TSP on a restricted diameter graph with vertices in the integer grid.

Let the distances between the given n points in R^k be in the segment $[a(n), b(n)]$. Then the suggested algorithm has an improved performance ratio if an upper bound for $b(n)/a(n)$ is at most $g(k) * n^{4/(k^2-1)}$, $k > 3$, where $g(k)$ depends only on the dimension of space R^k. For $k = 2$ and $k = 3$, upper bounds equal $g(2) * n^{11/6}$ and $g(3) * n^{5/6}/\ln n$, respectively.

This work was supported by the grant of the Russian Foundation for Basic Research (project N 02-01-01153) and Federal Program "Integration".

On the Project Scheduling Problem under Stored Resource Constraints of an arbitrary sign

Edward Gimadi
S.V. Sevastianov

Tu 15:00 - 15:30, Room HS 4

For the resource constrained project scheduling problem (RCPSP) it was introduced a notion of *stored* resources. Like it is for renewable resources, a predetermined number of units of a stored resource is available for every unit period of the planning horizon. But if some quantity of the resource is not utilized in period t, it can be utilized in any subsequent period $t' > t$.

Earlier it was proved that for the RCPSP which contains only stored resources of a positive sign, the optimal solution can be found in polynomial time.

In the talk a polynomial solvability of the problem is established under assumption that intensities of constrained storied resources available in any moment can be of an arbitrary sign. Nevertheless in the case of resource requirements of an arbitrary sign the problem is to be NP-hard.

This work was supported by the grants of the Russian Foundation for Basic Research (project N 02-01-01153), INTAS (project 00-217) and the Russian Foundations for the Humanities (project 00-02-00221a).

Routing of Snowploughs - A Column Generation Approach

Nima Golbaharan
Per Olov Lindberg

Th 11:00 - 11:30, Room HS 3

In countries with heavy winters, winter road maintenance, i.e. snow removal, salting, gritting etc, is an important problem. In Sweden e.g., the government spends up to 180 MEURO every year for the winter road maintenance of the national road network. Moreover, winter maintenance of the municipal road costs about 110 MEURO every year. Approximately half of these costs correspond to the costs for snow removal. The snow removal cost mainly consists of the costs for snowploughs, which in turn mainly depends on the routing of the snowploughs. In the present talk we study optimal routing of snowploughs after snowfall. One has then to design a set of routes starting and ending at given depots, such that each road segment gets ploughed within a prescribed time window, depending on the class of the segment. The solution approach is based on Dantzig-wolf decomposition with column generation. In the Master problem, generated routes are combined to cover the road segments. The subproblem is a resource constrained shortest path problem, which can be solved by dynamic programming, but problem size forces us to use some simplifications. In order to obtain an integer solution in the Master problem we have applied two heuristics procedures, one using branch-and-bound on a subset of the columns and the other one a greedy procedure. The solution method is implemented on the operation district of Eskilstuna (in the middle of Sweden) giving a network of 814 edges and 363 nodes.

A control theory investigation of demand bubbles

Paulo Goncalves

Mo 17:00 - 17:30, Room HS 1

When demand is higher than supply, retailers often hedge against possible shortages by placing multiple orders with multiple suppliers. As supply normalizes, retailers quickly withdraw their excess orders to avoid building up their inventories. Since suppliers have little visibility of end customer demand, they can easily mistake the speculative increase in retailer orders for a long-term increase in demand for their products. These bubbles in demand can have severe effects to suppliers and even retailers, such as excess capacity, excess inventory, low capacity utilization, financial and reputation losses. While this phenomenon is widely recognized by academics and practitioners, there is a lack of good recommendations preventing its impacts. This work investigates the amplifications in customer demand that take place due to supply shortages. We model the phenomenon using system dynamics, which allows the incorporation of important features present in real supply chains, such as supply chain physics (variable lead times, inventory and capacity constraints), explicit human behavior (managers' decision rules and perception and adjustment delays) and reinforcing feedbacks (retailers' ordering ahead, when delivery delays increase). In addition, we derive policies capable of mitigating its impacts using classical control theory. We investigate system behavior by dividing the system into regions where non-linearities are piece-wise linear and further using linearization. The resulting systems of equations can be solved in closed form to obtain the system eigenvalues. Finally, we derive stabilizing policies through the use of pole placement techniques and considering eigenvalue elasticity with respect to feedback loops.

Ideas on the value of heuristics

Peter Greistorfer
Stefan Voß

We 12:00 - 12:30, Room HS 2

Classical heuristic methods and above all prominent metaheuristics, such as tabu search, simulated annealing, scatter search and various evolutionary settings, have deserved considerable credit in the area of combinatorial optimization. Besides the technical aspect, one of the many key-questions in heuristic design finally is the evaluation of the results generated and in doing so a quality control with respect to the heuristic itself. We review the relevant literature in this area and show alternative evaluation techniques which go beyond a straightforward descriptive cost analysis derived from objective function values. It is shown that an accurate evaluation always builds on several interrelated factors, which demonstrates that heuristic performance actually is a highly multi- dimensional criterion.

Convergence of Path-Following Newton Methods via Classical Penalty-Barrier Results

Christian Grossmann Tu 11:30 - 12:00, Room HS 8

Interior point algorithms are widely known to be connected with path-following methods which base upon parametric logarithmic barrier functions. The concept of self-concordance forms a powerful tool to overcome the rapid reduction of the range of convergence of Newton's method caused by the asymptotic ill-conditioning of barrier methods.

In the present talk we study the effect of different convergence properties of Newton's method concerning starting points belonging to the tangent space w.r.t. active constraints and to its orthogonal complement. This type of split analysis can be used for stanard euclidean norm and can be applied to a wide range of penalty-barrier methods. In particular, based on classical results for general types of penalty-barrier functions we establish local convergence results for non logarithmic penalty-barrier path-following Newton-methods. One of the advantages of such methods is that they can be applied to optimization problems with non-void interior feasible domains and non-feasible starting points may be chosen. Numerical examples are given to illustrate the practical convergence behavior.

Intra-site logistics in the production of chemical commodities

Martin Grunow
Hans-Otto Günther Th 9:30 - 10:00, Room HS 2

Commodities in process and other industries are usually produced at a single production site. One focus of logistics planning thus lies on coordinating the intra-site activities. In the process industries, such production systems are regularly organized in three stages. In the first stage, continuous production mode prevails. Several tasks such as chemical reactions and mechanical manipulations on the generated substances are carried out. Equipment units (such as reactors) are combined into a so-called trains. Once a "run" is completed, the units may be reconfigured to produce another product. However, due to residues remaining in the equipment, the change of products inevitably leads to the production some output that does not meet the quality targets. The degree of this contamination depends on the quality parameters of the subsequent product and of the products that were previously produced on the individual equipment units of the train. Thus, depending on the number of units within the configuration, a multi-dimensional changeover matrix may result. In the second stage, the products are stored in a silo or tank system from which bulk material is loaded straight onto special purpose trucks or trains. Alternatively, the products may enter the third stage of the production system, the packaging. Packaged products can then be stored in any conventional warehouse system. A logistics planning tool has been developed in cooperation with a major German chemicals producer and implemented at one of the main production sites. The aim is to minimize the off-spec material produced while taking into account a wide range of constraints such as customer demands, limited silo capacities, feasibility of unit combinations, the plant's pipe system, and unit dependent production output. The approach is based on a mathematical optimization model. Novel types of constraint formulations allow to reduce the number of the required decision variables and thus the computation times considerably.

Calling for the integration of Information Technology and Operations Research: the Low Fare Search (LFS) problem

Guglielmo Guastalla
Benoit Janin Tu 17:30 - 18:00, Room HS 6

GDS's (Global Distribution System, or CRS – Centralised Reservation System) have traditionally played the role of intermediaries between travel and leisure providers, such as airlines, rail companies and hotels, and the final sellers, mainly travel agents. The advent of internet and e-commerce has implied a strong pressure for the development of on line distribution solutions, and a diversification for what concerns the users, with a growing attention towards the final traveller (corporate and not).

As a consequence, GDS's have to develop functionalities to address new needs, with very different – and more complex – characteristics. The Fare Quote department of Amadeus, for example, used to consider as one of the core topics the pricing problem and is now confronted with its evolution, the Low Fare Search (LFS) problem.

We begin by providing some background on the role of GDS/CRS's in the transportation industry and on the role of the Fare Quote department inside Amadeus. We then describe the complexities and issues that have to be dealt with when trying to provide a solution to the Low Fare Search problem. Being a large scale, stochastic and complex problem, we believe it to be ripe for further application of OR tools and techniques to complement the classical IT techniques, and we illustrate some results from earlier studies that have been conducted in partnership with universities.

The Crucial Role of Human Resources Management Functions in Preventing Traffic Accidents: Coach Operator Companies in Turkey

Osman Gök
Asena Altin Gulova

Tu 9:30 - 10:00, Room HS 3

Transport business in Turkey is heavily based on a number of private owned coach companies that operate locally and nationally. In a highly competitive market environment, operator companies have been investing heavily on the physical aspects of the service, such as brand- new buses and offices so that to attract more passengers. Recently, considerations on travel safety have been becoming more important both for the passengers and the government. According to recent traffic regulation issued in 1996, if any bus of a coach operator company involves to an accident, the brand name of the company can be announced and advertised to the public by the media. Such kind of image and prestige related regulation might reinforce the companies to invest on the human side of the service they offered such as recruiting, training and performance appraisals. The purpose of this study is to determine whether the human resources management policies of operator companies affected by the regulation. Additionally, accident figures will be compared before and after the regulation so that to uncover the possible effect of the law on the issue of travel safety.

A Branch-and-Price Algorithm for the Capacitated Facility Location Problem

Simon Görtz
Andreas Klose

Th 11:00 - 11:30, Room HS C

The Capacitated Facility Location Problem (CFLP) consists in selecting plant sites from a finite set of potential sites and in allocating customer demands in such a way as to minimize operating and transportation costs. A variety of lower bounds based on Lagrangean relaxation and subgradient optimization has been proposed for this problem. In this paper, we consider an exact IP reformulation whose LP relaxation is solved by means of column generation. The value of the bound provided by the LP relaxation of the reformulated problem is equal to the value of the Lagrangean dual obtained by dualizing the demand constraints. Since the restricted master problem can get very large and multiple columns are added after each call to the pricing subproblem(s), a stabilization of the decomposition is required in order to solve the master problem exactly. To this end a mixture of subgradient optimization and a variant of a "weighted" Dantzig-Wolfe decomposition scheme is used. For the purposes of further tightening the relaxation, we also consider the addition of polyhedral cuts. In order to compute optimal solutions for the CFLP, a fractional optimal master solution is eliminated by branching on simple special ordered set constraints. The branching constraints eliminate all plant sites from a given subset or require that at least one plant from this set has to be opened. Numerical results obtained for large-scale problem instances are given.

Planung der Bestückungsreihenfolge elektronischer Baugruppen mit Hilfe savings-basierter Heuristiken

Hans-Otto Günther
M. Grunow, M. Schleusener, I.O. Yilmaz

Mo 13:30 - 14:00, Room HS 1

Bei der Montage elektronischer Baugruppen, insbes. bei der Bestückung von Leiterplatten mit elektronischen Bauelementen, wird die Leistung eines Montagesystems wesentlich durch die zur Steuerung der Bestückungsautomaten eingesetzten Algorithmen bestimmt. Ein zentrales Problem ist die Planung der Reihenfolge der einzelnen Bestückungsoperationen mit dem Ziel, die Wege, die der Bestückungskopf des Automaten über der Leiterplatte zurücklegt, zu minimieren. Konkret wird ein sog. Collect&Place-Automat betrachtet. Dessen als Revolver ausgelegter Bestückungskopf kann eine beschränkte Anzahl von Bauelementen aufnehmen. Die Bauelemente werden zunächst aus dem Magazin des Automaten entnommen (d.h. der Revolver des Bestückungsautomaten wird geladen). Anschließend werden die geladenen Bauelemente nacheinander an den definierten Bestückungspositionen auf der Leiterplatte abgesetzt. Dieser Zyklus wiederholt sich, bis die Leiterplatte vollständig bestückt ist. Das hierbei zu lösende Optimierungsproblem ähnelt einem Vehicle-Routing-Problem. Daher liegt der Rückgriff auf die aus der Tourenplanung bekannte Savings-Heuristik nahe. Im ersten Schritt des Lösungsansatzes wird die Zuordnung von Bauelementetypen zu den einzelnen Positionen im Magazin des Bestückungsautomaten vorgenommen, wobei die zur Aufnahme der Bauelemente erforderlichen Verfahrwege des Bestückungskopfes minimiert werden sollen. Hierbei wird eine effiziente Zuordnungsheuristik eingesetzt. Im zweiten Schritt erfolgt die eigentliche Planung der Bestückungsreihenfolge. Die Anzahl der Bestückungsoperationen innerhalb einer Tour ist durch die Kapazität des Bestückungskopfes begrenzt. Daher werden die einzelnen Bestückungsoperationen zunächst einer Tour zugeordnet. Gleichzeitig wird die Bestückungsreihenfolge innerhalb einer Tour bestimmt. Hierzu werden unterschiedliche savings-basierte Heuristiken vorgeschlagen.

Ein interaktives Schnittebenenkonzept für ganzzahlige lineare Vektoroptimierungsprobleme

Walter Habenicht We 9:30 - 10:00, Room HS B

Es wird ein interaktives Lösungskonzept für ganzzahlige lineare Vektoroptimierungsprobleme vorgestellt. Dies Konzept basiert auf einem enumerativen Schnittebenenverfahren. Aufbauend auf der Darstellung des Konzepts enumerativer Schnittebenenverfahren werden Implementierungsaspekte für das interaktive Verfahren näher beleuchtet. Hierzu zählen in erster Linie eine ergebnisorientierte Wahl der schnitterzeugenden Körper sowie die Identifizierung erzeugter Facetten. Daneben werden und Konvergenzbetrachtungen angestellt.

Stichworte: Vektoroptimierung, Enumerative Schnittebenenverfahren, Intersection cuts, Interaktive Verfahren.

Strategien zur Beschleunigung der GGLP im Rahmen der Einsatzoptimierung von Energieversorgungssystemen

Peter Hackländer
Johannes Verstege Mo 14:00 - 14:30, Room HS 6

Im Zuge der Liberalisierung der Strom- und Gasmärkte ergeben sich für die Betreiber von Energieversorgungssystemen neue Bezugs- und Liefermöglichkeiten und damit deutlich erweiterte Handlungsspielräume – gleichermaßen nimmt aber mit fortschreitender Marktöffnung der Wettbewerbsdruck zu. Die Energieversorgungsunternehmen sind daher mehr denn je gefordert, die Versorgungssysteme durch gezielten Einsatz der technischen Anlagen und der bestehenden Energiebezugs- und -lieferverträge sowie durch Bewertung und Abwicklung unterschiedlicher Energiehandelsgeschäfte wirtschaftlich optimal, zugleich aber weiterhin mit hoher Zuverlässigkeit und Versorgungsqualität, zu führen. Diese komplexe Aufgabe kann nicht zuletzt aufgrund der Vielzahl der technischen und zum Teil zeitlich integralen Randbedingungen nur rechnergestützt und mit Methoden des Operations Research zuverlässig gelöst werden. Zur Lösung des Optimierungsproblems wurde in den vergangenen Jahren vorzugsweise die Gemischt-Ganzzahlig-Lineare-Programmierung (GGLP) eingesetzt, da diese eine exakte Berücksichtigung aller Nebenbedingungen ermöglicht und nachweislich die global optimale Lösung ermittelt. Da Entscheidungen zukünftig in immer kürzeren Abständen gefällt werden müssen, sind die akzeptablen Rechenzeiten für die Lösung des Optimierungsproblems stark beschränkt, so dass für eine Anwendung der GGLP neben der mathematischen Formulierung der Planungsaufgabe die Entwicklung geeigneter Strategien zur Beschleunigung des GGLP-Lösungsalgorithmus erforderlich sind. Im Rahmen des Vortrags sollen nach einer kurzen Analyse des aus der Betriebsplanungsaufgabe resultierenden Optimierungsproblems verschiedene Möglichkeiten zur Beschleunigung des GGLP-Lösungsverfahrens vorgestellt werden. Weiterhin wird die Umsetzung zu einem geschlossenen Optimierungsalgorithmus auf Basis eines kommerziell verfügbaren GGLP-Solvers demonstriert und dessen Funktionsfähigkeit anhand unterschiedlicher Beispiele diskutiert.

Choise of the Best Electric Energy Supplier

Suad Halilcevic Mo 14:30 - 15:00, Room HS 6

In the open electric energy systems, i.e. with the formed power markets in the many countries, the distribution organization and retail companies are subjected to the great risks. These risks comprise many factors, such as: price of electricity, reliability of electricity sources, ancillary service, etc. The described problem is multicriteria problem. This paper presents an analytic hierarchy process applied to the energy problem. Distribution company has to decide by which of electricity sources to cover the needs of its consumers. Taking into account the several decision alternatives, characteristics of the energy suppliers and own priorities, the distribution company gets a clear picture regarding the overall proccess for choosing of the best electric energy supplier.

A fuzzy linguistic based approach for the selection of sustainable product improvement alternatives

Anthony Halog Mo 17:30 - 18:00, Room HS 10

The research is focused on how companies can be assisted in their design of products so that quality, environmental and cost (QEC) requirements of stakeholders in life cycle perspective are addressed at an early stage for the eventual purpose of maintaining the firm's competitive advantage and meeting the current concern for sustainability. The consideration of these 3 design requirements leads to multi-attribute decision situation with regard to the selection of optimal product system improvement concept. The main objective is to develop a flexible decision-oriented life cycle approach that integrates QEC parameters at early stage of product development. A conceptual approach was developed which includes: (1) identification and documentation of QEC requirements' information; (2) generation of alternative concepts for product improvements and construction of sustainable concept comparison matrix where fuzzy terms were adopted to describe relationships and importance; (3) fuzzy linguistic decision support system was developed and applied to evaluate and select the optimal sustainable product improvement alternative; and (4) sensitivity and statistical analyses. The primary output of this work is the developed conceptual methodology itself. Specific to the case study, the ranking results of alternative options for system improvement with respect to environment, cost and quality including their interrelationships are reported.

Center Hub Location Problems

Horst W. Hamacher
Andreas Ernst, Houyuan Jiang, Mohan Krishnamoorthy, Gerhard Woeginger

We 11:30 - 12:00, Room HS C

In hub location problems one is asked to select a subset of the nodes, the hubs, such that the movement between the hubs is accelerared, and such that any traffic between nodes of the network has to pass through one or two hub nodes. Hub networks are used in traffic planning (e.g. in the planning of air lines and multi-modal traffic), the distribution of mail, etc.

In this talk, the center hub problem is considered, in which the maximal distance between nodes in a hub network is to be minimized. It is shown that the problem of selecting hubs, and of allocating non-hub to hub nodes are both NP-hard. New formulations as integer programs are introduced, and various heuristics are presented. The talk will include a report on numerical results obtained on the algorithms implemented so far.

Constrained Optimization Involving Expensive Function

Herbert Hamers
R. Brekelmans, L. Driessen, D. den Hertog

Th 10:00 - 10:30, Room HS 8

This paper presents a sequential method for constrained non-linear optimization problems. The principal characteristics of these problems are very time consuming function evaluations and the absence of derivative information.

Local linear approximations of the real model are obtained with help of weighted regression techniques. If the geometry of the points that determine the local approximations becomes bad, i.e. the points are located in such a way that they result in a bad approximation of the actual model, then we evaluate a geometry improving instead of an objective improving point. In each iteration a new local linear approximation is built, and either a new point is evaluated (objective or geometry improving) or the trust region is decreased.

Pricing Options on Leveraged Equity with Default Risk and Exponentially Increasing, Finite Maturity Debt

Michael Hanke

Mo 16:30 - 17:00, Room E1.05

We use a framework recently proposed by Ericsson/Reneby (1996/1998/2001) to derive a valuation formula for calls on leveraged equity similar to Toft/Prucyk (1997). In contrast to their derivation via partial differential equations, we choose a more elegant probabilistic approach using change of numeraire techniques. Considerably extending previous firm value based option pricing models, our framework features exponentially increasing, finite maturity coupon debt, along with taxes and deviations from absolute priority. It enables us to study effects of debt maturity and debt growth on prices of equity options. Numerical results provide new insights into possible causes for pricing biases of the Black–Scholes formula.

History dependence without unstable steady state: a non-differentiable framework

Richard Hartl
Peter M. Kort

Tu 14:00 - 14:30, Room HS 7

In this paper, a non-differentiability is identified as a new mechanism that creates history dependence in dynamic economic models. A unique characteristic is that this occurs although no unstable steady state exists. This is shown by studying a capital accumulation model in which the revenue function exhibits a kink. It can be expected that history dependence will occur in other models with non-differentiabilities as well.

Keeping up with the technology pace: a DNS-curve and a limit cycle in a technology investment decision problem

Josef L. Haunschmied
Gustav Feichtinger, Richard F. Hartl, Peter M. Kort

Tu 14:30 - 15:00, Room HS 7

Technology advances quickly these days. Therefore, in order to keep up with its economic environment a firm should respond to new technological developments. Otherwise, its products become old-fashioned and customers will tend to go to competitors. In the talk we establish an optimal technology investment decision within a dynamic model, in which the baseline technology level rises over time. The problem is analyzed by designing a two state variable optimal control model. It turns out that in the state space a DNS-(Dechert-Nishimura-Skiba-) curve can be determined that separates different long run behavior, like converging to a sink or to a limit cycle.

Keywords: technology investment, optimal control theory, bifurcation, multi-valued optimal feedback rules

---

Towards A Conic Bundle Package for Linear Programming over Symmetric Cones

Christoph Helmberg Mo 13:30 - 14:00, Room HS 8

Tools for Lagrangean relaxation that produce dual bounds as well as approximate primal solutions are in high demand in combinatorial optimization and stochastic programming. In principle, the spectral bundle approach may be seen as such a tool for conic linear programming over bounded sets. In practice, a software package has to provide more: special support for linear and second order cones, for block structure, and an oracle interface for user designed convex functions. We describe our efforts to offer this in the software package ConicBundle. Our code is designed for minimizing a sum of convex functions where each function is represented by an individual conic bundle. In particular, we present a bundle model for second order cone problems that allows to exploit the special structure like in the semidefinite case. Unfortunately, this model is not as easily generalized to second order cone problems with block structure. We also sketch some possibilities to deal with problems where no apriori bound on the size of a primal solution is known.

Analyzing Shiryaev's Detection Problem for Brownian Motion Using Linear Programming

Kurt Helmes Tu 11:30 - 12:00, Room HS 9

A computational method for the analysis of the disruption problem for Brownian motion – with and without additional constraints – is presented. The method uses linear and nonlinear programming models to compute upper and lower bounds for the optimal value of the associated optimal stopping problems as well as ranges for the optimal stopping points. The accuracy of the numerical results will be illustrated by comparing the numbers with the analytical values which are known for the case without constraints.

Multi-issue allocation games

Ruud Hendrickx
Pedro Calleja, Peter Borm Th 11:00 - 11:30, Room HS 5

In this talk, I present a new class of transferable utility games, called *multi-issue allocation games*. These games arise from various allocation situations and are based on the concepts underlying the bankruptcy model, as introduced by O'Neill (1982). In this model, a perfectly divisible good (estate) has to be divided amongst a given set of agents, each of whom has some claim on the estate. Contrary to the standard bankruptcy model, the current model deals with situations in which the agents' claims are multi-dimensional, where the dimensions correspond to various issues.

This class of multi-issue allocation games fills up the class of (nonnegative) exact games. One interesting solution is the run-to-the-bank rule, which extends O'Neill's method of recursive completion. This rule coincides with the Shapley value of the corresponding multi-issue allocation game and is characterised by means of a consistency property.

Agent-supported management systems in manufacturing: A cybernetic approcah

Jens Henoch Tu 12:00 - 12:30, Room HS 1

Due to changing customer demands and expectations firms, face uncertain times in a more complex environment. Management systems as a vital part of manufacturing systems have to master the new requirements, invoked by the paradigm shift towards Build-to-Order production. In this paper, a framework for integrating manufacturing control and planning procedures in a management system supported by a multi-agent system, is presented. The multi-agent system is structured recursively applying cybernetic concepts. The goal of the framework is to provide facilities to build-up eigen-variety needed for absorbing environmental complexity.

Determinanten eines erfolgreichen Data-Mining-Einsatzes

Andreas Hilbert We 14:00 - 14:30, Room E0.05

Die zunehmende Globalisierung der Wirtschaft sowie der gestiegene Kosten- und Wettbewerbsdruck haben in den vergangenen Jahren dazu geführt, dass das Thema Customer Relationship Management (CRM) immer mehr an Bedeutung gewonnen hat. Dabei ist es von entscheidender Bedeutung für Unternehmen, ihr implizit vorhandenes Wissen bzgl. der Kunden – in Form von Verkaufs- und Nutzungsdaten sowie von soziografischen Daten – adäquat im Rahmen des sog. quantitativen CRM unter Verwendung von Data Mining zu entdecken und zu nutzen. Da der erfolgreiche Einsatz des Data Mining jedoch nicht immer gewährleistet ist, versucht die vorliegende Arbeit aufzudecken, ob bzw. unter welchen Rahmenbedingungen sich die z.T. beträchtlichen Investitionen für Data Mining tatsächlich lohnen. Dazu wird basierend auf

Literatur-gestützten Überlegungen sowie einer theoretisch geleiteten, kausalanalytischen Diskussion unter Berücksichtigung der strategischen Analyse der Unternehmenskultur, des Unternehmensumfeldes sowie des Informationsmanagements des Unternehmens ein ganzheitliches Modell zur Erklärung der Erfolgsaussichten von Data Mining im Unternehmen entwickelt. Im Anschluss daran erfolgt eine Operationalisierung und empirische Überprüfung des Modells anhand deutscher Unternehmen mittels LISREL sowie weiterer multivariater Verfahren.

Stromerzeugungsprognose von Windenergieanlagen mit Neuronalen Netzen

Roman Hinteregger
Erich Fuchs, Herbert Müller

Mo 16:30 - 17:00, Room HS 6

Durch den derzeit beobachtbaren Wandel im Energiesektor, der durch Deregulierung und Liberalisierung sowie der Umwelt- und Ressourcenschonung bestimmt ist, ist ein Trend hin zu kleinen autark arbeitenden dezentralen Systemen zu erkennen. Damit solche Systeme bestehend aus kleinen Erzeugereinheiten (z.B. Windenergieanlagen, Photovoltaik, Biomasse), Speichern und Verbrauchern optimal betrieben werden können, ist neben einer Lastprognose, die Prognose aller in das Versorgungsgebiet einspeisenden dargebotsabhängigen regenerativen Erzeugungseinheiten von großem Interesse. Vor diesem Hintergrund beschäftigt sich diese Arbeit mit der Erstellung von Prognosen für die Stromerzeugung aus Windenergieanlagen mit Hilfe von Neuronalen Netzen. Da die Erzeugungsprognosen für ein lokales, begrenztes Gebiet erstellt werden, steht die Einfachheit, Robustheit und Kostengünstigkeit der Modelle im Vordergrund. Dies bedeutet, dass als Eingangsgrößen Standarddaten bzw. leicht messbare Größen verwendet werden. In dieser Arbeit werden hierfür die Wetterdaten des Deutschen Wetterdienstes DWD und Leistungsmessungen an einzelnen Windparks herangezogen, wobei besonderes Augenmerk darauf gelegt wird mit welchen Wettereinflussgrößen (Windstärke, Windrichtung, Lufttemperatur) und mit welchem Wetterdatensatz (historisch oder prognostiziert) die Trainingsphase des Neuronalen Netzes durchgeführt werden soll um die besten Ergebnisse zu erzielen. Die Ergebnisse der verschieden Prognosemodelle werden anschließend untereinander und mit einer auf konventionellen Weg, unter zu Hilfenahme der Herstellerkennlinie, erstellten Prognose verglichen. Hierbei zeigt sich, dass die mit Neuronalen Netzen erstellten Modelle, vor allem durch ihre Fähigkeit des impliziten Erlernens von komplizierten Umgebungseinflüssen (z.B. Windrichtungsabhängigkeit, Geländerauhigkeit) und der Eingangsdatenunschärfe (z.B. Wetterprognosefehler), leistungsfähiger als die konventionellen Modelle sind.

Max-Flow Min-Cut Duality for a Paint Shop Problem

Winfried Hochstättler
Thomas Epping, Marco Luebecke

We 12:00 - 12:30, Room HS B

Motivated by a problem from car manufactoring we consider the following: Given a word where each letter occurs exactly twice, color the letters in red and blue such that each letter occurs in both colors and the number of color changes between adjacent letters is minimized.

This turns out to be the dual problem of a min-cut problem for one point extensions of a certain class of regular matroids. We discuss consequences of max-flow-min-cut duality and algorithmic approaches.

Spectroscopic Data - A Classification Problem

Vera Hofer

Tu 17:00 - 17:30, Room E0.05

How to cope with a large data set when seeking solutions to classification and identification problems? Dealing with such questions the researcher will apply Discriminant Analysis and Principal Component Analysis. The possibilities, these methods offer, and their limits, the researcher will certaimly be confronted with, should be presented in the context of analysing spectroscopic data. Spectroscopic techniques are used in quantitative as well as qualitative studies. This research deals with the spectral lines of rocks, being treated with light in the ultraviolet, visible and infrared regions. The information provided by the spectral lines of rocks known should be used to find ways to classify any specimen of rock after having meassured the spectrum.

A Method For Solving $0-1$ Multi-Objective Linear Programming Problem, Using Data Envelopment Analysis

Farhad Hosseinzadeh Lotfi
G. R. Jahanshahloo, N. Shoja, G. Tohidi

We 17:30 - 18:00, Room HS 10

In this paper, by using Data Envelopment Analysis (DEA) technique a method is proposed to find efficient solutions of 0-1 Multi-Objective Linear Programming (MOLP) problem. In this method, from a feasible solution of 0-1 MOLP

problem, a Decision Making Unit (DMU) without input vector is constructed in which output vector for DMU is the values of objective function. The method consists of a two-stage algorithm. In the first stage, some efficient solutions are generated. In the second stage, the DMUs corresponding to the generated efficient solutions in the first stage together with the generated DMUs in the previous iterations are evaluated by using the Additive model without input.

Keywords: 0-1 MOLP, DEA Efficient Solution

A statistical model for optimal resource allocation in global optimization

Tomas Hrycej We 14:00 - 14:30, Room HS 8

A frequent approach to nonconvex optimization is with help of a population of samples individually optimized by convex optimization methods. However, many real-world global optimization tasks are too large for the cost function range to be covered to some degree of completeness by any sampling strategy, within given computing resource limitations. Then, the problem of resource allocation arises. The presented approach is to allocate the resources to the local optimization to those samples for which the expected result is optimal in the sense of statistical decision theory. One possible strategy is to use the extreme value distribution of type I for modeling the minimum expected to be reached by individual samples and by the whole population. The performance of the algorithm is illustrated on a neurocontrol problem with 115 variables. The presented algorithm was superior to the well-known multi-level single-linkage algorithm.

Starting Interior Point Methods: What is the typical situation at the start?

Petra Huhn We 9:30 - 10:00, Room HS 8

We are interested in average case results on interior point methods for linear programming problems. Inespecially, we look at linear programs in canonical form and with positive right hand side and we assume that the data of the linear program are distributed according to the rotation symmetry model – a stochastic model that was used for the average case analysis of the simplex method and of interior point methods. Under these assumptions the origin is feasible and can be used as starting point for an interior point method, respectively as starting point for a phase I algorithm to find an approximate center, which is actually used as starting point for interior point methods. From the stochastic settings we can derive some distributional results on the situation at the start of the phase I algorithm and we will characterize the typical (average) situation at this starting point. Moreover we will present some distributional results on the search direction of a centering step and the average improvement of the barrier function in the first step of the phase I algorithm.

Konfidenzintervalle für Ausfallwahrscheinlichkeiten

Stefan Huschens
Steffi Höse Tu 12:00 - 12:30, Room E1.05

Der Internal Ratings Based Approach (IRBA) von Basel II zur Erfassung des Kreditrisikos sieht vor, den Bonitäts- bzw. Ratingklassen zeitlich stabil und auf der Basis historischer Daten Ausfallwahrscheinlichkeiten zuzuordnen. Dabei liegen Beobachtungen aus relativ wenigen Jahren vor, so dass auch Querschnittsdaten genutzt werden müssen. Während im Längsschnitt stochastische Unabhängigkeit unterstellt werden kann, sind die Querschnittsdaten korreliert, wobei die Abhängigkeitsstruktur durch ein Gleichkorrelationsmodell für kontinuierliche Bonitätsvariablen beschrieben wird. Der Ausfall eines Kreditnehmers erfolgt, wenn die zugehörige Bonitätsvariable eine Schranke unterschreitet. Die Verteilung der Ausfallquote ist in diesem Modell eine Mischung von Binomialverteilungen, die analytischen Berechnungen schwer zugänglich ist. Sie konvergiert aber für wachsende Portfoliogröße schnell gegen eine asymptotische Verteilung, die in diesem Beitrag angegeben wird. Basierend auf dieser Verteilung werden Testzonen für Ausfallwahrscheinlichkeiten, die für ein Backtestingverfahren verwendet werden können, und Konfidenzintervalle für die Ausfallwahrscheinlichkeit bei korrelierten Beobachtungen hergeleitet.

Lotsizing in a production system with rework and product deterioration

Karl Inderfurth
Gerd Lindner, Nikolaos Rahaniotis Tu 17:30 - 18:00, Room HS 1

Production systems with rework are characterized by production processes where also under regular process conditions by-products or defectives occur which can economically be reprocessed for regaining useful products. Such systems are often found in process industries. Here it is also observed that recoverable products are deteriorating over time so that it may take longer or may be more costly to rework them the older they are. After exceeding a certain age, reworking

may even be impossible. Since setup costs and setup times are relevant issues in process industries, a major planning problem in such an environment is given by the task of determining economic lotsizes for production and rework. For a single-stage deterministic rework system with constant demand level and finite production and rework rates the optimal coordination of production and rework lots will be discussed. For a simple lotsizing strategy, as often found in practice, an analytical formula for the optimal production and rework lotsize under linear deterioration functions will be derived. It will be analyzed how lotsizing depends on theform of product deterioration. Furthermore, it will be shown to which extent the analytic lotsizing results can be used to approximate the optimal lotsize which is computed from complex lotsizing and scheduling models where each item and its respective aging is considered individually.

The combined use of ETA and FTA for diagnosing and evaluating the risk exposures of Hedge Fund investment

Antonio Iovanella
Dino Giancola, Paolo Mancuso

Tu 11:30 - 12:00, Room E1.05

In the last decade we have seen the rapid growth of Hedge Fund assets. The alternative investment still need a set of risk management protocols specifically designed for hedge fund investment. We have used binary tree to evaluate all the possible scenery and paths of a long-short equity Hedge Fund. Our basic hypothesis are no trading costs, no tax costs, no arbitrage opportunities and we have used the Event Tree Analysis (ETA) as an inductive method or a bottom-up approach. We describes all the possible scenery caused by the occurrence of the subsequent event after the starting event. The proposed procedure consists in four steps: firstly it identify the initiating event to be studied, secondly it identify the procedures and systems needed to deal with this event, after that we construct the event tree with this subsequent branches, and finally the event sequences and consequences. Each node of this tree, except the root, represent the Top Event for the Fault Tree Analysis (FTA). The procedure of the FTA starts defining the Top Event, then we build the Fault Tree Diagram from the Top Event to the basic (Primary Events). Logical relationship are made using AND and OR Gates. The procedures continues until all Basic Events are identified. After that we make a quantitatively and qualitatively evaluation of the FTD. The aim is to obtain the probabilities values and the payoffs of the intermediate events from those of known Basic Events. The Top Event probability value or distribution and payoff is finally obtained. Returning to the ETA we can obtain the quantitative evaluation of the initiating event. From the diagram and the relatives probabilities and payoffs we can obtain the highest intermediate events that contribute more to the occurrence of the undesired events. Hence, the combined use of FTD and ETD give the managers the chances to calculate all values of failure and take reasonable courses of action to reduce the bad consequences of such failures.

Methods of Reduced Directions for Parallel Computers Using Binary Trees

Viktor Izhutkin
O.V. Bastrakova

Tu 9:00 - 9:30, Room HS 8

The methods for solving nonlinear programming problem have been constructed in the uniform scheme of methods of reduced direction for sequential computers. The methods of mostly all known groups have been realized into the frame of the scheme mentioned above.

There was suggested to realize dialog system for solving optimization problems on parallel computers on the basis of the uniform scheme of methods of reduced directions.

It is offered to use binary trees to get automatic derivatives of the problem functions and also to calculate the values of constraint functions in dialog system of methods of reduced directions for parallel computer complexes:

- an algebraic expression is entered in the manner of string;
- it is produced syntax analysis of the string and transformation of the algebraic expression into the binary tree;
- the value of an algebraic expression is calculated over the binary tree;
- derivatives of an expression are calculated automatically over the tree.

This approach allows to avoid recompilation of the system when the current task is changed, so is no necessity to keep together with executable file all the modules of the system and compiler itself. So, the portability of the system increases. To change the current problem user has only to change strings - algebraic expressions of the functions. Besides, automatic derivatives calculation simplifies the entering of the task for user.

Strings-expressions of the functions are sent to processes, binary tree and derivatives building is made parallely with all processes, this decreases time expenseses; each process uses only its set trees for the further calculation i.e. trees are kept distributed, in local memory of each process.

Procedures to build binary tree and to calculate the value of the expression over the tree have been realized.

The Chaotic Model of Inflation and Unemployment:EU

Vesna Jablanovic Mo 16:30 - 17:00, Room E0.05

The basic aims of this paper are: firstly, to set up an endogenous chaotic model of the private consumption deflator and the unemployment rate in the European Union during the period 1970-2001 in the formal framework of the Rossler (1976) model; and secondly, to estimate the private consumption deflator regression equation and the unemployment regression equation. Empirical content of this model confirms the fact that movement of the private consumption deflator and the unemployment rate have stable character in the observed period.

Separation of loan and deposit policy: Some empirical results for German banks

Johannes Jaenicke Th 9:00 - 9:30, Room HS 3

In banking literature, typically a strict separation between a bank's credit and deposit policy is either assumed or the result of a restrictive model structure. The separation property allows the creation of independent profit centers for the credit side and the debit side.

We wanted to know wether this independence assumption, base for many a recommendation on a bank's price policy, is really valid. Therefore, we investigated this question empirically for the interest rate policy of German universal banks. We use a recently proposed one- and multi-step Granger-causality test that is designed for possibly cointegrated time series. The tests were carried out in trivariate VAR-models for the monetary regimes before and after the EMS-crises with eight credit and five deposit interest rates. If information about the interest rate policy of one side of the balance has predictive power for the other, the separation property has to be rejected. As the variable for the refinance conditions, we use the interbank call money rate in the information set.

For both periods, we find clear evidence for intertemporal dependence between the different loan and deposit rates. In the period from January, 1988 to August, 1992, a period with increasing interest rates, credit rates are granger-causal for deposit rates. An explanation of the focus on the credit side might be the increasing credit risk in periods of increasing interest rates. In the second period, the deposit side is granger-causal for the credit side.

In summary, the assummed or theoretically proven separation of loan and deposit rate policy is empirically rejected. In consequence, the often recommended creation of two independent profit centers, is likely to have suboptimal results.

Dynamic system approach for analysis of organizational culture

Javad Jafarali Jassbi Mo 14:00 - 14:30, Room HS 7
S.Khanmohamadi, A.Toloie

In the last decades, human resources played important role as the main part of organizations capital. This approach in organizations management arises day-to-day. In addition, managers and researchers keep their efforts to solve or improve the organizational behavior domain problems. One of the most important researches rated to human behavior is Organizational culture and its effects on strategic planning and structures of the organizations. Most of studies on this subject always have been based on criteria suggested by Sociologists and psychologists. In this type of approach, it is very difficult to define an appropriate relationship between organizational strategy (and structure) and organizational cultural criteria. It is also noted that these types of criteria are typically qualitative and verbal. This paper represents a new idea on applying dynamic system transfer functions that are used in control systems to measure the dynamic behavior of organizational culture and its effect on determining the organization strategy. There are three criteria (power, delay and time of decay) as the base parameters of transfer function. In other words, when an organization received a signal (external or internal) three factors namely: 1) signal rate force 2) reply delay to signal 3) decay time are key factors in signal life cycle and are consider as primary criteria in organizational culture . In this paper qualitative variables in measuring cultural organizations are transformed to quantitative variables for forecasting human resource behaviors. In this way the best strategy related to the organization is selected and the best structure for decision rules and managerial policies can be chosen.

Forecasting with leading economic indicators – a Neural Network Approach

Timotej Jagric Tu 11:30 - 12:00, Room E0.05

Leading economic indicators have a long tradition in forecasting future economic activity. Recent developments however suggest that there is scope for adding extensions to the methodology of forecasting major economic fluctuations. In this paper, the author tries to develop a new model, which would outperform the forecast accuracy of classical NBER leading indicators model. The use of artificial neural networks is proposed here. For demonstration a case study for Slovene economy is included. The main findings are that, at the twelve months forecasting horizon, a stable and improved forecast accuracy could be achieved for in- and out-of-sample data.

Performance Analysis of Make to stock Supply chain using Discrete time queue

Sandeep Jain
N.R.S. Raghavan

Tu 14:30 - 15:00, Room HS 2

We present a discrete-time queueing model of a 3-stage Supply Chain Network (SCN) consisting of single manufacturing plant, one warehouse and several retailer outlets. The developed model evaluates the performance of the SCN, which processes customer orders at discrete time intervals. Our objective is to devise the optimal inventory level that minimizes total cost (inventory carrying plus backorder cost), subject to service level constraint in terms of expected waiting time for customers. In this model, we assume that retailer orders arriving at warehouse are Poisson and the service process is assumed to be Negative binomial. The model is analyzed by using discrete-time queues. We use CONWIP as the inventory control model. Several examples are presented to validate the model and to illustrate its various features. We use numerical methods to obtain optimal inventory levels.

Scheduling problems with optimal due interval assignment subject to some generalized criteria

Adam Janiak

Mo 14:30 - 15:00, Room HS C

The paper deals with some single processor and parallel identical processors scheduling problems, in which a due interval should be assigned to each job. Due interval is a generalization of well known classical due date and describes a time interval in which job should be finished. Due interval assignment is a new approach in the scientific literature.

Generally, the problem is to find a sequence of jobs on a single processor or parallel identical processors and an assignment of due intervals to each job, which minimize the considered criterion. We will minimize the following two types of criteria:

1) the maximum of the following weighted three parts:

   – the maximum tardiness,

   – the maximum earliness and

   – the due interval parameters,

2) the sum of the following weighted three parts:

   – the total tardiness,

   – the total earliness and

   – the due interval parameters.

For the single processor cases, some original properties of the optimal solutions have been proved. Due to them, the polynomial time algorithms have been constructed. For the general parallel processors situation, the NP-hardness has been proved even for two processors cases. For the general problems, some approximation algorithms have been constructed and their worst case analyzes have been presented.

Single machine scheduling problems with exponential start time dependent job processing times

Adam Janiak
Aleksander Bachman, Mikhail Y. Kovalyov

Mo 16:30 - 17:00, Room HS B

The paper deals with single machine scheduling problems, where job processing times are given by start time dependent functions. There are many different models describing the dependency of job processing time on the starting moment of its execution. However, almost all of them are based on the linear functions. In this paper, we focus on exponential functions. We consider non-increasing and non-decreasing exponential functions of job processing times. We establish the computational complexity status of three single machine problems for the following criteria: the makespan, the maximum lateness and the total weighted completion time. For the non-decreasing functions, we prove ordinary and strong NP-hardness of the makespan minimization problem by the assumption that the jobs are available at their ready times. We present the same results, i.e., ordinary and strong NP-hardness, for the maximum lateness minimization problem, but for the non-increasing functions of job processing times. We prove also ordinary NP-hardness for the total weighted completion time minimization, by the assumption that job processing times are characterized by non-increasing functions. The application examples, where the process can be described by a start time dependent function can be found e.g. in computer science (the polling system for the single-server cyclic-queue), military (radar station recognizing objects approaching it), fire-fighting, metallurgy (preheating process in converter plants) and many others.

Scheduling Malleable Parallel Tasks: An Asymptotic Fully Polynomial-Time Approximation Scheme

Klaus Jansen Mo 17:00 - 17:30, Room HS C

A malleable parallel task is one whose execution time is a function of the number of (identical) processors allotted to it. We study the problem of scheduling a set of n independent malleable tasks on an arbitrary number m of parallel processors and propose an asymptotic fully polynomial time approximation scheme. For any fixed $\varepsilon > 0$, the algorithm computes a non-preemptive schedule of length at most $(1 + \varepsilon)$ times the optimum (plus an additive term) and has running time polynomial in n, m and $1/\varepsilon$.

Optimal Sorting Machine Allocation in the Postal Distribution Network

Jaroslav Janáèek Tu 17:00 - 17:30, Room HS 3

The postal distribution network is organized as many-to-many distribution system with several transhipments on the way of consignment. Substantial role among the transhipment places play so called sorting centres. All consignments originating in a given region are concentrated at the transit centres and then they are sent to the sorting centre associated with the region. The whole amount of the consignments is sorted in the sorting centre in accordance to their region of destination. This way, bulks of consignments arise and each bulk consists of consignments, which must be transported to the same region, more precisely, to the associated sorting centre. After arrival, each coming bulk is sorted ones again in this destination sorting centre to obtain finer itemization to smaller amounts of the consignments for the individual places of destination. The transport in the distribution network is performed by vehicles, aeroplanes or trains. Each of these transportation means follows its time-schedule. It means that if a bulk is not processed up to given time, all consignments of the bulk would be delivered with a considerable delay. To accelerate the sorting processes in a sorting centre, more sorting machines can be used, but any installation of an additional machine needs considerable sum of investment and operational costs. This way, a hard combinatorial problem arises, to minimize the total costs connected with machine installation subject to constraints on delivery time of each consignment. To solve this problem, we have formulated it using means of the mathematical programming and suggested a special exact method. This method is based on branch and bound technique and makes use of the dual approach to obtain a good lower bound. The resulting algorithm proved to be able to solve real size problems up to seventy sorting centres. In the following contribution we deal with the problem formulation and we present the above mentioned exact method.

An infeasible interior method with $1 - O(\sqrt{\theta})$ rate of convergence

Florian Jarre
Roland W. Freund Mo 14:30 - 15:00, Room HS 8

We present an infeasible interior algorithm for convex programs with $1 - O(\sqrt{\theta})$ rate of convergence, where θ is the self-concordance parameter of a barrier function for the feasible set. As an extension of the algorithm we discuss an application with nonlinear equality constraints.

A New Demand Forecast Model Which Allows for Seasonal Fluctuation, Price Elasticity And Resource Restrictions

Herbert Jodlbauer
Joachim Althaler Tu 17:00 - 17:30, Room HS 2

A model for determining an optimum demand plan is developed whereby both demand figures from the past are known as are the results of market research concerning price elasticity.

The demand demonstrates a high seasonal fluctuation as well as a short term fluctuation which is also relevant.

The production capacity is restricted.

The main idea of the model is to first approximate the past demand figures in order to predict future demand figures through extrapolation. In a second step, a non linear production optimisation model is applied for calculation of the cumulative demand plan taking into account both the price elasticity and resource restrictions. The final predicted demand data is shown by an extrapolated curve corrected by a constant. The latter is determined by the fact that the integral of the demand curve has to be the cumulative demand plan.

In addition to this result, a beta level of service and consequently the level of the safety stock can be calculated by means of a curvilinear regression analysis.

Computation Model for Option Evaluation on Probability Trees using EXCEL

Alfred Kalliauer
Andrea Kalliauer

Mo 17:00 - 17:30, Room E1.05

Evaluation of financial instruments means optimisation under uncertainty. For quantification - 'pricing' - of options a lot of methods are already available from Finance. In most cases these methods are only suitable for 'closed' analytical formulations of the mathematical problem and are not always appropriate for 'real-life'- problems of discrete type. On the other hand there are methods of OR which provide us with suitable numerical algorithms and allow us to use general probability trees for description of the stochastic process, e.g. for the market price. Option evaluation means more than only the pricing: often it is worth knowing about the optimal exercise behaviour of the counterpart - especially on electricity markets. This analysis is an essential part of evaluation of options apart from pricing.

As a consequence of the various new markets which have been introduced due to liberalisation of several areas of former public services – e.g. the electricity sector - this development creates a common need for an understandable access to the treatment of options for many people applying financial instruments although they are no specialists in Finance. Specially designed routines on common platforms – e.g. formulated for spreadsheets, like EXCEL - should be made available in order to provide enough insight to the computational mechanism for these people.

A special category of options traded on these new markets are the so-called 'swing'- options, which denote multi-exercisable American options. Such kind of options already existed traditionally on electricity markets before liberalisation. For this general kind of options and on basis of the aspects mentioned before a method has been developed using a special variation of the Stochastic DP-scheme and implemented in EXCEL.

This computation model is based on the idea to distinguish between several 'decision levels' of resource units (e.g. exercise rights) and to solve a sequence of 'flat' subproblems, each corresponding to a k-th resource unit. In this form the algorithm primly works from the k-th optimally allocated right to the $(k+1)$st and not – as usual in DP – from one time-stage to the next. This conceptual variation of application of the DP-scheme allows us a more straightforward implementation on a spreadsheet environment (e.g. on EXCEL) and seems to be more clearly understandable for a large community. The developed method can be interpreted as an extension of the so-called 'Backwards Induction Scheme' for simple American options due to Cox, Ross and Rubinstein.

A Remark on Quantitative Stability and Empirical Estimates in Stochastic Optimization

Vlasta Kankova
Michal Houda

We 11:30 - 12:00, Room HS 9

It is well–known that many optimization problems depending on a probability measure can be introduced in the form: Find

$$\inf\{\mathsf{E}_F g_0(x,\,\xi)|x \in X_F\},$$

where ξ is an s–dimensional random vector with a distribution function F and a probability measure P_F. $g_0(x,\,z)$ is a real–valued function defined on $R^n \times R^s$, X_F is a constraint set depending (generally) on F; (R^n, $n \geq 1$ denotes the n–dimensional Euclidean space, the symbol E_F is reserved for the operator of mathematical expectation corresponding to the distribution function F).

Evidently, stochastic programming problems with a penalty, two–stage stochastic programming problems as well as problems with probability constraints belong to the problems mentioned above. Of course, the probability measure can be then considered as a parameter of the problem and, moreover, it is "suitable" to investigate stability with respect to this parameter. In particular, it is suitable to investigate dependence of changes of the optimal value and the optimal solution set on small changes of the "underlying" probability measure. In the stochastic programming literature great attention has been paid to this topic. In this talk, first, we try to generalize (well known) assumptions under which

$$\begin{aligned} |\varphi(F) - \varphi(G)| &\leq m_1(d_s(P_F,\,P_G)), \\ \|x(F) - x(G)\| &\leq m_2(d_s(P_F,\,P_G)), \end{aligned} \tag{2}$$

where $\varphi(F)$, $\varphi(G)$ and $x(F)$, $x(G)$ are optimal values and optimal solutions of the considered stochastic programming problem corresponding to the probability measures P_F, P_G; m_1, m_2 are suitable real valued functions defined on $R := R^1$, d_s is a metric in the probability measure space. The symbol $\|\cdot\| := \|\cdot\|_n$ denotes the Euclidean norm in R^n. The Wasserstein metric and the Kolmogorov metric will be employed in (1).

Furthermore, we shall deal with the relationship between the stability and empirical estimates in the stochastic programming problems. In particular, employing the relation (1) we introduce some generalized assumptions for consistency and convergence rate of the above mentioned empirical estimates. In particular, we try to compare the results achieved for the Wasserstein metric and the Kolmogorov metric.

References:

[1] M. Houda (2001) *Stability and estimates in stochastic programming problems – special cases (in Czech). Diploma work FMF Charles University (supervisor V. Kaňková)*,

[2] V. Kaňková (1994) *A note on the relationship between distribution function estimation and estimation in stochastic programming. In: Trans. Twelfth Prague Conference, Academy of Sciences Czech Republic and Charles University, 122–126*,

[3] W. Römisch and R. Schulz (1993) *Stability of solutions for stochastic programs with complete recourse. Mathematics of Operations Research 18, 590–609*.

Common Property Resource and Private Capital Accumulation

Seiichi Katayama
Ngo Van Long

Mo 17:00 - 17:30, Room HS 7

When agents have free access to a common property resource, they tend to over-exploit the resource stock. The size of the stock declines at a much faster rate than the socially optimal rate. Those characteristics are reconsidered. In the existing literatures it is assumed that there are no other stocks such as private capital, and that the extracted resources are consumed. We consider the case where the resource extracted form a common pool is an input, which is used in conjunction with other inputs to produce a final good which can be consumed, or accumulated as private capital stocks.

Subnet decomposition in telecommunication by combinatorial stochastic optimization.

Georg Kern
R. Gismondi, W. Garn, G. Pflug

Tu 15:00 - 15:30, Room HS 6

We consider the problem of decomposing a telecommunication network graph into connected subgraphs and the selection of a specific node per subgraph (POI, point of interconnection). The POI's are the connection points to of incoming and outgoing traffic to other networks. For a fixed routing matrix, the expected costs are minimized with respect to the choice of subgraphs and POI's.

Due to regulatory, economic and technical reasons, the objective function is rather complex and discontinuous.

The uncertainty of future traffic volume is represented by a stochastic model. Using a statistical forecast of future traffic intensities, a scenario model has been generated. In contrast to the pure deterministic model, the solution turns out to be more stable.

The stochastic combinatorial algorithm of simulated annealing type was programmed in C++, the source code is about 5000 lines long (without GUI). One optimization run, using 200 nodes, 1000 links and 10 scenarios takes about 30 minutes of runtime on a workstation. We will also show results for other optimizations algorithms and discuss the influence of different search strategies.

Fuzzy simulation of job shop scheduling system using beta shape membership function

Sohrab Khanmohammadi
A. Ghanbari, S. Hajforoosh, J.Jassbi

Tu 15:00 - 15:30, Room HS 8

Real world systems are almost always non linear. The available modeling data and parameters of these systems are imprecise. It is almost impossible or very difficult to obtain appropriate solutions by means of statistical calculations, for the problems involving such systems. However, it is shown that the theory of fuzzy systems is more suitable procedure for solving problems with uncertain nature. One of the well-known complex systems is the Job-Shop scheduling system where the parameters are probabilistic. In this paper the fuzzy decision making procedure is used for simulation of Job-Shop scheduling problems. The b shape membership function is introduced as a more flexible method for fuzzification of imprecise parameters. The Single Channel Single Station system is simulated to verify the validity of fuzzy simulation procedure with b shape membership function. The simulation results show that the introduced method is well suited for simulation of such systems.

The influence of the order waiting time on safety-stocks in a supply chain

G.P. Kiesmüller

Tu 14:00 - 14:30, Room HS 2

In a supply chain we can often observe locally controlled inventories. Then the replenishment leadtime of a lower level inventory location includes the order waiting time at an upper level inventory. Therefore, in order to determine the safety stocks we need some information about this order waiting time.

In this paper a divergent multi-echelon network is considered where each stocking point is controlled by continuous (s, nQ) installation stock policies. We show how the first two moments of the order waiting times in such a system can be computed. Further we present a method to determine the safety stocks such that a given target customer service level can be met and we analyze the system.

Inner and Outer Approximations of Non-Convex Multicriteria Programs

Kathrin Klamroth
Jørgen Tind, Margaret M. Wiecek

We 14:00 - 14:30, Room HS 10

Finding good and at the same time simple approximations of the nondominated set of general multicriteria programs is a challenging task both from a theoretical and a practical point of view. We propose an approximation approach using solutions of a series of subproblems selected in a problem-dependent way. Polyhedral distance functions based on the approximation itself are used to evaluate the quality of the approximation. The functions automatically adapt to the problem structure and scaling which makes the approximation process unbiased and self-driven.

Second order optimality conditions for $C^{1,1}$ programs and their application to solution stability

Diethard Klatte
Bernd Kummer

We 12:00 - 12:30, Room HS 8

For nonlinear programs with $C^{1,1}$ data, we present necessary and sufficient optimality conditions which are closed to each other in some sense. It turns out that these conditions play an essential role in the Lipschitz analysis of (stationary and optimal) solutions under small data perturbations. Motivations and applications in the context of Newton-type methods and exact penalization are discussed.

Human-Guided Tabu Search

Gunnar W. Klau
Neal Lesh, Joe Marks, Michael Mitzenmacher

We 14:00 - 14:30, Room HS 2

We present a human-guidable and general tabu search algorithm. Our work expands on previous interactive optimization techniques that provide for substantial human control over a simple search algorithm.

There are two primary advantages of involving people in the process of optimization. First, we can leverage people's skills in areas in which humans currently outperform computers, such as visual perception, learning ability, and strategic assessment. Second, interactive optimization allows people to steer the computer towards solutions based on their knowledge of real-world constraints, such as which customers are the most important or which machines are the most reliable. Furthermore, people can better understand, trust, and explain solutions if they participate in constructing them.

We present our general framework for interactive optimization, describe a new human-guidable tabu search algorithm, and discuss results from applying this algorithm on to a variety of problems in application areas as different as scheduling, protein folding, map labeling, graph drawing, and logistics.

Distance Maximization in DEA

Andreas Kleine
Bodo Glaser

We 14:30 - 15:00, Room HS 10

If we want to measure efficiency of some units under consideration, we can utilize approaches of Data Envelopment Analysis (DEA). In DEA a decision making unit (DMU) is characterized on the one hand by inputs needed and on the other hand by outputs resulting. A scalarizing function (efficiency measure) reduces all information of a DMU under consideration to one real number.

From MCDM we know a variety of scalarizing methods. As the concept of distance minimization is not directly applicable to DEA, we will utilize the so-called method of distance maximization. We introduce a general DEA model, which maximizes distance between a given (feasible) production and the efficient frontier. On these grounds we will present relations to well known DEA models and in addition develop some new ones. In particular a numerical example serves to illustrate some features, which are of special importance.

Utilization of the Level Method for Dual Decomposition in Convex Quadratic Programming

Matthias Knobloch

We 9:00 - 9:30, Room HS 8

We describe a method to solve optimization problems resulting from dual decomposition approaches. We use a cutting plane method of level-type. This method allows us to get rid of the compactness condition for the resulting inner problems. The principal aim is the description of an appropriate oracle. A detailled algorithm for optimization problems with convex quadratic objective function and affine-linear constraints is given. Some numerical tests for problems with exclusively finite function values are presented where we compare the standard method with a method using normalized subgradients.

Hard Instances for the Uncapacitated Facility Location Problem

Yuri Kochetov
Dmitrii Ivanenko

We 9:30 - 10:00, Room HS 2

According to the big valley conjecture, in average, local optima for NP-hard combinatorial problems have non uniform distribution in the feasible domain. As a rule, they are clustering in an area of small diameter (the so-called big valley for minimization problem). This conjecture allows us to explain the good behavior of the meta-heuristics for NP-hard problem and gives new ideas to develop more powerful methods. We use this conjecture to generate computationally hard instances with low dimension for the Uncapacitated Facility Location problem. The main idea of the research is to apply binary perfect codes in order to create instances with large diameter of the valley.

We consider Hamming code for 0-1 hyper cube. For dimension $n = 7$, this code divides the cube into 16 spheres of radius 1. There are 280 different perfect codes for this dimension. Moreover, the set of perfect codes is partitioned into 35 disjoint subsets. Each subset has 8 codes. Each pair of codes for the subset has the mutual distance 32. Hence, we may generate random instances for the Uncapacitated Facility Location problem with diameter of the valley at least 32. In fact, the diameter is greater than 54 for the add-drop-swap neighborhood. Cardinality of local optima set grows exponentially if dimension increases. These instances are difficult for the classical meta-heuristics: tabu search, simulated annealing, and genetic algorithm. We computational study basins of attraction for local optima and compare them with basins for easy instances: Euclidean case and polynomial solvable cases. Other difficult instances for the Uncapacitated Facility Location problem are discussed as well.

Lead Optimization for Pharmaceutical Research Projects

Rainer Kolisch
Konrad Meyer

Tu 14:00 - 14:30, Room HS 4

Lead optimization is one phase of pharmaceutical research projects. Here a substance is evolutionary optimized with the objective to obtain a high effectiveness and a well toleration by the human body. Each lead represents one project. Due to scarce capacity of laboratory resources the set of possible lead projects have to be selected and scheduled. To support this decision we propose a model and a heuristic method. The latter uses information from the optimal solution of an aggregated problem formulation. The method is validated by computational experiments.

On Stability of some Integer Programming Algorithms

Alexander Kolokolov
Marina Devyaterikova

We 14:30 - 15:00, Room HS C

Many processes in economy, management, design and other fields are described by integer programming (IP) models. The input data of many practical problems have inexact nature therefore stability analysis of IP problems and algorithms for their solving under variations of problems parameters is very important.

We introduce the definition of the integer programming algorithm stability in terms of iterations number. By algorithm stability we mean a polynomialy bounded growth of the iterations number while the relaxation sets of IP problems vary insignificantly. The L-class enumeration method and the fractional dual completely regular cutting plane process [1] are investigated. Using results from [2] we prove that these algorithms are stable on the integer programming problems with closed bounded relaxation sets.

References:

[1] Kolokolov A.A. Regular partitions and cuts in integer programming, Discrete Analysis and Operations Research. - Kluver Academic Publishers, Netherlands, 1996. - P. 59-79.

[2] Devyaterikova M.V., Kolokolov A.A. Analysis of L-structure stability of convex integer programming problems, Operations Research Proceedings, Springer, 2000. - P. 49-54.

On Buffers Allocation Problem: Complexity and Heuristic Solution

Alexander Kolokolov
A. B. Dolgui, Anton Eremeev, V. S. Sigaev

Th 11:00 - 11:30, Room HS 1

A problem of buffer devices allocation in flow-line manufacturing system of machines is considered. It is assumed that the system has a series-parallel structure and machines are subject to breakdowns. The failure and repair times of machines are supposed to be exponentially distributed and the processing time of a part at each machine is deterministic.

The buffers allocation problem consists in determining the buffers capacities with respect to given optimality criterion which depends on the average production rate, the buffers allocation cost and the inventory cost of holding parts in buffers.

The quality of solutions is evaluated by means of approximate decomposition and aggregation method based on the Markov models (see e.g. [2]).

We show the NP-hardness of a special case of this problem and consider several versions of genetic algorithm (GA) combined with different local optimization heuristics. This hybrid GA is compared to the complete enumeration and to the iterative local search with random restarts. The computational experiments are carried out on several series of problem instances of different structure (e.g. from [1]) and show a better quality of solutions obtained by the hybrid GA compared to pure GA and the iterative local search. In cases where the complete enumeration of solutions space was possible, the average objective function value of the hybrid GA solutions turned out to be close to the optimum.

The research is supported in part by the INTAS Grant 00-217.

References:

[1] Ancelin B., Semery A.. Calcul de la productivite d'une ligne integre de fabrication, RAIRO APII, vol. 21, 1987, pp. 209-238. (in French).

[2] Dolgui A. Analyse des performances d'un atelier de production discontinue: methode et logiciel. Rapport de recherche INRIA, No 1949, 1993. (in French).

Application of the entropy-like proximal method in the solution of the probabilistic constrained linear programming problem

Éva Komáromi We 14:30 - 15:00, Room HS 9

We are concerned with the following problem: $ux \rightarrow min$ subject to $P(Ax \geq \beta) \geq p$ where $u \in R^m$ is a given positive vector, A is a deterministic matrix of dimension $m \times n$, P denotes probability, β is an m-dimensional random vector with given joint probability distribution function $F, 0 < p < 1$ is a constant reliability level. This problem is shown to appear in the dual of the probabilistic constrained linear programming problem. We assume that F is logarithmic concave which garantees the convexity of the set of solutions of the problem for a rather broad class of probability distributions, including the multivariate normal distribution. For solving this problem we apply the proximal point method for the Lagrangian of this problem. The method generates a sequence of points the k-th elements of which minimizes the $objective\ function + \omega^{-1}(x - x^{k-1})^2$ but in the place of the quadratic term we use an entropy-like distance. We investigate the convergence of the algorithm in the presence of different entropy-like distance functions.

On solvability of multi-index axial assignment problem on single-cyclic permutations and the algorithm for three-index case.

Natalie Korkishko
E. Kh. Gimadi We 9:00 - 9:30, Room HS C

We consider a multi-index axial assignment problem on single-cyclic permutations. This problem is MAX SNP-hard, because its two-index case coincides with well-known Traveling Salesman Problem. We prepouse a criterion of solvability of the m-index assignment problem on single-cyclic permutations for $3 \leq m \leq 7$: there exists a number $n(m)$, such that for every $n > n(m)$ the problem is solvable if and only if n is odd.

We suggest a polynomial-time approximation algorithm for tree-index case. A probabilistic analysis of the algorithms is performed in the case of random matrix entries. We established some sufficient conditions for the asymptotical optimality of the suggested algorithm.

This work was supported by the grant of the Russian Foundation for Fundamental Research (project N 02 -01-01153), Russian Federal Program "Integration" and INTAS 00-217.

Efficient Globalization of the Convergence of Newton-Type Methods

Ekaterina Kostina
H. G. Bock, J. P. Schloeder Tu 12:00 - 12:30, Room HS 8

Newton methods for nonlinear equations form the basis of nonlinear programming methods. They possess nice local convergence properties if a full step is permitted, and global convergence is guaranteed by line-search or trust-region strategies based on suitable merit functions. However, descent strategies based on classical merit functions may unnecessarily slow down the convergence – even for mildly ill-conditioned problems and even in the local convergence domain. We present a new globalization philosophy based on "natural level functions" with no use of descent arguments. Extensions to the related problems of parameter estimation are suggested. Numerical results are given for real-life applications in aerospace and chemical engineering.

An Approximation Algorithm with Absolute Worst-Case Performance Ratio 2 for Two-Dimensional Vector Packing

Vladimir Kotov
Hans Kellerer

Mo 17:30 - 18:00, Room HS C

In the classical one-dimensional *bin packing problem* we are given a set of items with weights in $]0, 1]$ and an infinite number of unit-capacity bins. The goal is to pack the items into a minimum number of bins such that the total weight of the items in each bin does not exceed the bin-capacity one. The *d-dimensional vector packing problem* is the generalization of one-dimensional bin packing to d dimensions. Instead of being a single number, in the d-dimensional vector packing problem each item is a d-dimensional vector with coordinates in $[0, 1]$. The goal is to pack all items into a minimum number of bins provided with d corresponding capacities all equal to one.

It is well-known that bin packing and vector packing (as a generalization) are NP-hard in the strong sense. Fernandez de la Vega and Lueker gave an *asymptotic polynomial time approximation scheme* (APTAS) for bin packing. They extended their method to an asymptotic $(d+\varepsilon)$-approximation algorithm for d-dimensional vector packing where ε can be chosen arbitrarily close to zero. Chekuri and Khanna improved this result for arbitrary $\varepsilon > 0$ proposing a polynomial-time algorithm with worst-case performance ratio $1 + d/k + H_{k-1}$ where $k = \lceil \frac{1}{\varepsilon} \rceil$ and $H_k := 1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{k}$.

In this paper we will address the *two-dimensional vector packing problem* (2-DVPP). Items $b = (b^x, b^y)$ are two-dimensional vectors with x-coordinate and y-coordinate. They have to be packed in a minimum number of bins with two capacities each equal to one.

We will present an approximation algorithm for the 2-DVPP with an *absolute* performance guarantee 2. If C^H denotes the number of bins used by our heuristic and C^* denotes the number of bins in an optimal solution, we will show that $C^H \leq 2C^*$ holds independently of the instance of the 2-DVPP. Note that the approach by Chandra and Chekuri yields only an approximation algorithm with worst-case performance ratio 3.

Investment climate for pension funds

Erzsebet Kovacs

We 17:30 - 18:00, Room E1.05

The need for high returns on pension assets can be reached by international asset diversification. Three ranks will be combined by factor analysis to measure the investment climate in 31 European countries. Groups of countries with similar investment ranks will be analyzed. The results can provide impression of how demographic structure and investment flows are connected.

Using the MPL Modeling System and the Optimax 2000 Component Library to create Embedded Optimization Applications.

Bjarni Kristjansson

Tu 15:00 - 15:30, Room HS 1

The OptiMax 2000 is a new object-oriented Component Library that allows the model developer to easily create customized end-user applications to solve real-world optimization problems.

We will demonstrate how this allows seamless integration of optimization models into easily maintainable applications, by connecting the MPL modeling language with any object-oriented programming language, such as VBA for Excel/Access, Visual Basic, Visual C++, Java, Delphi, and web scripting languages.

Generalization and construction of economic functions in Data Envelopment Analysis

Vladimir Krivonozhko
O.B. Utkin, A.V. Volodin, I.A. Sablin

We 11:30 - 12:00, Room E0.05

Data Envelopment Analysis (DEA) proposed by A. Charnes and W. Cooper is a powerful approach to determine the efficiency of economic systems. Most scientific publications on DEA deal mainly with calculations of certain features of a production unit behaviour, for example, efficiency measures for each unit, returns to scale, efficient targets, an efficient reference set, etc. However, such methods show the behaviour of production units in local vicinity and do not depict the frontier in the whole.

In our work, a family of new parametric optimization methods is proposed in the DEA framework. This approach enables us to generalize and to construct well-known functions in mathematical economics: production functions, isoquant, isocost, isoprofit, ect.

Moreover, on the basis of these parametric methods we can calculate various economic factors in DEA applications, such as marginal rate of substitution, marginal product and so on. Thus, we can reduce the analysis of economic systems to investigation of these functions. The proposed methods are applied to efficiency analysis of economic systems in Russia.

A New Exact Resource Allocation Model with Hard and Soft Resource Constraints

Ferenc Kruzslicz Mo 17:00 - 17:30, Room HS 4

In this paper we present a new bilevel resource allocation model with hard and soft resource constraints for projects. By definition, a hard resource constrain is not resolvable within the given planing horizon, but a soft resource conflict may be managed by a flexible “hiring-firing” strategy.

According to the definition, firstly we solve a “makespan-minimization” problem for the hard resources. After that, we solve a “resource balancing” problem on the set of “hard resource feasible” schedules. In the “well-balanced” schedule searching phase we characterize the soft resource requirements with a new bicriteria measure, namely with the “peak resource requirement” and the “idle time”, simultaneously.

In the proposed approach, in the efficient solution searching phase we applied a new a “trees in tree” like implicit enumeration method with effective pruning rules.

The practical interpretation of the proposed model is demonstrated in an analysis of a simplified small-scale business software development environment. In the presented problem we assumed that the number of software designers is a hard constraint within the given planing horizon, but the availability of programmers and testers are soft constraints, which can be resolved by “hiring-firing” in short term base. In this example we exploited the fact that in a small-scale bussines software developing process the usual iterative “waterfall” structure might be replaced by a serial “designer-programmer-tester” chain.

Methoden zur Leistungsanalyse im Supply Chain Planning

Heinrich Kuhn
Georg N. Krieg We 12:00 - 12:30, Room HS 1

Zur Lösung der Planungs- und Steuerungsaufgaben in einer Supply Chain (Lieferkette) werden z.Zt. zahlreiche Supply Chain Planning (SCP)-Systeme angeboten, die jedoch die stochastischen Einflußgrößen in einer Supply Chain i.d.R. vernachlässigen. Da zahlreiche Größen innerhalb einer Supply Chain jedoch stochastischen und dynamischen Einflüssen unterliegen, bietet es sich an, neben generativen Ansätzen zur Planung der Supply Chain (Supply Chain Optimization, SCO) auch evaluative Ansätze (Supply Chain Evaluation, SCE) bereitzustellen, damit alternative Entscheidungssituationen unter Berücksichtigung stochastisch/dynamischer Einflüsse realitätsnäher beurteilt werden können. In dem Beitrag werden analytische Ansätze vorgestellt, mit denen sich diese stochastisch/dynamischen Einflußgrößen erfassen und abbilden lassen. Die analytischen Ansätze basieren im wesentlichen auf Warteschlangennetzwerkmodellen, die mit Hilfe von Dekompositionsverfahren ausgewertet werden. Mit diesen Verfahren ist es in relativ kurzer Rechenzeit möglich, einzelne Netzwerkkonfiguration zu analysieren. Somit lassen sich diese Verfahren auch systematisch im Rahmen von Optimierungsverfahren einsetzen.

Von der Prädikatenlogik zur unternehmerischen Entscheidungsunterstützung

Friedhelm Kulmann
Wilhelm Rödder Tu 17:30 - 18:00, Room HS 10

Mit der Expertensystemshell SPIRIT steht ein mächtiges Instrument zur unternehmerischen Entscheidungsunterstützung auf der Basis probabilistischen konditionalen Wissens zur Verfügung. In mehreren Arbeiten – wie zum Beispiel [KRE 2000], [KUL 2002] – wurde über ihren professionellen Praxiseinsatz berichtet. Wegen der hohen Komplexität der Entscheidungsmechanismen bedarf es zumeist intensiver Gespräche bis zur Akzeptanz der zugrunde liegenden Theorien; letzte Zweifel werden jedoch häufig nicht ganz ausgeräumt. Mit diesem Beitrag wird nun für die Verwendung von SPIRIT ein neues Einsatzgebiet gewählt und damit ein noch nicht da gewesener Zugang geschaffen. Konditionalmodelle sind auch bei der Lösung prädikatenlogischer Aufgaben einsetzbar, wie sie beispielsweise in sogenannten Logikrätseln gestellt werden. Damit wird gleichsam für derartige Aufgaben eindrucksvoll nachgewiesen, dass die Fähigkeit des Menschen zur Deduktion von Wissen aus Wissen auf dem Computer formalisierbar ist. Nach einer kurzen Darstellung des in SPIRIT implementierten Inferenzmechanismus (vgl. hierzu [ROE 2000], [ROE 2001]) werden einige, in ihrer Struktur unterschiedliche prädikatenlogische Aufgaben verbal formuliert, in der Shell kausal modelliert und für verschiedenartige Fragestellungen eindeutig gelöst. Im letzten Teil des Beitrags wird durch Aufzeigen von Analogien deutlich, dass der Weg von “Logeleien” zu ernsthaften ökonomischen Anwendungen nicht weit ist. Mit dem Verständnis des Mechanismus zur Modellierung und Lösung prädikatenlogischer Aufgaben kann so vielleicht der Widerstand gegen die Verwendung probabilistischer, mathematisch fundierter Konzepte abgebaut werden.

Literatur:

[KUL 2002] Kulmann, F.: Wissen und Information in konditionalen Modellen - zur Entscheidungsvorbereitung im Anfrage- und Auftragsmanagement, (DUV Gabler, Wiesbaden, 2002).

[KRE 2000] Kulmann, F.; Reucher, E.: Computergestützte Bonitätsprüfung bei Banken und Handel, DBW - Die Betriebswirtschaft, 60 (2000) 113-122.

[ROE 2000] Rödder, W.: Conditional Logic and the Principle of Entropy, Artificial Intelligence, 117 (2000) 83-106.
[ROE 2001] Rödder, W.: Knowledge Processing under Information Fidelity, Proc. IJCAI 2001 - Seventeenth International Joint Conference on Artificial Intelligence, Seattle, Washington (2001) 749-754.

Fuzzy Control in System Dynamics modelling

Pierre Kunsch
J. Springael, J. P. Brans

Tu 17:00 - 17:30, Room HS 7

The "Adaptive Control Methodology" (ACM) for the planning and control of complex socio-economic systems combines System Dynamics with Group Multicriteria Decision Aid. The treatment of uncertainties is however not entirely satisfactory in the initial approach. The present paper analyses the potential of a fuzzy version of the approach. Fuzzy logic and rules are introduced for dealing with uncertainties on the parametric variables and on structural equations in the model. The aim is to have enhanced pro-active capabilities for planning and real-time control of the decision process with multiple stakeholders.

Optimal control of multi-echelon inventory systems using simulation optimisation

Peter Köchel
Ulf Nielaender

We 17:30 - 18:00, Room HS 1

Multi-echelon inventory systems (MEIS) are one of the most widely investigated fields in mathematical inventory theory. Although the number of publications on that topic is extremely voluminous, the analytically tractable models suffer from various restrictive assumptions. To overcome these restrictions, various approximate solutions have been developed as well as simulation of the corresponding model has been used. However, simulation by itself is not an optimisation approach; a simulation experiment can only estimate the performance of a given system design. On the basis of such estimations the designer has to answer two basic questions: To continue searching for a good design variant or to stop, and, if he is going to continue, how to find an improved design solution. Whereas the first question can be answered by defining various stopping criteria, the second question is the crucial one. Therefore, we propose the simulation optimisation approach where a simulator for the underlying system is combined with an appropriate optimisation tool. Such a combination has at least two advantages. First, by defining suitable interfaces in fact arbitrary simulators and optimisers can be connected. Second, the searching process for a good solution can be realised without intermediate actions of the designer.

In our presentation we show how simulation optimisation successfully can be applied to find optimal policies in MEIS. The first step is to modify the classical Kanban control principle in such a way that it is applicable to the optimal control of MEIS. Consequently we use the framework of KaSimIR, currently being developed at Chemnitz University of Technology for the simulation of very general Kanban systems. We modify and extend it to implement continuous-review, order-point, order-quantity strategies for MEIS. Our simulator owns the advantages, amongst others, that we can investigate MEIS with arbitrary structure, with in fact arbitrary demand processes and arbitrary random delivery and transportation times, and with arbitrary cost and gain functions. Combining KaSimIR with the non-standard genetic optimisation tool LEO, we are able to optimise those arbitrary MEIS with respect to different cost and service level criteria. Finally, we also provide some numerical examples to show the usability and the advantages of our approach.

Splitting and localization of the epi-topology combined with randomness

Petr Lachout

We 14:00 - 14:30, Room HS 9

The epi-convergence is a powerful tool for investigation of sensitivity and stability of optimization problems, see [5]. Having an optimization problem with random parameters we are interested in sensitivity and stability in probability or in law. That requires a topology or another similar structure, [2]. Therefore, we restrict our interest into topological spaces where the epi-convergence is induced by epi-topology, [5] or [1]. Thus, the epi-convergence in probability and in law can be defined on the base of the epi-topology, see [3].

We present a deeper discussion on the epi-topology. A splitting and a localization of the epi-topology are introduced. These procedures are giving a structure finer than any topology. Moreover, they induce convergences which can be established in probability and, as well, in law. The setup generalizes the ideas due to [4].

Reference

[1] G. Beer: *Topologies on Closed and Closed Convex Sets.* Kluwer Academic Publishers, Dordrecht, 1993.
[2] E. Èech: *Topological Spaces.* Academia, Praha, 1966.
[3] R. Lucchetti, G. Salinetti and R.J-B. Wets: Uniform convergence of probability measures: topological criteria. *J. Multivariate Analysis* **51** (1994), 252-264.

[4] S. Vogel: A stochastic approach to stability in stochastic programming. *J. Comp. Appl. Math.* **56** (1994), 65-96.
[5] T. Rockafellar, R. J-B Wets: *Variational Analysis.* Springer-Verlag, Berlin, 1998.

Online-Algorithmus zur Steuerung von Verkehrslichtsignalanlagen

Klaus Ladner Mo 17:00 - 17:30, Room HS 3

Es wird ein Algorithmus entworfen, der laufend verkehrsabhängige Daten einer Kreuzung und strategische Vorgaben des Verkehrsrechners verarbeitet, um den jeweils nächsten Umlauf einer Ampelanlage zu planen.

Dabei werden die Vorstellungen des Verkehrsplaners berücksichtigt. Es können Zeitfenster definiert werden, innerhalb denen Verkehrsströme entweder keinesfalls Grün haben dürfen oder unbedingt Grün haben müssen, um die Koordinierung mit den umliegenden Kreuzungen ermöglichen zu können.

Es werden Kombinationen von Verkehrsströmen der betrachteten Kreuzung so zu Phasen zusammengefasst, dass dabei sinnvolle Phasenwechselschemata erstellt werden können. Aufgrund einer definierten Zielfunktion und mehreren Nebenbedingungen werden zulässige Kombinationen von Phasen gesucht, welche die “Leistungsfähigkeit” der Steuerung maximieren. Dazu wird das Problem in einen Zustands-/Schichtengraph übergeführt, in dem ein längster zulässiger Weg gesucht wird.

Da der Algorithmus auf Kreuzungsrechnern laufen soll, muss er extrem schnell und mit bescheidenem Speicheraufwand gute Ergebnisse liefern können.

Mathematical Programming Model of the Critical Chain Method and Its Solving on a Spreadsheet

Pavlina Langrova
Tomas Subrt Mo 17:30 - 18:00, Room HS 4

In the field of the project management classical deterministic (CPM) and stochastic (PERT) methods for project duration assignment are commonly used. The project duration is determined by the duration of critical (or attempted critical) path. Currently there is increasingly indicated that most of these methods are not suitable for working with ill structured and not enough quantified inputs. Using these methods precise results from the inaccurate numbers ere obtained. Applying such numbers on a real problem points to the non-performance of project duration through the critical path overrun. New methods that are able to work with not enough quantified inputs start to gain ground. Beside soft approach based on fuzzy modeling one rather new method called Critical Chain will be mentioned in this paper. This method respects a human factor influence on project duration. Critical Chain method has mainly empirical character, it has a relatively sufficient software support, but it is still waiting for detail analysis. The aim of the following paper is to present one possibility of how to model and solve a critical chain problem in an activity on node (AON) network models using bivalent programming tools. As a fundament for the following approach it was taken a maximum flow mathematical programming problem modified into AON “longest route” problem. This way an AON critical path discrete programming model was established. Solving it we obtain a standard critical path. Using Linkosa Excel Add Inn tool we receive the structure of optimal solution and we also achieve a cost sensitivity analysis. These partial results will be used as an input to the next step of Critical Chain method solution. In this step all variables and objective function must agree with critical chain requirements. Comparing sensitivity analysis of non - basic variables costs (slacks) with previously estimated task duration new tasks durations can be set. Using intervals of cost stability the amount of time necessary for feeding buffers installation is calculated. All other characteristics typical for critical chain model are derived from this solution.

Neues über Lotka-Volterra-Experimente

Ferri Leberl
Ortwin Becker, Christoph Kohlbach, Alois Lafer, Ulrike Leopold-Wildburger We 14:30 - 15:00, Room HS 5

Das hier beschriebene Experiment hat sich die Problematik von wirtschaftspolitischen Stabilisierungsversuchen zum Ziel gesetzt, aber hauptsächlich aus Gründen der Vereinfachung übertragen wir die Fragestellung auf ein biologisches Umfeld. Ein Biotop, bestehend aus zwei Populationen, soll mit Hilfe des Einsatzes von vier verschiedenen Instrumenten auf einen Fixpunkt gebracht werden. Bei jedem Durchlauf steht allerdingsnur ein Instrument zur Verfügung, um das zweidimensionale Ziel zu erreichen. In dieser Arbeit wollen wir Informationen über Lernprozesse der Teilnehmer sammeln. Wir untersuchendie Bedeutung des Startpunktes, den Leistungsansporn durch finanziellen Anreiz, und auch den Zahlenfindungsprozeß beim Mitteleinsatz.

Gestaltung integrierter Produktions- und Rückführungsnetzwerke

Baptiste Lebreton
Jürgen Friedl, Stephan Franke, Axel Tuma

Th 9:30 - 10:00, Room HS 6

Betrachtet man die aktuelle Diskussion im Rahmen der Gestaltung von Produktions- und Zuliefernetzwerken, trifft man zunehmend auf Ansätze zur Integration von Rückflüssen. Zentrale Konzepte zur Schließung von Stoffkreisläufen betreffen etwa “Reuse”, “Remanufacturing” und “Recycling”. Die Eignung derartiger Konzepte zur effizienten Gestaltung von Produktions- und Rückführungsnetzwerken hängt insbesondere von der Struktur der Erzeugnisse sowie der Implementierung entsprechender Produktnutzungskonzepte ab. Die sich hieraus ergebenden Netzwerke unterscheiden sich sowohl in ihrer Struktur als auch in den zu lösenden Koordinierungsaufgaben. Ausgehend von einer Analyse unterschiedlicher Konsummuster werden verschiedene Netzwerktypen diskutiert. Darauf basierend werden spezifische Aufgabenmodelle aufgezeigt und Lösungsansätze entworfen. Exemplarisch wird dies für die Koordination einzelner Produktionseinheiten in einem Produktdienstleistungsnetz verdeutlicht.

A Ranking Method for Fuzzy Numbers Based on Extended Fuzzy Preference Relations

Hsuan-Shih Lee

Tu 15:00 - 15:30, Room HS 10

The crux of this paper is to propose a new ranking method for fuzzy numbers based on preference relation not only easy to compute but also perserving some good properties such as additivity. First, we extend the definition of fuzzy preference relaiton so that the degree of preference is not confined within 0 and 1. With the extension of the definition, we propose an extended fuzzy preference relation satisfying additivity. By additivity, we mean if the degree of preference of fuzzy number A over fuzzy number B is x and B over C is y then A over C is $x + y$.

Bounds & Likelihoods Procedure Revisited

Johannes Leitner
O. Becker, U. Leopold-Wildburger, J.H. Schuetze

We 14:00 - 14:30, Room HS 5

The Bounds & Likelihoods-procedure (Becker/Leopold 1996) provides a way to describe expectation formation. In an experiment subjects are asked to predict the next value of an univariate time series on the basis of only the past oberservations. The time series was generated by a stochastic second order difference equitation. The average forecasts of the subjects are surprisingly well described by a simple heuristic, the “Bounds and Likelihood procedure”.

In addition the behaviour and score of the subjects are analysed with the Selective Attention test (Brickenkamp,1996) and the Intelligence test for reasoning (Horn, 1968/1991).

The preliminary results indicate that the level of attention and the level of reasoning have a certain impact on the forcasting performance of the subjects.

Keywords: Experimental economics, forecasting, visual extrapolation, time series, concentration, d2-test, intelligence, memory, attention

JEL-classification: C91, C92, C53

Separable Programming in Optimal Control Problem

Lado Lenart

We 14:00 - 14:30, Room HS 7

Numeric procedures in optimal control theory, which were used in the simulation and timetable project for Slovenian railways, are described. The dynamic system of the train is modelled with two types of nonlinear second order differential equations, which were put into difference form. Minimal fuel problem then can be solved as separable linear program with linear objective function and partially nonlinear constraint functions. The nonlinear constraints are separable, i.e. nonlinearities are mathematically independent. This property in conjunction with the finite bound on the decision variables permits the development of a piecewise linear approximation for each function in the problem. Separable programming method guarantees an approximate global optimum to the original problem only when one is minimising a convex function over a convex set. When solving a convex programming problem, we may solve approximate problem using ordinary linear programming methods without enforcing the so called adjacency restrictions. The interior point algorithm then in the sparce matrix environment of the problem appears to be quite efficient. However, depending on boundary conditions, a convex programming problem can occur as the nonconvex one and then the introduction of adjacency restrictions becomes unavoidable. The interchange of basic and nonbasic variables while pivoting in the primal problem then depends on the adjacency constraints. The degeneracy of the linear programming can be the source of further complications. It was our aim to fix some effective algorithms for solving the minimal fuel problem. The results were compared with the results of some simplified models, obtained with Hamilton-Jacoby equation analysis.

The Results of the Elektronic Management Game

Ulrike Leopold
Tanja Feit, Susanne Lind

Tu 15:00 - 15:30, Room HS 5

The SINTO-Market was played with students of the University of Graz and the University of Kalmar . The results of the game depend on the one hand by/on the decisions, which were made by students using computers and on the other hand by the answering the questionnaires. The student have to answer some questions about the game. In our lecture we will give a short overview about the Management game SINTO-Market and some interesting results, like the realistic fact, that changes of the brands have a negative reaction on the owner's capital situation.

On Optimal Linear Arrangements of Weighted Graphs

Victor Lepin

Tu 17:00 - 17:30, Room HS C

Let $G = (V, E)$ be a graph with weights $\omega : V \to R$ and $\phi : E \to R$. For a linear arrangement $f : V \to \{1, 2, \ldots, |V|\}$, the length of an edge $uv \in E$ is defined as

$$\lambda(uv, f, G_{\omega\phi}) = \phi(uv) \left(\sum_{f(v)<i<f(u)} \omega(f^{-1}(i)) + \frac{\omega(u) + \omega(v)}{2} \right).$$

The cost of $G_{\omega\phi}$ with respect to f is

$$\psi_f(G_{\omega\phi}) = \sum_{uv \in E} \lambda(uv, f, G_{\omega\phi}).$$

We investigate the problem of finding a linear arrangement f of a graph $G_{\omega\phi}$ such that $\psi_f(G_{\omega\phi})$ is minimized. We present some well-solvable cases and technique for finding heuristic solutions of this problem.

Multiple Criteria Analysis of Facilities Management Alternatives

Natalija Lepkova
E.K. Zavadskas, A. Kaklauskas

Tu 12:00 - 12:30, Room HS 10

A lot of various definitions of facilities management are proposed by different researches, practicians and institutions. In this article presented the facilities management conception proposed by authors taking into consideration economic conditions in Lithuania. It is also striving to apply the multiple criteria analysis methods for facilities management process. In this article presented the example of multiple criteria analysis of commerce centre in Vilnius. There is carried out comparison of premises lease alternatives: from tenant point of view and from owner point of view. The result - the best variant for tenants and owner is to rent the premises with all services.

Short-term capacity planning in manufacturing companies with a decentralized organization

Peter Letmathe

Tu 9:30 - 10:00, Room HS 1

Bottleneck stations limit the output rate of production systems. They are defined to have a production rate lower than the demand rate for parts they are producing. Short-term capacity planning's purpose is to reduce the bottlenecks' negative impact on the output rate. This paper discusses several opportunities to adjust capacity to the system's requirements in a decentralized production organization. The starting point is a given workload of a bottleneck station which may consist of one or more machines. The sum of processing and setup times needed to produce all parts is higher than the station's standard capacity. Every part has to be produced within a given time window which includes the processing time of this part and an additional time buffer. The opportunities of short-time capacity adjustment are positively correlated with the ratio of buffer and processing times. To cope with this bottleneck problem, the bottleneck station may produce parts in advance, it may work overtime, the machines may be run with higher speed, the number of machine setups may be reduced, the station may solve the bottleneck problem in concert with other production stations or some of the parts may be bought from external suppliers. Since all these opportunities are related to additional costs, it is crucial to find a cost-efficient solution of this problem. For this purpose, a linear model is proposed which can be used to find the optimal mix of short-term capacity adjustment measures. The model can be recalculated easily to take the actual output and capacity requirements into account if any deviations from the original plan occur. The presentation of the model is combined with an example which illustrates that several measures may be used simultaneously.

Constraint Qualifications and Necessary Optimality Conditions in Terms of Convexificators

Xiao Feng Li
Jian Zhong Zhang

Th 9:30 - 10:00, Room HS 8

For optimization problems with locally Lipschitz objective and inequality constraint functions, constraint qualifications are proposed and Kuhn-Tucker type necessary optimality conditions are derived for optimality under the constraint qualifications. A necessary and sufficient condition is also presented for the set of Kuhn-Tucker multiplier vectors to be nonempty and bounded. The constraint qualifications and the Kuhn-Tucker type necessary optimality conditions concerned in this study are expressed in terms of convexificators which, introduced recently for lower semicontinuous functions, extend and unify some well-known generalized subdifferentials of locally Lipschitz functions. The necessary optimality condition results obtained in this study extend the corresponding ones expressed in terms of the Clarke subdifferentials.

Total weighted tardiness, total weighted earliness and total weighted compression cost minimization in a single machine scheduling problem with controllable processing times

Maciej Lichtenstein
Krzysztof Chudzik, Adam Janiak

Mo 13:30 - 14:00, Room HS C

In the paper we consider a single machine scheduling problem with controllable processing times and the non-regular cost-related criterion. In this problem, each job is characterized by the release date, the due date, and the controllable processing time, which may vary in the given limits. The scheduling objective is the minimization of the non-regular cost-related criterion, which is composed of three parts: total weighted earliness - represents the total costs of storing ready-made jobs (i.e. jobs completed before their due dates), total weighted tardiness - represents the total costs (penalties paid to the customer) of not meeting the stated deadlines (calculated for jobs completed after their due dates), and total weighted compression costs. We also assume that jobs are processed with no preemptions and machine idle time between job processing is permitted. We show that the problem of finding the schedule (i.e., jobs starting and completion times) for a given sequence of jobs is solvable in polynomial time, by formulating it as a linear programming task (LP). We also propose some sophisticated algorithm of determining the schedule for a given sequence of jobs, which significantly overcome the classical methods of solving LP in terms of the running time. For finding the sequence of jobs we propose several approximation algorithms and verify their efficiency by extensive experimental analysis.

Total weighted completion time minimization in a single machine scheduling problem with resource dependent setup times

Maciej Lichtenstein
Adam Janiak

Mo 17:00 - 17:30, Room HS B

Scheduling problems with setups consideration have many practical applications, which can be found either in production as well as in computer systems. In such problems jobs are grouped into families, and during job processing, between two jobs which belong to different families a setup is inserted. The setup time may depend either on the family which is processed and the family which will be processed (sequence-dependent setups) or only on the family which will be processed (sequence-independent setups). There also may be considered a Group Technology (GT) restriction which require that job families cannot be split into smaller batches. In this paper we consider a single machine scheduling problem with GT restriction and with sequence-independent setup times given as some linear, nonincreasing functions dependent on resources. The objective is to find a sequence of families and the sequence of jobs within the families, which minimize the total weighted completion time under a given constraint on the total resource consumption. The cases with continuously and discretely divisible resource are considered. We show that the problem with discretly-divisible resource is NP-hard, and we propose an approximation algorithm, which efficiency is verified by some experimental analysis. The computational complexity of the problem with continuously-divisible resource remains open question, however, we have derived some specific problem properties, which allow us to optimally solve several special cases of the problem. For the general case, we propose an approximation algorithm. Extensive numerical experiments show that this algorithm delivers optimal or near-optimal solutions for a wide range of problem instances.

Single machine scheduling problem with discretely-divisible resource dependent setup and processing times

Maciej Lichtenstein
Adam Janiak

Tu 12:00 - 12:30, Room HS C

Scheduling problems with set-ups have attracted a great attention in the literature over several recent years. This is motivated, beside obvious theoretical significance, by many applications, which can be found in production and computer

systems. However, most of authors of the papers have treated set-up and job processing times as some fixed given parameters. In many practical situations the job processing times and set-up times may be compressed (i.e. shortened) through the consumption of some additional resources such as energy, financial outlay, catalyzer, etc. This paper deals with a single machine scheduling problem, in which both, the processing times and the set-up times are described as linear, nonincreasing functions dependent on some discretely divisible resources. The model of job processing time and set-up time consists of two parts. One part is a constant and describes the maximal requirements of job processing time or set-up time when there are no resources assigned to them. The second part is variable and decreases the job processing time or the set-up time if some amount of resource is assigned to them. We consider the following two problems: the minimization of the makespan value under a given constraint on the total resource consumption, and the dual problem, i.e., the minimization of the total resource consumption under a given constraint on the makespan value. We show that both problems are NP-hard, even for the case if only one of the parameters (i.e., processing time or set-up time) depends on the resources. We also derived some specific problem properties, which allowed us to develop polynomial-time solution algorithms for several special cases of the problems. For the general cases of the problems we propose an approximation algorithms whose efficiencies were verified by some experimental analyses.

Weshalb Qualitätsmanagement in der Produktentwicklung so früh wie möglich?

René Lind Tu 15:00 - 15:30, Room HS 2

Der Vortrag beschäftigt sich mit dem Einsatz von präventiven Qualitätsmanagementmethoden in der Fahrzeugentwicklung. Nach einer Einleitung, welche die Kosten und den Nutzen des Methodeneinsatzes beleuchten wird, werden wir uns folgenden Fragen widmen:

Wie ist die Stellung der einzelnen Methoden, wie der Fehler-Möglichkeiten- und Einflussanalyse (FMEA), Quality Function deployment (QFD) und der Versuchsmethodik im Serienentwicklungsprozess? Wie werden diese Methoden in die Zulieferkette für das Entwicklungsprojekt integriert?

Wie muss das Projektmanagement für einen erfolgreichen Einsatz der Methoden aufgebaut bzw. organisiert sein (Fokus: Simulataneous Engineering).

Wie werden Methoden durch die modernen Entwicklungsindstrumente, wie Simulation, gefördert?

Wie stehen die einzelnen Methoden untereinander im Zusammenhang?

Wo sind die Grenzen des Einsatzes? Worin liegen die Unterschiede zwischen Theorie und Praxis?

Ist Entwicklungsplanung der Weg zum effektiven Einsatz von QM-Methoden in einen Entwicklungsprojekt?

The Demonstration of The Electronic Management Game

Susanne Lind-Braucher
Tanja Feit, Ulrike Leopold Tu 14:30 - 15:00, Room HS 5

We give a short demonstration of the SINTO-Market, which runs via internet. All firms are in the same situation at the start of the game. Each firm has ten registered brand names available. The firm must establish the following for each brand offered on the market:

the combination of the three brand characteristics,

the production quantity,

the amount of expenditure assigned for advertising,

the price.

The results of each period are given to each firm at the end of that period. This includes the closing balance, the profit and loss account, a market overview, which describes the brands offered in that period together with their taste characteristics, quality and price.

There are no theories of price stickiness by asking actual decision makers which are accepted in a unique way. It is the intention of our simulation study to give the oligopolists hints for efficient behavior strategies and to let them avoid serious mistakes.

Multi-Class User Equilibria under Social Marginal Cost Pricing

Per Olov Lindberg
Leonid Engelson, Maria Daneva
We 9:30 - 10:00, Room HS 3

In the congested cities of today, congestion pricing is a tempting alternative. With a single user class, already Beckman et al. showed that 'system optimal' traffic flows can be achieved by social marginal cost (SMC) pricing, whereby each traveler has to pay the extra cost he is incurring on other travelers. It is however well known that different user classes can have wildly varying time values. Hence, when one introduces tolls, one should consider multi-class user equilibria, where the classes have different time values. For fixed tolls, the single class user equilibrium is known to be generalizable to the multi-class case and solvable as a convex optimization problem. With SMC pricing, the situation is more complex, and Netter claims that the equilibrium problem cannot be stated as an optimization problem. We show that, depending on the formulation, the multi-class SMC-pricing equilibrium problem (with different time values) can be stated either as an asymmetric or as a symmetric equilibrium problem. In the symmetric case, the equivalent optimization problem is in general non-convex. For this non-convex problem, we devise descent methods of Frank-Wolfe type. We apply the methods and study local minima for a synthetic case based on Sioux Falls, and a real case from the Stockholm region.

Minimizing a supermodular set function on comatroids

Nickolay Valeryevich Linker
Victor Il'ev
We 17:00 - 17:30, Room HS C

Let U be a finite set and $\mathcal{D}$ be a nonvoid family of subsets of U with the property $(D \in \mathcal{D}, D' \supseteq D) \Rightarrow D' \in \mathcal{D}$. A *circuit of a set* $X \subseteq U$ is a minimal set $C \in \mathcal{D}$ containing X. A family $\mathcal{D}$ is called a *comatroid* if all circuits of every set X have the same cardinality.

We consider the problem

$$\min\{f(X) : X \in \mathcal{D}\}, \tag{1}$$

where $f : 2^U \to R_+$ is a nonincreasing and *supermodular* set function, that is $f(X) + f(Y) \leq f(X \cup Y) + f(X \cap Y)$ for all $X, Y \subseteq U$. The well-known p-median minimization problem is a special case of problem (1).

We obtain approximation guarantees of the greedy descent ("worst out") algorithm for problem (1). We show that this algorithm always finds a solution with value at most $(1 - s)/(1 - 2s)$ times the optimal value, where s is the "steepness" of f, a parameter which describes the rate of decrease of the function f. We also derive another bound on worst-case behaviour of the algorithm that generalizes the bound obtained in [1].

References:

[1] V.P. Il'ev, *An approximation guarantee of the greedy descent algorithm for minimizing a supermodular set function*, Discrete Appl. Math. 114 (2001) 131–146.

Combining Branch-and-Cut-and-Price with a Memetic Algorithm for Biconnectivity Augmentation

Ivana Ljubic
Petra Mutzel, Guenther Raidl
We 11:30 - 12:00, Room HS 2

In our experimental study on the Minimum-Cost Vertex Biconnectivity Augmentation Problem, we show that an exact algorithm can benefit from the knowledge previously obtained by a metaheuristic.

As the metaheuristic we used an evolutionary algorithm (a population-based method) with incorporated local improvement and problem dependent operators (initialization, crossover and mutation) - also known as memetic algorithm (MA). Branch-and-Cut-and-Price (BCP) is the exact technique based on the dynamical generation of constraints and variables during the LP-based Branch-and-Bound Algorithm. The way how the initial set of variables is chosen plays an important role in the design of BCP. We usually start from a set of edges/variables representing a sparse graph, and we maintain an additional set of promising edges (making a so-called reserve graph). These edges should be checked first if they can improve the objective function. Only if all of them price out correctly, the complete pricing should be performed. Such an approach is well suited for problems with a large number of variables. The straight-forward way of creating the sparse and reserve graph is to take k_1, respectively k_2, nearest neighbors of each node in the graph - we call it Nearest Neighbor BCP (NNBCP). In our paper, we suggest running the MA in order to find the set of promising edges (we call this method MABCP): all edges presented in the last obtained population represent the sparse graph. The reserve graph is created out of the initial population.

Experimental comparisons show that the usage of MABCP can improve standard Branch-and-Cut and NNBCP with respect to both: the running time and the quality of solutions.

Three-group classification using goal programming

Constantine Loucopoulos Tu 17:30 - 18:00, Room E0.05

MIP models for the three-group classification problem may have alternate optimal solutions in the training sample. The choice of the alternate solution used for generating the discriminant function can have a significant effect on the classificatory performance of the model in the holdout sample. This problem is addressed in this paper by considering goal programming models, with the goal of minimizing the number of misclassifications in the training sample being assigned preemptive priority. The number of misclassifications in the training sample is minimized using a single-function model that assigns a weight to each attribute variable, thus generating a discriminant score for each observation. These scores are projected onto a line which is divided into three intervals with gaps between adjacent intervals. The secondary goal of maximizing the deviation between the projected means of the groups assigned to the leftmost and rightmost intervals is used for the enhancement of group separation. The secondary goal of maximizing the minimum deviation between the projected group means is also considered. Another secondary goal that is included in this study is the maximization of the sum of the minimum deviations of the discriminant scores of correctly classified observations from the endpoints of the gaps between adjacent group intervals. This goal indirectly maximizes the width of the gaps between adjacent group intervals. Under different data configurations and group overlap, each of these secondary goals can improve the classificatory performance in the holdout sample of a model that assigns preemptive priority to the minimization of the number of misclassifications in the training sample.

Process Optimisation via Conventional Factorial Designs and Simulated Annealing on a Path of Steepest Ascent for a CSTR

Pongchanun Luangpaiboon We 14:30 - 15:00, Room HS 8

Industrial processes have some process variables, such as temperature and pressure in a chemical plant, and speed of lathe and advance of cutting tool in machining, which can be adjusted by plant operators or by automatic control mechanisms. Care must be taken to operate industrial processes within safe limits, but optimal conditions are rarely attained and increased international competition means that deviations from the optimum can have serious financial consequences. In many cases the optimum changes with time and there is a need for a routine mode of operation to ensure that the process always operates at optimal or near-optimal conditions. Response surface methodology (RSM), first introduced by Box and Wilson (1951), is taken to find the location of a set of process variables that optimise the response (Y) of a process. Box (1957) then proposed Evolutionary Operation (EVOP) for a permanent mode of operation. EVOP usually rest on the use of conventional factorial designs. Under EVOP the process is perturbed in a systematic manner so as to maximise the information obtained. The operating conditions are then adjusted to bring the process towards the optimum. However, the variance of Y is not constant conventional factorial design on the path of steepest ascent can be misleading. This study proposes a case study of an application of a heuristic approach, simulated annealing, on a path of steepest ascent. Simulated annealing has been used in an interesting analogy between problems in statistical mechanics and optimisation. Its properties expose useful information and overcome the large and noisy systems (Kirkpatrick et al., 1983). The objective of this study is to compare the efficiency of sequential algorithms for on-line optimisation of an industrial process in the presence of noises. Conventional factorial designs and simulated annealing on a path of steepest ascent are implemented on a simulated continuous stirred tank reactor (CSTR). In this process a stream rich in reactant of feed concentration is flowing into a reactor at a feed flow rate and a feed temperature. The reaction in the CSTR is an irreversible, first order exothermic reaction. The reactant A is converted to a product B, which at high temperature undergoes further reaction and is decomposed to form C. The context is maximising the productivity of a chemical reactor with respect to feed rate, concentration, temperature and coolant control parameters.

References:

Box, G.E.P. (1957), Evolutionary Operation: a Method for Increasing Industrial Productivity, Applied Statistics, 6, 81-101.

Box, G.E.P. and Wilson, K.B. (1951), On the Experimental Attainment of Optimum Conditions, Journal of the Royal Statistical Society, Series. B, 13, 1-45.

Kirkpatrick, S., C.D. Gelatt and M.P. Vecchi. (1983), Optimisation by Simulated Annealing, Science, 220, 671-680.

An evolutionary algorithm for Bayesian network triangulation

Tomasz Lukaszewski Th 9:00 - 9:30, Room HS B

The problem of finding an optimal Bayesian network triangulation is considered. The problem arises in the general evidence propagation procedure on Bayesian networks. The problem of optimal triangulation (in terms of the sum of the clique sizes or the weight of the triangulated network) is NP-hard.

The basic technique applied to triangulate a graph G is to add extra edges T produced by elimination of the vertices of G. A vertex V is eliminated by adding edges such that the vertices adjacent to V are pairwise adjacent and by subsequent

deletion of V and its incident edges. The quality of the solution depends on the order in which the vertices are eliminated. The number of possible orders grows exponentially with the number of vertices making this enumerative approach inefficient.

Various heuristic approaches to solve this problem have been proposed in the literature, among others a simulated annealing and genetic algorithm approach. The results obtained by these two metaheuristics are significantly better than results obtained by dedicated heuristics.

We propose a local search heuristic based on the idea of evolutionary programming. Different crossover and mutation operators have been tested. Very extensive computational experiments have been conducted to choose the best parameter configuration. Comparison of results obtained by our approach and by heuristics known from the literature is presented. The results show that our algorithm is competitive to the existing ones.

Scenario Updating Method for Stochastic Mixed-integer Programming Problems.

Guglielmo Lulli Mo 16:30 - 17:00, Room HS 9
Suvrajeet Sen

A variety of applications in the literature (e.g. scheduling, routing, location, production planning and finance) are formalized as integer and combinatorial optimization models. Even though, in traditional approaches these applications usually assume that all data are known with certainty, this is seldom the case. Operations problems often involve parameters (e.g. demand, lead-time etc.) that are unknown at the time of planning, and their values are unveiled over time, thus leading to the so called stochastic mixed-integer programming (SMIP) problems.

In this paper/presentation, we propose an approximation scheme to solve large SMIP problem with fixed recourse. We refer to this as the Scenario Updating Method. The algorithm is based on solving instances of the problem, which contain only a subset of the scenarios in the scenario tree. At each iteration, the subset of scenario is updated adding those scenarios, which imply a certain degradation of the objective function. The algorithm is terminated, when a certain gap from the optimal solution is reached. Different selection and updating rules are discussed.

We validate our method on a multi-stage stochastic batch-sizing problem, which is solved using a branch-and-price algorithm, at each iteration. The quality of the computational results demonstrates the viability of the proposed method.

Optimal Rail Car Allocation Problems

Marco E. Lübbecke We 14:30 - 15:00, Room HS 3
Uwe T. Zimmermann

The pratical background of this talk is the rail car management at industrial in-plant railroads. Production terminals demand for materials or empty cars. These requests are characterized by a track, a car type, and the desired quantity. If available, substitution types may be delivered at no extra cost. The planning task consists of allocating cars to requests at a minimal total transportation cost (measured e.g., in minutes). As long as available, use physically (or soon to be) present cars, otherwise reject the request or hire additional cars. Usually, requests are not fulfilled without interruption but split into shunting units, each of which can be seen as an unsplitable duty element for the performing locomotive.

The design of shunting units naturally decomposes into two levels. At an upper level, a rough distribution of cars from one region to another takes place. Here, the underlying model merely is a transportation problem, but immediate extensions are NP-hard. At a lower level, for each region, a collection of shunting units which fulfill the demand for each car type is sought, minimizing the total amount of shunting. The corresponding problem is shown to be NP-hard. We present simple approximation algorithms and an exact integer program for the lower level. Encouraging computational experience is given. We conclude with potential further research directions and how to install our work in practice.

Minimum Turn Cycle Covers in Grid Graphs

Marco E. Lübbecke Mo 14:00 - 14:30, Room HS B
Gunnar W. Klau

We are given a node induced subgraph G of the integer lattice (an "orthogonal grid graph"). We seek a cycle cover of G, that is, a collection of cycles such that each vertex is contained in at least one cycle. The objective is to minimize the total number of bends or turns the cycles make. Each change of direction at a vertex by 90 degree counts as one turn. This problem arises as a subproblem in finding a minimum turn covering tour in grid graphs. The latter problem is known to be NP hard. We give some intuition about our problem which gives rise to our conjecture that the cycle cover problem be NP hard as well. We present natural integer programming formulations. We study solutions from the linear programming relaxation of one of the models, and we deduce conditions under which this relaxation yields a 2-approximation algorithm. In a problem variant, the minimum turn cycle partition problem, we require each vertex to be contained in exactly one

cycle. That is, we seek a minimum turn 2-factor of G. We prove that the optimal face of the associated polytope is integral (even though the polytope itself is not!). A related set partitioning formulation of the cycle partition problem may in fact be the key to a combinatorial polynomial time algorithm.

Scheduling Preemptable Malleable Tasks

Maciej Machowiak Mo 16:30 - 17:00, Room HS C
J. Blazewicz, M.Y.Kovalyov, D. Trystram, J. Weglarz

The problem of optimal scheduling n independent tasks in a parallel processor system is studied. The tasks are malleable, i.e. a task may be executed by several processors simultaneously and the processing speed of a task is a non-linear function of the number of processors allocated to it. The total number of processors is m and it is an upper bound on the number of processors that can be used by all the tasks simultaneously. It is assumed that the tasks are preemptable and the number of processors to one task allocated may change during its execution. The objective is to find a task schedule and a processor allocation such that the overall task completion time, i.e. the makespan, is minimized. The problem is motivated by real-life applications of parallel computer systems in scientific computing of highly parallelizable tasks. An $O(n)$ algorithm is presented to solve this problem when all the processing speed functions are convex. If these functions are all concave the rectangles packing algorithm is presented, which solves the problem in polynomial time. A relaxed problem, in which the number of processors allocated to each task is not required to be integer, can be solved in $O(n \max\{m, n \log^2 m\})$ time. It is proved that the minimum makespan values for the original and relaxed problems coincide. This algorithm converts an optimal solution for the relaxed problem into an optimal solution for the original problem in $O(n^2)$ time.

Control of an Isolated Intersection During Hyper-congestion

David Mahalel Mo 16:30 - 17:00, Room HS 3
Irit Talmor

This paper presents an algorithm for the signal design of an isolated intersection (i.e. long queues can be accommodated) during severe conditions of congestion, characterized by long queues stretched over long distances and causing long delays and severe environmental damage. During these periods, the total effective green light is a scarce resource; its best allocation is crucial for the operation of the intersection and sometimes even for a large network. The aim of the procedure presented here is to maximize the average throughput of the intersection. By achieving this goal, the number of vehicles in the queue is reduced at the fastest rate, and the period of congestion is shortened. The maximum throughput is proved to be gained when the marginal saturation flow of each phase is equal to the average throughput. The algorithm developed takes into account the decay of the saturation flow during long periods of green.

Delayed action and the stability of dynamical systems in Hilbert spaces

Miklavz Mastinsek We 14:30 - 15:00, Room HS 7

The objective of this paper is to study the effect of the delayed action to the long term stability of the dynamical system described by the delay differential equation DDE:

$$\begin{aligned} &du(t)/dt = Au(t) + Bu(t-h) + (a * Cu)(t) \\ &u(0) = x \\ &u(s) = y(s) \qquad s \in [-h, 0) \end{aligned}$$

where A is the infinitesimal generator of a strongly continuous semigroup in a Hilbert space X while B and C are densely defined closed operators in X. The convolution term contains a square integrable real function $a \neq 0$ and h represents the maximal delay. Thus the stability results obtained for the DDE can be applied to partial integrodifferential equations with delays appearing even in the first or second order derivatives.
The main objective is to consider the following question: Suppose that the nondelayed system is stable ($h = 0$). Does it remain stable if the action is delayed ($h > 0$)? We treat here three different cases: the case where only discrete delay appears in equation ($C = 0$), the case where only distributed delay appears ($B = 0$) and the case where both the discrete and the distributed delay appear in the equation ($B \neq 0$ and $C \neq 0$). In order to get stability results for these equations we associate with the DDE the solution semigroup $T(t)$ given by: $T(t)(x, y) = (u(t), u_t(.)) \quad t \geq 0$ for every $(x, y) \in Z$, where Z is the apropriate subspace of the product space $X \times L^2(-h, 0; X)$. Here u_t represents a segment of u given by $u_t(s) = u(t + s),\ s \in [-h, 0]$. By studying the characteristic operators $\triangle(\lambda)$ associated with the infinitesimal generator Λ of the solution semigroup $T(t)$ we can obtain the necessary information on the spectrum of Λ.
We obtain the necessary as well as sufficient conditions for the stability of the solution semigroup of DDE. Moreover we

can give conditions which guarantee that the system described by DDE remains stable even if the action of B is delayed for any time $h > 0$.

The Allocation of Storage Space in a Capacitated Multi-Period Transshipment Problem

Dirk Christian Mattfeld Tu 17:30 - 18:00, Room HS 3

This contribution addresses the planning of transportation and storage capacity over time. Transshipment tasks compete for storage space in spatially distributed storage locations of finite capacity. Although the optimization model suggests to consider individual tasks, the Genetic Algorithm proposed evolves a capacity utilization strategy with respect to the periods considered. Based on these capacity specifications a construction heuristic decides upon the assignment of transshipment tasks to periods and performs the allocation of storage locations.

Stability and Interaction in Cellular Games

Alexander Mehlmann We 15:00 - 15:30, Room HS 5

Conways classical cellular automaton, widely known as the "game of life", is usually played on a cellular grid extending infinitely in every direction. In this paper we will restrict our attention to a special class of cellular automata simulating different modes of repeated play. Starting from a given one-shot game played by a finite population of agents living on line, i.e on a constrained or circular grid like game board structured by the classical definitions of neighborhood, we define transformation rules for cellular automata, which are determined by different modes of learning behavior. As a special case we also consider rules determined by the best-reply behavior in standard two-person symmetric bimatrix games.

A meaningful concept of solution for the underlying population games will necessarily include robustness against any possible unilateral deviation undertaken by a single player. The resulting process of cellular transformation is then analyzed and finally compared with the outcomes of more prominent evolutionary processes, such as the replicator dynamics or the KMR-model proposed by Kandori, Mailath and Rob.

Capital Market Efficiency – An Empirical Analysis of the Dividend Announcement Effect for the Austrian Stock Market

Roland Mestel
Henryk Gurgul, Christoph Schleicher Mo 14:00 - 14:30, Room E1.05

This study using daily stock returns of companies listed in the Austrian Traded Index (ATX) investigates the dividend announcement effect. In this context the semi-strong form of capital market efficiency hypothesis is examined for the Austrian stock market, i.e. the authors prove whether the market adjusts in an efficient manner to new dividend information. It is well known that dividends are an important signal from management to investors concerning the prospective development of the firm. Most dividend paying companies exhibit behaviour that results in constant dividend payouts that are increased only when management is relatively certain that the higher dividend payout can be maintained in the long run. Therefore a significant impact of dividend announcements on stock prices should be expected. The investigations were performed on the basis of approximately two hundred dividend announcements of cited companies between 1992 and 2002. These announcements were filtered by the authors from some thousands information included in the Factiva database. For each company the very first official announcement coming from the management of this company was found. The announcements were divided into several clusters depending on whether the dividends will be constant, increased or decreased compared to the dividends the year before. The autocorrelations in daily excess returns and changes in their variances conditional on the event (dividend announcement) under study is taken into account by selected time series models. Parameters of the applied models were estimated on the basis of a pre-event data window. Return forecasts were estimated for each day of the established event period and next abnormal returns and cumulative abnormal returns were derived. Finally relevant tests of significance concerning abnormal returns were applied in each cluster.

Innovation, Operations Research & Decision Support in the Military

Heiner Micko We 12:00 - 12:30, Room HS 10

Operations Research as a scientific discipline initially started some decades ago within the Military, focussing that time on logistics and questions about effective distribution of ressources.

Nowadays Operations Research has won a strong role within nearly all fields of innovative economy, and has also gained a certain acceptance at different departments of the governments.

Military Applications of Operations Research recently include as well all topics of governmental Decision Support in peacetime as some more operational tasks of Decision Support in wartime and Wargaming Applications, the latter often being called – and mixed up with – Cyberwar.

Main purpose of Operations Research in the Military can be seen as a knowledge base for decisions, innovation and change management, promoting and helping decisions about organizational change.

This paper tries to explain the theoretical role of decision support within an innovation context, and to give some possible practical options for operations research in the Military.

Approximation algorithms for k-center problem: an experimental evaluation

Jurij Mihelic
Borut Robic

Th 11:30 - 12:00, Room HS C

In the paper we deal with the so called k-center problem, a problem which is a part of the discrete location theory. Informally, given a set of cities, with intercity distances specified, one has to pick k cities and build warehouses in them so as to minimize the maximum distance of any city from its closest warehouse. Formally, the problem is defined as follows. Let $G(V, E)$ be a undirected graph with edge costs satisfying the triangle inequality, and k be a positive integer not greater than $|V|$. For any subset S of V, and vertex v from V, we define $d(v, S)$ to be the length of a shortest path from v to S (i.e. to any vertex in S). The problem is to find such an S, where $|S| = k$, which minimizes $\max\{d(v, S)\}$, v in V. The problem is known to be NP-hard on general graphs $G(V, E)$.

In the paper we examine several approximation algorithms that achieve approximation factor of 2 as well as other heuristic algorithms. In particular, we focus on the clustering algorithm by Gonzalez, and the parametric pruning algorithm by Hochbaum-Shmoys. We also examine an approximation algorithm that we developed on Shmoys' algorithm for the decision version of the k-center problem. We examined several versions of Gonzalez algorithm (e.g. with computing 1-center, vertex scan, and random selection of the first node), Hochbaum-Shmoys algorithm (e.g. with different application of the maximal independent set algorithm) as well as our modification of the Shmoys (e.g. randomized, greedy). For the heuristic algorithms we discuss several variants of the greedy approach, a cluster-merging algorithm, and a solution-improving algorithm.

We have implemented and experimentally evaluated all the algorithms mentioned above on 40 standard test graphs. In the paper we discuss the experimental results and compare them with the results (for the same test set) found in the recent literature.

Decision Support for Cooperative Economic Ordering

Stefan Minner

We 11:30 - 12:00, Room HS 1

The paper presents model based decision support for the estimation and allocation of benefits from cooperative ordering. This addresses the issue of horizontal cooperations in supply chain management. Well known lot-sizing models are used as a basis to illustrate the incentives of one time joint orders and long-term sourcing agreements. Following concepts from game theory, the presented models provide insights into the impact of bargaining power, information asymmetry, transaction costs, quantity discounts, and terms of payment on decisions whether to initiate joint ordering, how to share ordering costs and discount benefits, and whether to accept received orders to jointly purchase requirements.

A Conjugate Direction Frank-Wolfe Method with Applications to Traffic Assignment

Maria Mitradjieva-Daneva
P. O. Lindberg

Mo 13:30 - 14:00, Room HS 3

We will present a version of the classical Frank-Wolfe method for linearly constrained convex programs, in which consecutive search direction are made conjugate to each other. We will also present preliminary computational studies in a MATLAB environment. In these we apply the classical Frank-Wolfe, the Conjugate Direction Frank-Wolfe (CDFW) and the PARTAN methods to some classical Traffic Assignment Problems. CDFW compares favorably to the other methods in this study.

Probabilistic Critical Path in Stochastic PERT

Davaadorjin Monhor Tu 9:00 - 9:30, Room HS C

The notion of critical path is a key issue in the temporal analysis of project scheduling modelled by CPM (Critical Path Method). Modelling durations of activities in stochastic PERT by random variables reflects well the inherent random nature of PERT. Because of presence of randomness, however, there arise a number of difficulties concerning the conversion of deterministic notion of critical path to stochastic one. In the present paper we introduce a new notion termed probabilistic critical path and develop bounds and approximations for relevant probabilities.This new approach enables us to take into account the interdependence of random durations of paths and to treat them probabilistically. Also, numerical and illustrative examples will be presented.

Multiperiod Portfolio Optimization with Parallel Decomposition Algorithms

Hans Moritsch Th 9:30 - 10:00, Room E1.05

Financial management applications modelling realistic risk factors over many periods of time have to process large input data in scenario tree structures.

The Aurora Financial Management System under development at the University of Vienna is a decision support system for portfolio and asset liability management. In order find an optimal investment strategy, it solves a multistage stochastic optimization problem.

Based on a set of financial contracts, an investor chooses an investment strategy over a given planning horizon. Models taking into account many risk factors and transaction costs result in a computational complexity which requires high performance computing.

In this paper we present an optimization method based on the Nested Benders Decomposition algorithm. The whole optimization problem is represented as a set of local problems defined at nodes of a scenario tree. By iteratively solving and - through data exchange with neighbor nodes - modifying their local problem, all nodes contribute to the overall solution.

We present a parallel implementation of this technique in Java and compare a synchronous with an asynchronous version We will discuss in detail our implementation strategy and experimental results obtained on a Beowulf SMP-cluster as well as on a network of workstations.

Monte Carlo Methods for Establishing Solution Quality in Stochastic Programs

David Morton Mo 13:30 - 14:00, Room HS 9

The ability to determine whether a candidate solution is (or is not) an optimal, or near-optimal, solution plays a prominent role in optimization theory, methods and computation. Many stochastic programs can be categorized as linear programs, smooth nonlinear programs, nonsmooth convex program, etc. So, optimality conditions for stochastic programs can frequently be borrowed from their deterministic counterparts. The pitfall with this approach is that for all but the simplest of stochastic programs, the function values and (sub)gradients needed to test these conditions cannot be computed.

We describe a statistical procedure for testing the quality of a feasible candidate solution for an important class of stochastic programs. Quality is defined via the so-called optimality gap and the output of the proposed procedure is a confidence interval on this gap. Two Monte Carlo simulation-based tools are proposed to make the procedure efficient and to tighten the width of the resulting confidence interval. Specifically, an asymptotically valid confidence interval is constructed using a single replication (instead of multiple replications) and a generalized jackknife estimator is used to reduce bias.

Ansätze zur räumlichen Ausbauoptimierung von Fernwärmenetzen

Petra Mutzel Mo 17:30 - 18:00, Room HS 6
Johannes Hackner, Gunnar Klau, Gabriele Kodydek, Ivana Ljubic, Andreas Moser, Philipp Neuner, Günther Raidl, Martin Schönhacker, Rene Weiskircher

Im Bereich der Wohnungsbeheizung gewinnt komfortable Fernwärme in Österreich immer mehr an Marktanteil. Insbesondere der Trend zur Nutzung heimischer Biomasse läßt immer neue örtliche Fernwärmesysteme entstehen, wobei viele dieser Fernwärmeversorgungen an der Grenze zur Wirtschaftlichkeit operieren. Durch eine optimale Ausbaustrategie lassen sich Planungs-, Bau- und Betriebskosten minimieren und somit die Wirtschaftlichkeit absichern. Betrachtet man ein ausgedehntes Fernwärme-Hoffnungsgebiet aus planerischer Sicht, so kann man leicht feststellen, daß die gewinnoptimale Auswahl der zu versorgenden Kundenobjekte und die Auswahl der zu verrohrenden Straßenabschnitte ein sehr komplexes Optimierungsproblem darstellt, das sich als ein Graphenproblem formulieren läßt.

Gegeben sei ein Graph $G = (V, E)$ mit einer Menge V von Knoten und einer Menge E von Kanten, die den Trassen entsprechen. Jede Trasse besitzt eine Länge. Gegeben sei weiters eine ausgezeichnete Teilmenge K von V, die den potentiellen Kunden entsprechen. Jeder Kunde besitzt ein Wärmepotential. Weiterhin gibt es eine ausgezeichnete Teilmenge S

von V, die den Energiewandlern (Sources) entspricht. Gesucht ist die optimale Kundenauswahl K^* aus K und die optimale Trassenauswahl E^* aus E, die zusammen die Wirtschaftlichkeit maximieren.

Wir experimentieren mit verschiedenen Zielfunktionen, (u.a. die Maximierung des Wärmebelags) und zeigen erste experimentelle Ergebnisse, die auf Ideen von Verfahren zur Lösung des "Prize-Collecting Steiner-Tree Problems" in Graphen basieren.

Fund of Funds: Information for Fund-Picking, An Empirical Study

Alexander Mylius
U. Leopold-Wildburger, J.H. Schuetze

We 11:30 - 12:00, Room HS 5

We examine the information used for fund-picking for fund-of-funds. The pre-test includes Austrian bank managers and fund managers. The questionnaire consists of four sections, asking for criteria and their relevance:

1. Personal data of the interviewed person and the employer
2. General information about available funds
3. Company communication as a source of information
4. Fund consultant as a source of information

The project is work in progress.

Keywords: Opinion poll, forecasting
JEL-classification: C91, C53

Minimizing Total Weighted Tardiness on Parallel Batch Process Machines Using Genetic Algorithms

Lars Mönch
Hari Balasubramanian, John Fowler, Michele Pfund

Tu 9:00 - 9:30, Room HS 4

We present a method to solve batch scheduling problems with incompatible job families for parallel machines. Problems of this type arise, for example, in the diffusion process in semiconductor manufacturing and have great practical relevance. We extend previous research on the single machine case [1,3] to the more general parallel machine case. Because the problem is NP-hard, we decompose the problem. We suggest a four-phase algorithm. In the first phase we form batches using the dispatch heuristics ATC and EDD. Then we use a genetic algorithm in order to assign the batches to the parallel machines in a second phase. Because we need a complete schedule in order to evaluate the fitness function of the genetic algorithm we have to sequence the batches on each single batch process machine. For that purpose we perform experiments with various heuristics, including the ATC rule, the EDD rule and a sequence decomposition method due to Mehta and Uszoy [2] (third phase). In order to improve the objective function value we use the swap procedure suggested in [1] for all batches of a family across machines and in a second experiment only for the batches of each single batch machine. We report on computational experiments based on generated test data.

References:

[1] Devpura, A., J. W. Fowler, M. W. Carlyle, I. Perez. 2000. "Minimizing total weighted tardiness on single batch process machines with incompatible job families". Proceedings Symposium on Operations Research, 366-371.

[2] Mehta, S. V., R. Uzsoy. 1998. "Minimizing total tardiness on a single batch processing machine with incompatible job families." IIE Transactions, 30, 165-178.

[3] Perez, I., J. W. Fowler, M. W. Carlyle. 2002. "Minimizing total weighted tardiness on a single batch process machine with incompatible job families", submitted to Computer and Operations Research.

Non-linear programming in a decision support tool for electric utility planning in liberalised energy markets

Dominik Möst
Wolf Fichtner, Otto Rentz

Mo 13:30 - 14:00, Room HS 6

The world wide liberalisation of energy markets has far-reaching implications for energy utilities. Competition on national and supranational level leads to a situation in which strategic planning tasks such as capacity expansion and long term production planning become increasingly important for energy utilities. Motivated by the deregulation, an energy and material flow model has been developed to give decision support for strategic planning of energy utilities in liberalised energy markets. The model determines the "optimal" structure of the future energy system of an utility for a typical time horizon of about 20 years considering environmental constraints. So far the model employed a mixed-integer linear programming approach and was successfully used to support European energy utilities. In order to achieve a better

description of technical coherences a non-linear optimisation approach has now been implemented. Furthermore, by using non-linear programming the models can be simplified through the direct formulation of non-linear technical coherences, because no circumstantial approximations are needed. Therefore, several non-linear coherences with regard to the target function and constraints have been integrated in the model:

- a price-demand function in the target function,
- a profitability maximisation as target function instead of profit maximisation,
- an efficiency depending on the load of a power plant as constraint.

Because there are different methods for solving non-linear models, for each type of problem an adequate solver had to be detected. In this paper different classes of models will be analysed and several solvers will be tested. By comparing the non-linear model with the mixed-integer linear model the advantages and disadvantages of both methods in a decision support tool for electric utility planning will be discussed.

Decomposition Method for Bounding Expectations of Multivariate Higher Order Convex Functions of Discrete Random Variables Based on Moment Information

Gergely Nagy Mo 14:30 - 15:00, Room HS 9

The multivariate discrete moment problem (MDMP) has been formulated as a methodology to find the minimum and/or maximum of the expected value of a function of a random vector, the support of which is a known discrete (usually finite) set. The vector has unknown probability distribution, but some of the moments are known. The moments may be binomial, power or of more general type. The MDMP has been initiated by Prekopa who developed a linear programming theory and methodology for the solution of the univariate discrete moment problems (DMP's) as well as MDMP's, under some assumptions that concern the divided differences of the function. The central results in this respect are the theorems which characterize the structures of the dual feasible bases. These bases provide us with the bounds. In case of DMP, Prekopa has found all the dual feasible bases if a given order of divided differences of the function are nonnegative. Based on them we can obtain the sharp bounds by the use of numerically stable dual algorithms. In case of MDMP's, there is no general dual feasible basis characterization theorem. However, Nagy and Prekopa have found a variety of dual feasible bases for the case, where all divided differences of a given total order and further divided differences in the individual variables, are known. In addition, they worked out an algorithm to find further dual feasible bases for bivariate DMP's, providing us with good bounds. In this paper a decomposition type method is presented for bounding the problem, based on some dual feasible basis information. We also show that our method is more efficient in this case, than the former methods, which give bounds by-passing the numerical difficulties arising because of the badly conditioned matrix of the constraints.

Optimization on OC-convex sets

Vladimir Naidenko We 17:30 - 18:00, Room HS 8

In the paper, we consider directional convexity that generalizes the concept of classical convexity. It arises in problems of image processing, databases, VLSI design, etc. Let O be a set of vectors in $\mathbb{R}^n$. A set $C \subset \mathbb{R}^n$ is called O-convex (directional convex) if for any two points $x_1, x_2 \in C$ such that the segment $[x_1, x_2]$ is parallel to some nonzero vector of O, we have $[x_1, x_2] \subseteq C$.

A semispace of directional convexity (at a point $a \in \mathbb{R}^n$) in the form $\mathbb{R}^n \setminus (a + C)$ is called a OC-cemispace, where C is an acute convex cone. The pair $(\mathbb{R}^n, OC)$ yields OC-convexity, if OC contains only the following sets: 1) $\mathbb{R}^n$, 2) all OC-semispaces, 3) the intersections of arbitrary OC-cemispaces. A point set $A \neq \mathbb{R}^n$ is called OC-convex, if it is defined as the intersection of appropriate OC-cemispaces.

By (x, y) we denote the scalar product of vectors $x, y \in \mathbb{R}^n$. Let A be an arbitrary compact OC-convex set in $\mathbb{R}^n$. We consider the following optimization problem

$$\begin{array}{l}(a, x) \to \max \\ x \in A,\end{array} \tag{1}$$

where a is fixed and x is a variable vector.

A point $a \in A$ is called OC-extreme for A, if there exists an OC-semispace S_a^{OC} at the point a, such that $S_a^{OC} \cap A = A \setminus \{a\}$. Let O be any infinite set of vectors in $\mathbb{R}^n$. Then the following theorem holds.

Theorem. There exists at least one OC-extreme point a for A, which is a solution to problem (1).

Research supported in part by INTAS (Project 00-217).

The Structure of Optimal Decision Rules in the European Monetary Union

Reinhard Neck Mo 17:30 - 18:00, Room HS 7
Doris A. Behrens

This paper makes use of dynamic game theory to consider interplay and dependence between the decision-makers in a monetary union - where each country is characterized by a stylized time-discrete macroeconomic system - and to determine their choices of optimal control strategies. We show why different solution concepts for the dynamic game between the common central bank and the national fiscal policies result in conflicts and how they can be resolved by means of the OPTGAME algorithm. These results are applied to current political issues in the European Economic and Monetary Union (EMU).

Die Modellierung bedingter Schiefe in Finanzzeitreihen

Michaela Nettekoven We 14:30 - 15:00, Room E1.05

Asymmetrische, zeitabhängige Volatilität hat in der Literatur große Beachtung gefunden. Hingegen wurde die Schiefe eher vernachlässigt, obwohl es allgemein bekannt ist, daß wichtige ökonomische Variablen wie Aktienrenditen oder Wechselkursänderungen eine schiefe (d.h. nicht symmetrische) Verteilung aufweisen.

In der jüngeren Literatur existieren verschiedene Ansätze zur Modellierung zeitabhängiger, bedingter Schiefe. In dieser Arbeit wurde die Methode von Harvey und Siddique (1999) angewendet: In einem GARCH Modell wird zusätzlich zur Gleichung für die Varianz eine Gleichung für die Schiefe eingeführt. In jedem beobachteten Zeitpunkt werden die Momente der Verteilung gemäß dieser Gleichungen ermittelt und so die Verteilungsparameter berechnet. Mit diesem Modell wurden die tägliche Renditen von deutschen und englischen Aktienindizes geschätzt.

Vergleicht man die Ergebnisse dieses Modells mit jenen von Standard-Volatilitätsmodellen wie GARCH oder TARCH, so zeigt sich, daß durch die explizite Berücksichtigung der bedingen Schiefe die bedingte Varianz ein fast konstantes Verhalten aufweist. Der Likelihood-Ratio-Test zeigt deutlich, daß dieses neue Modell einem Standard GARCH oder TARCH Modell vorzuziehen ist.

Mathematical Programming Models for Strategic Supply Chain Planning and Design

Stefan Nickel Mo 17:30 - 18:00, Room HS 1
M. Teresa Melo, Jörg Kalcsics

Although facility location and configuration of global manufacturing and distribution networks have been studied for many years, a number of important real world issues have not received adequate attention in the literature. For example, the supply chain structure typically consists of arborescent structures usually limited to at most two echelons, a system of distribution channels between these echelons, and a relatively simple cost structure. Our objective is to fill this gap by proposing realistic models for the strategic planning and design of global supply chains. Our main concern is to provide comprehensive models which explicitly capture the essential elements of many industrial environments.

We consider a general supply chain network where different products are delivered to satisfy the requirements of several customer zones. No restrictions are imposed on the number of different facility types and on the transportation channels used by the company for shipping its products. In other words, commodities can be transported between any type of facility. This allows, for example, the return of pallets or empties (e.g. bottles) to be modelled.

Each end product may have a bill of materials which describes the requirements for components, subassemblies and raw materials. In addition to production, commodities may be purchased from outside suppliers. The objective is to determine the optimal number of operating facilities and their locations, as well as the amount of products to procure, the amount of products to manufacture and the flow of products throughout the network in such a way that the overall costs are minimized subject to various side-constraints.

The presented model is now part of the software tool Supply Chain Design of the SAP AG which assists decisions-makers in the strategic planning and design of supply chain networks. Moreover, current extensions to this model are discussed.

State Estimation in Radial Distribution Networks

M. D. Nimrihter We 12:00 - 12:30, Room HS 9
G. Bojkovic, V. Bajovic, Z. Radojevic

The subject of this paper is application of short-term and long-term monitoring of currents on a small number of measuring positions aimed to obtain a picture of state (currents and voltages) in an overall distribution network. For the state estimation within a longer time period, the PC program, based on the Monte Carlo method, was developed. Quasi-statistical data of loads of consumer nodes are obtained by modeling of a real course of the hours change process of the

load current. The results are corrected by means of measured indices of power values on a small number of measuring positions. This calculation is done respecting a stochastic nature of load of consumer nodes and estimation of node voltages and currents in network sections. Proposed methodology is tested on a part of the real-life distribution network. The usage of permanent measurement of the section current extremely increase the quality of state estimation in the distribution network.

Minimum cost spanning tree games and population monotonic allocation schemes

Henk Norde
Stefano Moretti, Stef Tijs

We 12:00 - 12:30, Room HS 5

The objective in minimum cost spanning tree problems is the construction of a network of minimal cost which provides for every node in the network a connection with the source. An example of a minimum cost spanning tree problem is the problem of carpooling. Suppose that some employees of a firm consider the possibility of carpooling in order to reduce their daily travel cost. A spanning tree connecting these employees and the firm corresponds to a plan of carpooling.

Having solved the problem of finding a minimum cost spanning tree, i.e. an optimal plan of carpooling, the employees are confronted with the problem of how to divide the costs of this plan in a fair way. At this stage cooperative game theory enters the scene. The employees consider the associated minimum cost spanning tree game (Bird (1976)). One way of dividing the joint costs in a fair way is by means of a core allocation (Gillies (1953)), which is an efficient vector giving no subgroup an incentive to deviate. Bird (1976) showed how to compute a core element of a minimum cost spanning tree game. First one has to find a minimum spanning tree by means of Prim's Algorithm (Prim (1957)). Secondly the Bird rule assigns the cost of an edge which forms in some step of the algorithm to the node which gets a connection with the source in that same step.

Now suppose that a new employee is asking whether he can join the carpoolers. Application of the Bird rule to this new situation can yield an allocation in which one of the employees becomes worse off. Therefore, if the employees use the Bird rule in order to divide joint costs, some employee can veto the entrance of new carpoolers.

The central question in this paper is whether every minimum cost spanning tree game has a population monotonic allocation scheme (pmas) (Sprumont (1990)), which is an allocation scheme that provides a core element for the game and all its subgames and which, moreover, satisfies a monotonicity condition in the sense that players do not have to pay more in larger coalitions. We will answer this question in the affirmative and we will provide the Subtraction Algorithm, that computes for every minimum cost spanning tree game a pmas. We will show that this algorithm is closely related to Kruskal's algorithm for finding a minimum spanning tree (Kruskal (1956)). The Subtraction Algorithm is based upon a decomposition theorem, which shows that every minimum cost spanning tree game can be written as a nonnegative combination of minimum cost spanning tree games with $0-1$ cost functions.

References

Bird, C.G. (1976), On cost allocation for a spanning tree: A game theoretic approach, Networks 6, 335-350.

Gillies, D.B. (1953), Some theorems on n-person games, Ph.D. Dissertation, Princeton University Press, Princeton, New Yersey.

Kruskal, J.B. (1956), On the shortest spanning subtree of a graph and the traveling salesman problem. Proceedings of the American Mathematical Society 7, 48-50.

Prim, R.C (1957), Shortest connection networks and some generalizations. Bell Systems Technical Journal 36, 1389-1401.

Sprumont, Y. (1990), Population monotonic allocation schemes for cooperative games with transferable utility, Games and Economic Behavior 2, 378-394.

A Multilevel Scheme for the Travelling Salesman Problem

Bouhmala Noureddine

Tu 12:00 - 12:30, Room HS B

In this paper, we will introduce a multilevel scheme for the traveling salesman problem. The methos starts by reducing the problem into a sequence of smaller problems, find a tour at the lowest level, and finally proceed by an improvement phase at each level of the expansion phase.

Optimal Pricing of a Product which Diffuses in Rich and Poor Populations

Andreas J. Novak
Richard F. Hartl, Ambar G. Rao, Suresh P.Sethi

Mo 16:30 - 17:00, Room HS 7

We consider a market consisting of two populations, termed rich and poor for convenience. If a product is priced such that it is very expensive for the poor, but affordable to the rich, then it becomes a status symbol for the poor and this makes

it more desirable for the poor. At a lower price the product is affordable by both populations. However, as more of the poor buy the product, it ceases to be a status symbol and becomes less appealing to the rich. We present a two-state non-linear optimal control problem that aims to obtain profit-maximizing prices over time in this environment. We find that there are three categories of optimal price paths. One is status symbol pricing with high initial price, declining over time. The other two are mass market pricing, with price declining in one, and increasing and then decreasing in the other.

Dying out or dying hard? Disposition investors in stock markets

Andreas Oehler Mo 14:30 - 15:00, Room E1.05
Klaus Heilmann, Volker Läger, Michael Oberländer

Prior research documents that many investors disproportionaly hold on losing stocks while selling stocks which have gained value. These systematic behavior is labeled the "disposition effect". The phenomenon can be explained by prospect theory's idea that subjects value gains and losses relative to a reference point like the purchase price, and that they are risk-seeking in the domain of possible losses and risk-averse when a certain gain is obtainable. Our experiments were designed to test whether individual-level disposition effects attenuate or survive in a dynamic market setting. We analyze a series of 36 stock markets with 490 subjects. The majority of our investors demonstrate a strong preference for realizing winners (paper gains) rather than losers (paper losses). We adopt different reference points and compare the behavioral patterns across three main trading mechanisms, i.e. rules of price formation. The disposition effect is greatly reduced only within high pressure mechanisms like a dealer market when the last price is assumed as a reference point which is a more market driven (external) benchmark. If disposition investors use the purchase price as a reference point which is a more mental-accounting driven (internal) benchmark they are dying hard in all market settings.

Production in Oligopoly with Intertemporal Demand Interactions

Koji Okuguchi Mo 17:00 - 17:30, Room E0.05
Ferenc Szidarovszky

In dynamic situationss with more than one period of production, the product price in one period is likely to depend on the denmands in more than one period. In this paper we will formulate a dynamic programming model for firms' optimal output strategies in oligopoly with intertemporal demand interactions. We will identify the equilibrium industry output in each production period with a unique fixed point for a function involving only the industry output. The firms' subgame perfect equilibrium outputs are determined taking into account the relationships between individual firms' outputs and the industry output. Our new approach for deternmining the equilibrium industry output in each period will allow us to easily analyze a general case of nonlinear (inverse) demand functions

---

The complexity of some problems on maximal independent sets in graphs

Yury Orlovich We 14:00 - 14:30, Room HS B
Igor Zverovich

Let $mi(G)$ be the number of maximal independent sets in a graph G. A graph G is mi-minimal if $mi(H) < mi(G)$ for each proper induced subgraph H of G. The problem of determining the maximum value of $mi(G)$ for a general graph G of order n was proposed by Erdos and Moser and solved by Moon and Moser. In 1996, Jou considered the problem of determining graphs G satisfying $mi(G) = k$ for fixed k. It has been proved that every graph G without isolated or duplicated vertices has at most $2^{k-1} + k - 2$ vertices, where $k = mi(G) \geq 2$. Hence the extremal problem of calculating $m(k) = \max\{|V(G)| : G \text{ is a mi-minimal graph with } mi(G) = k\}$ has a solution for any $k \geq 1$. We show that $2(k-1) \leq m(k) \leq k(k-1)$ for any $k \geq 2$ and conjecture that $m(k) = 2k - 2$. As a corollary, we obtain that the class $IN(k) = \{G : mi(G) \leq k\}$ is hereditary for all $k \geq 1$ and that it has a finite forbidden induced subgraph characterization. In particular, the recognition problem $G \in IN(k)$ is solvable in polynomial time for any fixed $k \geq 1$. We also prove that the following problems are NP-hard.

MI-MINIMAL GRAPH
INSTANCE: A graph G.
QUESTION: Is G a mi-minimal graph?
MI-CRITICAL VERTEX
INSTANCE: A graph G and a vertex u of G.
QUESTION: Is it true that $mi(G - u) < mi(G)$?

Next, we discuss the complexity of some problems arising from the theory of partition graphs. These graphs recently have been characterized in terms of covers by universal cliques. A clique in a graph G is universal if it intersects all maximal independent sets of G. We prove that the problem NON-UNIVERSAL CLIQUE is NP-complete even when

the graphs in question are weakly chordal and therefore perfect. Finally, we present some complexity results concerning graphs in which every pair of maximal independent sets S and T satisfies $|S| \equiv |T| \pmod{m}$, where $m \geq 2$.

Research supported by INTAS (Project 00-217).

Stochastic Optimization of Long Term Contracts in a Central American Electricity Market with Multiple Future Uncertainties

Georg Ostermaier We 15:00 - 15:30, Room HS 6
Gido Haarbrücker, Karl Frauendorfer

Power providers all over the world face the liberalization of the electricity markets and have recognized that the probabilistic consideration of future uncertainties is crucial for efficient decision making. One of the most difficult decisions in the long term is how much energy to sell on the spot market and how much to contract bilaterally with the distribution companies or clients. The energy that is contracted at a fixed future price must be optimized with respect to hedging against low spot prices as well as to not losing opportunities in case of high spot prices.

We apply multistage stochastic programming with barycentric approximation of the multidimensional probability space. Besides the spot market prices, the demand of the system, the reservoir inflows and the strategy of the competitors is modelled stochastically. The result of the optimization is the weekly generation per plant as well as the optimal contract design over the year. The optimal first stage solutions take into account the stochastic dynamics of several future uncertainties as well as the rebalancing decisions at future stages.

We present linear and linear mixed-integer models that represent a power supply system as well as the relevant electricity market in Central America. Thereby we focus on the the optimal allocation of contracted energy within an annual planning horizon and its effect on the profit distribution. Recent results and experiences of the practical application of these models will be discussed.

On the Weighted Simultaneous Consecutive Ones Problem

Marcus Oswald Tu 17:30 - 18:00, Room HS C
Gerhard Reinelt

A 0/1-matrix has the simultaneous consecutive ones property if its columns and rows can be permuted in such a way that in every row and every column the ones occure consecutively. In this paper we present a branch-and-cut approach to optimize a given weight-function over all these matrices. Furthermore we give some theoretical results on this problem.

Sequence coordination in supply chains

Dario Pacciarelli Tu 11:30 - 12:00, Room HS 4
A. Agnetis, N.G. Hall

A critical issue in supply chain scheduling is the coordination of the decisions made by decision makers at different stages, for example a supplier and a manufacturer, within a supply chain.

Let $N = \{1, \ldots, n\}$ denote a set of jobs to be processed. A single supplier, S, supplies manufacturers $M_1, \ldots, M_G$. The time horizon is divided into T time slots. Processing of a job takes one time slot, for both the supplier and the manufacturer. If a job is not processed by the supplier and manufacturer in concecutive time slots, then it waits in an intermediate buffer of finite capacity b.

Both the supplier and each manufacturer have an ideal sequence in which they would like to process the jobs. An interchange occurs for the supplier (resp., the manufacturer) whenever job i is processed strictly before j, whereas in the ideal sequence of the supplier (resp., the manufacturer) j strictly precedes i. Without loss of generality, we let the cost of an interchange relative to an ideal sequence be 1. The cost of storing one job for one time slot in the buffer is denoted by w. The decisions to be made include finding an optimal supplier's sequence, an optimal manufacturer's sequence for the j-th manufacturer, $j = 1, \ldots, G$, or an optimal combined sequence.

We discuss properties of the optimal schedule and provide practical algorithms for several variations of these problems. These results suggest conditions under which collaboration between the supplier and a manufacturer improves their total profit, and mechanisms for collaborative cost sharing.

MCDM and Performance Measurement Using a Decision Model

Celik Parkan Mo 13:30 - 14:00, Room HS 10

We introduce a decision model that can be used for multi-criteria decision-making (MCDM), performance measurement, as well as decision-making under partial probability information. The model has two components: the loss or gain associated with the choice of a course of action when an event occurs; and the relative importance of loss or gain for the final decision with respect to an event. We show that this model can be constructed in various configurations depending on the definition of loss and gain to obtain different measurement procedures. Two particular configurations of the model lead respectively to data envelopment analysis (DEA) and the operational competitiveness rating (OCRA) procedure. We illustrate the application of the model by an example where we incorporate decision makers' pair-wise comparisons of the decision criteria into the computation of performance ratings.

Tabu Search Based on Lagrangian Relaxation for the Generalized Assignment Problem

Mikhail Paschenko
Yuri Kochetov We 14:30 - 15:00, Room HS 2

In the generalized assignment problem we are given the sets of jobs and agents. Each agent has a finite capacity. We wish to assign each job to exactly one agent so as to minimize total cost subject to the available capacities. A new two-stage heuristic for this problem is proposed. At the first stage, the Lagrangian dual problem is solved to obtain the lower bound and initial solution. The exact algorithm of Fayard and Plateau is used for the 0-1-knapsack problems. This algorithm is not polynomial, but as a rule it is faster than sorting. At the second stage a probabilistic tabu search algorithm is applied. Statistic information from the first stage is used to reduce the neighborhoods. The information is accumulated like in the Volume algorithm of Barahona and Anbil. Three types of neighborhoods are considered: 1. The shift neighborhood consists of the solutions that can be obtained by reassigning a job from one agent to another. 2. The double shift neighborhood consists of the solutions that can be obtained by successive reassigning two jobs. 3. The shift and swap neighborhood consists of the solutions that can be obtained by replacing a job with two jobs from another agent. The neighborhoods can include infeasible solutions. Moreover, for some instances feasible solution has infeasible neighborhoods. So we allow to explore infeasible region using a penalty function. This algorithm is tested on the instances from OR-Library. For small instances we often find optimal solutions. For large instances our approach allows to obtain solutions comparable with results of Yagiura, Ibaraki and Glover without complicated neighborhoods. In all the cases, the running times are sufficiently small.

Ein Verfahren zur Steuerung von flexiblen Mehrprodukt Produktionslinien

Henrik J. Paul
Christian Bierwirth, Herbert Kopfer Mo 16:30 - 17:00, Room HS 2

Als Produktionslinien werden Fließfertigungsanlagen bezeichnet, die mehrere Arbeitsstationen umfassen, wobei eine Zwischenlagerung der Werkstücke zwischen den Arbeitsstationen nicht möglich ist. Die Produktionslinie heißt flexibel, wenn die erforderliche Bearbeitungszeit der Werkstücke an den Arbeitsstationen durch Mindest- und Höchstzeiten vorgegeben wird. Aufgrund des Verbots der Zwischenlagerung von Werkstücken zwischen den Arbeitsgängen muss die Fördereinrichtung im Rahmen der Steuerung der Produktionslinie als mögliche Engpaßressource berücksichtigt werden. Beispiele deratiger Produktionssysteme finden sich in der Leiterplattenherstellung und der Galvanisierung metallischer Bauteile.

In der Literatur wird fast ausschließlich der Einproduktfall behandelt. Die vorgeschlagenen Steuerungsverfahren zielen hier im Prinzip auf eine zyklisch wiederkehrende Bedienfolge der Arbeitsstationen durch die Forderressource ab. Im Mehrproduktfall ist dieser Ansatz zur Reduzierung der Lösungskomplexität aufgrund produktspezifischer Arbeitsgangfolgen nicht direkt anwendbar. Das einzige für diesen Fall bekannte Steuerungsverfahren generiert Permutationsablaufpläne, d.h. die Arbeitsstationen bearbeiten die eingelasteten Werkstücke in der gleichen Reihenfolge. Dieses Konzept dient ebenfalls der Komplexitätsreduzierung, es schließt aber potenziell zulässige und bessere Lösungen aus der Betrachtung aus. Dieser Beitrag stellt ein neues Steurungsverfahren für den Mehrproduktfall vor, das weder permutations- noch zyklusbasierte Beschränkungen vornimmt. In einer Simulationsstudie wird die Leistungsfähigkeit des vorgeschlagenen Verfahrens anhand von Fertigungsdaten aus dem Flugzeugbau evaluiert.

Exact and approximation algorithms for a two-machine flow shop with a single robot

Grzegorz Pawlak
Jacek Blazewicz, Andrzej Krygier, Frank Werner Tu 14:30 - 15:00, Room HS C

In the paper the problem of a simultaneous scheduling jobs on two machines and a single robot have been considered. The motivation for this work was taken from the practically existing two-machine flexible manufacturing system. The

system consists of buffers: unlimited input and output buffers and limited transitional one. The considered model is defined as the two-machine flow shop with a transportation system represented by a single robot. Moreover, some of the jobs need for their execution additional operation called cooperative task. The cooperative task is placed between the first and the second operation on machines M1 and M2, respectively. The set-up times have been taken into account. The above scheduling problem is a generalisation of the known NP-hard problem of scheduling tasks in two-machine flow shop problem with a limited intermediate buffer and the schedule length criterion.

The branch and bound method, tabu search algorithm, and some greedy-like heuristics have been constructed for above formulated problem. The computational experiment comparing the efficiency and quality of the algorithms mentioned has been presented.

Constraint Propagation and Problem Decomposition: A Preprocessing Procedure for the Job Shop Problem

Erwin Pesch
Ulrich Dorndorf, To'an PhanHuy

We 15:00 - 15:30, Room HS 4

In recent years, constraint propagation techniques have been shown to be highly effective for solving difficult scheduling problems. We present an algorithm which combines constraint propagation with a problem decomposition approach in order to simplify the solution of the job shop scheduling problem. This is mainly guided by the observation that constraint propagation is more effective for 'small' problem instances. Roughly speaking, the algorithm consists of deducing operation sequences that are likely to occur in an optimal solution of the job shop scheduling problem (JSP). The algorithm for which the name edgeguessing procedure has been chosen – since with respect to the job shop scheduling problem (JSP) the deduction of machine sequences is mainly equivalent to orienting edges in a disjunctive graph – can be applied in a preprocessing step, reducing the solution space, thus speeding up the overall solution process. In spite of the heuristic nature of edgeguessing, it still leads to nearoptimal solutions. If combined with a heuristic algorithm, we will demonstrate that given the same amount of computation time, the additional application of edgeguessing leads to better solutions. This has been tested on a set of wellknown JSP benchmark problem instances.

Optimization In The Liberalized Energy Market

Gerold Petritsch

We 14:00 - 14:30, Room HS 6

In many European countries the electricity market has been liberalized during the last decade. The demand for optimization tools has changed: instead of minimizing costs we have to maximize profit. The market prices of electricity in the (long term) forward and the (short term) spot market can be used as a benchmark for marginal costs of generation for each period - in economics this is the equilibrium point of demand and supply. This leads to a decomposition of the production units, which on the one hand makes optimization easier. On the other hand, however, we run additional risks: while in earlier years we only had to cover the uncertainty of demand and supply (risk of quantity), we now also have to face price risks, because traded standard products cannot precisely match actual demand. The modelling of these risks requires powerful stochastic optimization procedures. The lecture will treat the optimization of production with special emphasis on thermal - heat-combined cycle - power plants. By using stepwise quadratic production curves fast and accurate algorithms can be constructed. Some practical applications will also be demonstrated.

The Subset Sum Heuristic for Bin Packing

Ulrich Pferschy
Alberto Caprara

Mo 13:30 - 14:00, Room HS B

We analyze the worst-case ratio of a natural heuristic for the bin packing problem, which proceeds by filling one bin at a time, each as much as possible. This is a natural pseudopolynomial-time heuristic that has been considered in a few papers. It runs fast in practice and gives on average better solutions than other fast heuristics like FF or FFD.

Graham pointed out in 1972 that the worst-case ratio of this heuristic is at least $\sum_{k=1}^{\infty} \frac{1}{2^k-1} = 1.6067\ldots$. In this paper, we show a nontrivial upper bound of $4/3 + \ln(4/3) = 1.6210\ldots$, thus determining the exact value of the worst-case ratio within a relative error smaller than 1%.

This bound is obtained by analytically solving a suitable (nonlinear) mathematical program. We also discuss how the lower and upper bounds extend to the case in which the maximum item size is bounded. It is shown that the worst-case ratio of our heuristic is sandwiched between those of every any fit decreasing and every any fit heuristic, respectively, for any value of the maximum size.

We also consider natural generalizations where priority is given to the packing of the large items, for which we can show a nontrivial upper bound of $13/9 = 1.4444\ldots$ on the worst-case ratio as well as some lower bounds.

Mehrperioden-Risikomaße und konvexe Optimierung

Georg Pflug Tu 15:00 - 15:30, Room E1.05

Typische stochastische Optimierungsmodelle der Finanzplanung enthalten Return- und Risikoziele: Der Return soll maximiert und das Risiko minimiert werden. Diese einander widersprechenden Ziele müssen miteinander in Einklang gebracht werden. Dies geschieht dadurch dass man entweder das Risiko bei gegebenem Return minimiert, oder einen risikobereinigten Return maximiert.

Für Mehrperiodenmodelle entsteht das Problem der Definition von Mehrperiodenreturns und Mehrperiodenrisikos. Es ist oft nicht sinnvoll, nur terminale Werte (terminal wealth, terminal risk) zu vergleichen. Der Mehrperiodenreturn wird als erwarteter, abgezinster Return definiert. Schwieriger ist die Messung des Mehrperiodenrisikos. Dieser Vortrag stellt einige Konzepte für diese Messung vor und zeigt, unter welchen Bedingungen die resultierenden Optimalitätsprobleme auf konvexe mathematische Programme führen. In speziellen Fällen sind die resultierenden Programme sogar linear oder quadratisch. Konkrete Beispiele erläutern die Methode.

Einsatz innovativer Planungsmodelle zur Unterstützung des Advanced Available to Promise

Richard Pibernik Tu 17:30 - 18:00, Room HS 2

Available to Promise- (ATP-) Systeme unterstützen den Entscheidungsträger bei der Bestimmung von Lieferterminen und -mengen für Endprodukte auf Basis von Kundenanforderungen. Die Kundenanforderung läßt sich durch das nachgefragte Endprodukt, die nachgefragte Quantität des Endproduktes sowie ein vorgegebenes Lieferzeitintervall spezifizieren. Der Hersteller des Endproduktes muß über die Annahme oder Ablehnung des Kundenauftrages entscheiden, d.h. es ist zu prüfen, ob der Kundenauftrag gemäß den Kundenanforderungen erfüllt werden kann. Diese Prüfung erfolgt entweder auf Basis der geplanten, im Lieferzeitintervall disponierbaren Lagerbestände des Endproduktes oder auf der Basis der verfügbaren Ressourcen für die Herstellung und die rechtzeitige Auslieferung des Endproduktes. Bei einer Annahme des Auftrages ist für den Kunden ein verbindlicher Liefertermin innerhalb des vorgegebenen Lieferzeitintervalls zu bestimmen, dem Kunden mitzuteilen, die benötigten Endprodukte bzw. Ressourcen zu reservieren und ggf. ein Produktionsauftrag zu generieren. Der Bestimmung von realisierbaren Lieferterminen und der Einhaltung der Lieferterminzusagen kommt eine entscheidende Bedeutung bei der Gestaltung von wettbewerbsfähigen Supply Chains zu. ATP-Systeme bilden eine wichtige Schnittstelle zwischen dem Produktions- und Logistikmanagement und dem auf der nachgelagerten Stufe der Supply Chain befindlichen Kunden. ATP-Systeme übernehmen folglich eine wichtige Rolle bei der Koordination der Kundenanforderungen mit den Wertschöpfungsaktivitäten im Rahmen der Produktion- und Distribution. Im Rahmen des Beitrages werden innovative Planungsmodelle zur Unterstützung der Liefertermin- und Mengenplanung vorgestellt, die sich für eine Implementierung in Advanced ATP-Systemen eignen. Hierfür erfolgt zunächst eine theoretische Fundierung von Ansätzen zur Bestimmung von Lieferterminen und -mengen. Es werden generische ATP-Typen identifiziert und kurz charakterisiert. Für ausgewählte ATP-Typen wird aufgezeigt, wie eine ATP-Planung durch geeignete Planungsmodelle unterstützt werden kann. Unter Einsatz der vorgestellten Planungsmodelle lassen sich für potenzielle Kundenaufträge Liefertermine bestimmen und alternative Maßnahmen bei temporärer Lieferunfähigkeit (z.B. Teillieferungen, Lieferung von Substitutionsprodukten, Lieferung von alternativen Produktions- und Lagerstandorten aus) generieren und bewerten.

Algorithmic Analysis of Expression Data with Polyhedral Structures

Stefan Pickl Tu 14:00 - 14:30, Room HS B

Many problems in the field of computational biology or computational finance ask for an analysis of so- called expression data. The succesful application of discrete optimization techniques and the exploitation of the underlying combinatorial structure can lead to a better understanding in that field. For the concrete example of DNA-expression data we extend an algorithm which was introduced by Brayton and Tong exploiting its combinatorial structure and symmetry properties of an inheritance labeling.

Existence and Algorithmic Determination of Core Elements exploiting Dualisation Theory

Stefan Pickl
Silja Meyer-Nieberg Mo 14:30 - 15:00, Room E0.05

Motivated by an economic example, we ask for the existence of core elements. A necessary and sufficient condition is derived by exploiting the special structure of related subsets of the core. Applying dualisation techniques, we develop an algorithm for the determination of such elements. The solution will be embedded in the software TEMPI (Technology Emissions Means Process Identification) as an instrument to simulate and optimize financial investments which will be presented at the end of the talk.

Implementing Supply-Chain Optimisation Models in an Algebraic Modelling Language

Sandip Pindoria Tu 14:30 - 15:00, Room HS 1

Supply-Chain Management solutions are increasingly utilising optimisation models to provide better decision making information.

We will discuss how supply-chain optimization models can be implemented in an algebraic modelling language, such as MPL, leading to reduced development times.

We will demonstrate a standalone supply-chain application written in Visual Basic that incorporates an optimisation model.

Model analysis and expectations of the causalities and cointegrations between some basic economic indicators -Case of Croatia-

Snjezana Pivac
Zdravka Aljinovic Tu 9:00 - 9:30, Room E0.05

Expectations can be defined, from the point of view of economy, as the forecasts of the future values of uncertain and fluctuating variables, such as future interest rate, prices, taxes etc. Indeed, they have been gaining the importance in contemporary economic theories. Aiming to explain in detail the elaboration of model, expectations and cointegrations between basic economic indicators, the cognition about fundamental elements of economic structure and their relationships as well as about basic principles and rules of operation of an economy (taken as an open complex system), seems to be of crucial importance. To this end, many different econometric studies on one hand, and studies regarding time-series analysis of the growth rates of the money supply and GDP, on the other hand, have been developed in economic theory. In addition, causality tests are taken in the case of stationary stochastic processes that, naturally, do have an implicit economic reason. Regression and error correction model (ECM) are applied to analyze long-term cointegrations between original economic time-series. In brief, taking into account principles of mathematical modeling as well as econometric and economic criteria, it is the authors' intention to investigate whether the correctly estimated parameters both illustrate properly the current conditions in the Croatian economy and allow the forecasts of their future trends.

Polynomially Solvable Cases of the Bilevel Programming Problems

Alexander Plyasunov
Yuri Kochetov Th 9:00 - 9:30, Room HS C

A new method of finding polynomially solvable cases of the bilevel programming problems using a decomposition of the feasible set is presented. The method is based on optimality conditions for parametrized lower problem and reduces the bilevel problem to a short sequence of the linear programming problems.

Let us consider the bilevel problem with linear objective function and linear constraints of the upper problem. These constraints contain both variables of upper and lower problems. It is shown that the bilevel problem is polynomially solvable if the lower problem is (i) the linear knapsack problem; (ii) the linear multiple-choice knapsack problem; (iii) a special case of nonlinear knapsack problem.

Polynomial-time approximation algorithms with performance guarantees are developed for the bilevel uncapacitated facility location problems. Sufficient conditions of polynomial solvability are presented.

Vintserving: new virtual technology of collective multi-discipline training and research in a service area

Olga Popova
Vyacheslav Filimonov We 9:00 - 9:30, Room HS 5

The general problem of high education in the service area is under consideration. The most complex part of it is a process of collective multi-discipline training and research. This process strongly depends on the qualities of a collective.

New author's method named "Virtual INformation Technology for SERVice area - VInTSERVing" have been proposed. The method generates some special system of tools, which is adequate to the collective and to the project of the collective as well. A special room named "EKRAN-service center" have been created for training and research activity of students and teachers.

Some projects for administrative decision making on a regional level such as monitoring of emergency state, training systems, system for strategic planning and management of city education are discussed.

Semidefinite Programming and some Economic Problems

Janez Povh Mo 14:00 - 14:30, Room E0.05

In this paper we show that many classes of optimization problems (linear programming, quadratic programming, fractional programming, ...), which arise naturally in economy, could be seen as a special case of semidefinite programming. We show also that that using semidefinite programming gives more accurate results for problems, which have to be linearized because of easier solving.

Ein Algorithmus zur sicheren elektronischen Stimmabgabe über das Internet

Alexander Prosser Tu 17:00 - 17:30, Room HS 6

Mit der zunehmenden Verbreitung des Internet stellt sich die Frage nach der Abwicklung demokratischer Abstimmungsprozesse über dieses Medium. E-Voting geht über die reine Automatisierung des Wahlvorganges in der Wahlzelle, etwa durch Touch-Screen-Terminals, hinaus, mit dem Ziel die Abwicklung rechtsgültiger, öffentlicher Wahlen über das Internet, beispielsweise vom Heim-PC aus, zu ermöglichen. Dabei müssen natürlich die Wahlrechtsgrundsätze eingehalten werden, insbesondere das Problem der absolut sicheren Identifizierung des Wahlberechtigten bei gleichzeitiger Anonymität in der Stimmabgabe ist hier zu lösen.

In einem grundlegenden Beitrag beschreiben Nurmi et al. die Elemente jedes e-Voting-Systems: Registration und Stimmabgabe. Der vorliegende Beitrag beginnt mit einer Übersicht über die in der Literatur vorgeschlagenen kryptographischen Algorithmen für diese beiden Funktionen und untersucht sie auf ihre Tauglichkeit für demokratische Wahlen. Die Diskussion kommt zum Schluß, daß die besprochenen Algorithmen (i) sicher sind, aber nur unbefriedigend skalierbar (bspw. ANDOS-Verfahren), oder (ii) sie die Anonymität in der Stimmabgabe nicht garantieren können (Verwendung von Zero-Knowledge Proof-Protokollen für e-Voting und Verfahren, die die Blind Signature von Chaum nutzen, aber beide Phasen in einem Schritt durchführen), oder (iii) das Problem "gelöst" wird indem für die Stimmabgabe die Existenz eines anonymen Kanals postuliert wird.

Im zweiten Teil beschreibt der Beitrag einen zweiphasigen Algorithmus auf Basis der Blind Signature nach Chaum, der das Ziel hat, sichere Identifizierung in der Registrationsphase und technische Garantie der Anonymität in der Stimmabgabe zu verbinden. Die Abwehr von Standardangriffen zum Durchbrechen der Anonymität und Integrität werden diskutiert.

Da Registrations- und Stimmabgabephase getrennt werden, muß die bei der Registrierung gelöste elektronische Wahlberechtigung zwischengespeichert werden. Abschließend diskutiert der Beitrag die bei der Zwischenspeicherung der Wahlberechtigung auftretenden Probleme.

The imitation analysis of the Product Sharing Agreement in contemporary Russia

Artem Protsenko We 9:30 - 10:00, Room HS 4

Given work is dedicated to the development of methods of economic evaluation for mineral deposits in contemporary Russia. The main idea is to calculate a natural rent on the basis of machine imitation of the mineral resource exploitation process by a rational investor in the framework of economic mechanism in the transit economy and in compliance with established trends reflecting the development on the world mineral markets. The primary attention is devoted to the analysis of influence of alternative basic models of the nature management – License Agreement in framework of today standard tax schema, or Product Sharing Agreement (PSA), creating the constant tax environment for the Investor reclaiming the deposit, on the complex economic evaluation of the mineral deposit. For this approach a detailed computer model of the process of a resource-processing unit was developed. Such unit is created by the Investor to perform full range of tasks starting from extraction, primary processing, transportation and to product realization under different price regulating norms. The proposed imitational model allows to imitate reaction of the management of the prototype object and give answers to the question: "What would be, if ...?" – productive approach mainly in the condition of transition period, when traditional forecasting methods based on extrapolation of current trends do not give the reliable results. Using this comparative analysis one can to determine the efficiency of varying tax environment for raw material projects and to show the diapasons of basic parameters of the PSA, effective from the Investor's point of view. Therefore, finding the "government" points that reflect in the best way possible to the interests of RF in this diapasons, we will achieve the rational compromise and create the prerequisites for the fundamental improvement of the investment climate in the country.

Competition and cooperation in non-centralized linear production games

Justo Puerto Th 9:00 - 9:30, Room HS 5
F.R. Fernandez, M.G. Fiestras-Janeiro, I. Garcia-Jurado

In this paper we consider non-centralized linear production situations. In one of those situations, each producer i of a set N has an optimal production plan x_0^i for a linear production problem given by $\max\{c^i x^i : A^i x^i \leq b^i, x^i \geq 0\}$. In

order to maximize the benefits, the producers decide to take profit of their surpluses $(b^1 - Ax_0^1, \ldots, b^n - Ax_0^n)$. We study the games which describe this interactive situation when players do not cooperate (section two), when players cooperate and side payments are possible (section three), and when players cooperate and side payments are not possible (section four).

Computing graph invariants

André Pönitz Th 10:00 - 10:30, Room HS C

The talk is about a method for the construction of algorithms for the computation of graph invariants that already has been applied successfully to various problems ranging from reliability measures over chromatic invariants up to the travelling salesman problem.

The main advantage of the method is the simplicity of the generated algorithms. The problem dependent part of such an algorihm often consists only of a few dozen lines of code leading to very short development times.

The generated algorithms are usually less efficient than fine-tuned hand-made algorithms, but in some cases they are on par or even surpass the latter.

During the talk algorithms for the graph and the list colouring problems are outlined.

A new model for the parallel machine lot-sizing problem

Daniel Quadt Th 9:00 - 9:30, Room HS 2

We present a new big bucket model for the single-stage, multi-product capacitated parallel machine lot-sizing problem with backorders, setup times and setup carry-over. Because of the intractability of the original problem, the model contains only a single machine explicitly. It accounts for the parallel resources implicitly by using fixed-step setup costs occurring whenever a parallel machine has to be set up for a product, avoiding the symmetry problem of traditional parallel machine lot-sizing models. Solution of the model are the production-, inventory- and back-order volumes as well as the number of machines used for each product in each period. A mixed integer formulation is presented which can be solved to optimality using a standard procedure (CPLEX) for real-life problems. An example solution is interpreted and numerical results are presented.

An optimal replacement policy using two stage markovian shock model

Abdur Rahim
S. N. Khursheed Mo 17:00 - 17:30, Room HS 2

The paper presents the problem of optimal determination of replacement time that offers the best trade-off between the cost of non-conforming items and the cost of tool replacement. If the tool is replaced too frequently, the resulting cost of replacement will be higher and the number of non-conforming items produced may be lower. On the other hand, if the tool is used for too long, the cost of replacement will be less but the number of non-conforming items produced may be more. The objective is to minimize the total tool related cost which includes the purchasing cost, material cost and the tardiness penalty cost of not meeting due dates. The work suggests an optimal replacement policy using a two stage markovian shock model. Application of the model is demonstrated through numerical illustration.

An ant colony heuristic algorithm to solve the water network design problem

Efstratios Rappos
Eleni Hadjiconstantinou Tu 15:00 - 15:30, Room HS B

We consider the problem of designing a reliable water distribution network. Given an undirected graph, the objective of the problem is to find a least cost network configuration such that the flow balance equations are satisfied and the network has a predefined degree of network reliability. The cost function for each edge is integer and consists of a fixed component and a variable component which is proportional to the flow passing through the edge. We present a heuristic algorithm based on the ant colony optimization system, together with preliminary computational results and a comparison with other techniques for solving the problem.

Modelling the effects of the Austrian inpatient reimbursement system on length-of-stay distributions

Marion Sabine Rauner Tu 11:30 - 12:00, Room HS 5
Achim Zeileis, Michaela-Maria Schaffhauser-Linzatti, Kurt Hornik

This paper analyses the effects of the new Austrian performance-oriented inpatient payment system on discharge strategies of hospitals by investigating length-of-stay (LOS) distributions. Using generalised linear models applied to data from 1998, we calculate the impact of day and month of admission as well as types of admission and discharge on the LOS of inpatients with major diagnoses. Hereby, we prove significant interdependencies among these variables and reveal hospital behaviour such as 1) premature discharges of inpatients or "unbundling" and 2) "patient splitting". Hence, our findings illustrate that hospitals perfectly react to incentives set by the new system in order to maximise their revenues which does not necessarily correspond with the overall aims of the new reimbursement system such as cost reduction and perpetuation of the high quality of health care. Our strategic policy model supports decision makers in disclosing these negative effects and provides policy implications to close exploitable gaps within the new reimbursement system.

Optimal time control for the model of a discrete accumulation process in transport

Julius Rebo Tu 14:30 - 15:00, Room HS 3
Ondrej Bartl

Successful effort to economize goods transport is a natural ambition of the management process in transport system operation. The system with the transport of elements (e.g. containers) has been considered in the paper. The elements arrive at the accumulation site according to a Poisson process and join the queue where they wait for a batch service. At most M elements are served, i.e. transported to the destination site, each T time units. As the servidce capacity limit M is finite, a rest of elements may stay waiting to be served later. The question to answer is how to choose the cycle length T if the associated costs incurred in accumulating and transporting elements should be minimized. This time control problem has been analysed in terms of a discrete-time Markov chain with a countable state space. The condition for the accumulation process stabilization has been formulated and the technique to compute the steady-state probabilities and performance measures has been revealed. The method to determine an optimal (continuous) values of the cycle length has been described in the paper when the expected average cost per element accumulated and transported has represented the criterion of interest. The cycle length optimization with respect to the expected average time consumption per element waiting in the queue has been discussed in the paper as well.

Zur Problematik der Auswahl geeigneter Input- und Outputfaktoren bei Leistungsvergleichen mit Hilfe der DEA am Beispiel von Fachhochschulbibliotheken in Deutschland

Gerhard Reichmann Tu 9:30 - 10:00, Room HS 5
Margit Sommersguter-Reichmann

Mit der Data Envelopment Analyse (DEA) hat sich in den vergangenen Jahren ein Verfahren etabliert, das einen Performancevergleich von Non-Profit Unternehmen basierend auf einem relativen, aggregierten Performanceindikator, dem DEA-Effizienzmaß, ermöglicht. Neben der Auswahl des zugrundeliegenden Modells wird dieses DEA-Effizienzmaß wesentlich von der Wahl der Input- und Outputfaktoren, also der Art und Anzahl dieser Faktoren abhängen. Es ist demnach sinnvoll, mit Hilfe von Sensitivitätsanalysen in Form von Effizienzvergleichen auf Basis variierender Input- und Outputfaktoren zu klären, ob das resultierende Effizienzmaß als stabil bezeichnet werden kann. Insbesondere wird dabei nicht nur auf die durchschnittlichen Ergebnisse auf Gruppenebene, sondern auch auf die Individualergebnisse zu achten sein. Im Rahmen der geplanten Untersuchung wird die Performance von 29 Fachhochschulbibliotheken in Deutschland mit Hilfe der DEA verglichen, wobei die Stabilität des Effizienzmaßes mit Hilfe einer Sensitivitätsanalyse untersucht werden soll. Im Rahmen dieser Sensitivitätsanalyse wird sowohl die Anzahl als auch die Art der einbezogenen Input- und Outputfaktoren variiert. Insgesamt werden 4 verschiedene DEA-Effizienzmaße berechnet und einander gegenübergestellt. Um etwaige Unterschiede zwischen den 4 verschiedenen Varianten nachhaltig bestätigen zu können, werden diese Vergleiche zusätzlich für drei verschiedene Jahre durchgeführt. Weiters wird untersucht, ob es – abhängig von der jeweiligen Variante – signifikante Produktivitätsunterschiede zwischen verschiedenen Typen von Fachhoch-schulbibliotheken, wie etwa "größeren" und "kleineren" Fachhochschulbibliotheken, gibt.

Savings based Ants divide and conquer the VRP

Marc Reimann We 15:00 - 15:30, Room HS 2
Karl Doerner

We propose a new Ant System algorithm for the Vehicle Routing Problem based on observations of the scaling behavior of our previous work on the Savings based Ant System (Reimann et al., GECCO 2002). The approach is also inspired by

and related to the work of Taillard (Taillard, Networks 1993). The main idea is to repeatedly divide solutions to VRPs into disjoint sets of tours and to solve the resulting sub-problems using the Savings based Ant System. We test the approach on the new large-scale VRP instances of Golden et al. and show that the algorithm is much more efficient than the embedded Ant System itself. Also, we show that the approach is competitive to other state-of-the-art techniques recently proposed.

Einsatz eines Simulationswerkzeuges im Zusammenhang mit Blended Learning

Torsten Reiners Tu 14:00 - 14:30, Room HS 8
C. Frank, I. Sassen, L. Suhl, S. Voß

Didaktische Lernmethoden unterliegen einem ständigen Wandel. Mit dem vermehrten Einsatz von neuen Medien wie z.B. virtuellen Lernumgebungen zeigen sich vermehrt Tendenzen zum so genannten Blended Learning, bei welchem verschiedenartige Lernmethoden und Lernkonzepte derart miteinander in Kombination gebracht werden, dass dem Lernenden ein bestmögliches Lernerlebnis geboten wird. In diesem Beitrag erweitern wir dieses Konzept dahingehend, dass neben der reinen Kombination auch eine Integration aller Lernmethoden mittels einer zu verwendenden Technologie erfolgen sollte, um dadurch ungewünschte Medienbrüche zu vermeiden. Anhand eines entwickelten Simulationswerkzeuges zeigen wir, inwieweit eine Lernumgebung sowohl für die Präsentation innerhalb einer Vorlesung als auch für ein Selbststudium mit oder ohne Führung, Klausuren oder kooperative Gruppenarbeiten Verwendung finden kann. Dabei ist insbesondere die Synchronisation der einzelnen Lernkomponenten von hoher Bedeutung, so dass z.B. in der Vorlesung verwendete Lernmaterialien in der dortigen Reihenfolge inklusive durchgeführter thematischer Exkursionen einen Einfluss auf die Lernmaterialien für das Selbststudium bzw. mögliche Skripte, Übungen oder Tests haben. Darüber hinaus stellen wir ein diskretes, ereignis-orientiertes Simulationswerkzeug vor, bei dem insbesondere pädagogische Aspekte im Vordergrund stehen, um in der Lehre die Abläufe und Zusammenhänge bei der Simulation zu verdeutlichen. Neben herkömmlichen Komponenten zum Aufbau von einfachen Modellen wurde hierbei insbesondere auf die Darstellung von internen Abläufen, einfache intuitive Bedienbarkeit sowie Konfigurierbarkeit in Form von Lektionen mit entsprechender Freischaltung von Funktionalitäten – um den Lernenden nicht von Anfang an durch die Komplexität zu demotivieren – Wert gelegt.

Meta-Heuristiken in virtuellen Lernumgebungen

Torsten Reiners Th 9:30 - 10:00, Room HS B
Imke Sassen, Stefan Voß

In der Lehre gewinnt der Einsatz von virtuellen Lernumgebungen immer mehr an Bedeutung, wobei insbesondere im Bereich Operations Research aufgrund der Anforderungen an eine praxisorientierte Ausbildung ein erhöhter Bedarf an qualitativ hochwerigen Lernangeboten besteht. Aktuell ist eine hohe Diskrepanz zwischen den vielfältigen Einsatzmöglichkeiten in der Praxis und dem Stellenwert in der Lehre zu verzeichnen. Anhand von konkreten Lerninhalten soll aufgezeigt werden, auf welche Weise eine Verknüpfung der theoretischen Grundlagen mit praktischen Anwendungen hergestellt werden kann. Hierzu erarbeitet der Lernende grundlegende Begrifflichkeiten und Zusammenhänge, die in einem weiteren Schritt anhand von realen Problemstellungen aus einer neuen realitätsbezogenen Perspektive betrachtet und dadurch vertieft und gefestigt werden. Dieses erfolgt unter Einbindung der Softwarebibliothek HotFrame in die virtuelle Lernumgebung, wobei der Lernende mit einem Software-Generator entsprechende Optimierungsverfahren erstellt und in Experimenten auf reale Problemstellungen anwendet. Durch die Integration von Lehre und Praxis soll neben einem besseren Verständnis der Materie auch eine Motivationssteigerung erreicht werden, da der Lernende der Relevanz von Meta-Heuristiken durch ihre konkrete Verwendung in Beispielen einen höheren Stellenwert beimessen kann.

Estimating Brand Switching from Scanning Data

Heribert Reisinger Tu 9:00 - 9:30, Room HS 2
Udo Wagner, Matthias Schuster

The identification of loyal consumers as well as customers who are expected to switch to/from the brand of interest lies at the heart of any marketing strategy. Marketing researchers have addressed this issue usually by employing panel data on individual buyers. We propose an alternative solution to this problem making use of scanning data. In fact, the basic concept behind this approach is the idea that symptomatic behavior extends to a wider range of cross-sectional units (e.g., stores) and thus may be identified by means of statistical inference. The method presented may be regarded as a certain kind of disaggregation as it makes use of accumulated figures to obtain individual level information.

The formulation of our model is based on well established empirically observed regularities of buying behavior on markets for frequently purchased consumer goods. Additionally, we take advantage of an existing approach that estimates the shares of voters switching between competing political parties by using data from two consecutive elections over a large

number of electorial districts. Finally, we tackle the problem of non-buyers which are of greater concern in a marketing context and provide a means for estimation.

There is a fundamental difficulty encountered when validating the proposed model in a real life context: 'true' switching behavior is not known by definition since we use aggregated data only. Therefore we search for situations in which we are not subjected to this limitation. In particular we use both empirical scanning data and simulation analysis. The results for the real world situation is judged upon face validity by the marketing managers. Further we perform a large scale simulation experiment and create different market environments in order to assess their influence on the goodness of fit of the model; on the whole the models seems to work quite well.

A reverse logistics model with integer setup numbers

Knut Richter
Imre Dobos

Tu 17:00 - 17:30, Room HS 1

A reverse logistic system is investigated. A constant demand can be satisfied by production and recycling. The used items are bought back and then recycled. The not recycled products are disposed off. A model is examined with EOQ-type inventory holding costs and linear waste disposal, recycling, production and buyback costs. The optimal integer setup numbers are looked for. It will be shown that not always the boundary solution is optimal. The paper generalizes a former model proposed by the authors for the case of integer recycling and production batches.

Keywords: EOQ model, Reverse Logistics, Production, Recycling, Waste disposal, Cost minimization

---

The Economic Life of Industrial Equipment Reconsidered

Markus Ricke
Andreas Pfingsten

We 12:00 - 12:30, Room E1.05

The paper deals with two particular investment decisions: optimizing the investment date and optimizing a single identical replacement. The objective is to maximize the net present value. For the common and convenient assumption of a flat term structure of interest rates, two results are known. Firstly, it is never optimal to delay an investment with a positive net present value. Secondly, the optimal economic life of the first machine is less than or equal to the optimal economic life of the second machine ("general law of replacement"). We demonstrate that both results seize to hold when non-flat term structures are allowed. Examples are provided for inverse as well as normal term structures, and it is shown why the latter are necessarily more complicated. In a broader perspective, the paper proves that the assumption of a flat term structure is not innocuous and the seemingly general well-known results only hold for a special case.

Dualizations, duality gaps and dual decomposition of nonconvex multistage stochastic programs

Werner Roemisch
Darinka Dentcheva

Mo 17:30 - 18:00, Room HS 9

We consider nonconvex multistage stochastic programs and discuss dualization approaches leading to scenario, nodal and geographical decomposition schemes for computing lower bounds of optimal values in case of a discrete underlying probability distribution. We compare the size of duality gaps for these decomposition approaches and draw some conclusions on the design of solution methods for applied stochastic integer programming models.

Application of computer simulation modelling in farm management analysis

Crtomir Rozman
Jernej Turk

Mo 13:30 - 14:00, Room HS 5

Accurate and reliable information is the basis for decision making process in farm management. One of the most important information is the one regarding economic feasibility of the planned farm alternative (production). To obtain various economic indicators of individual farm production, the estimation of production costs (enterprise budget) must be carried out. In the case of new production, there is usually not enough technical data to prepare enterprise budgets. Simulation modelling can be applied in order to gain more information on that particular (new) production. The model represents a simplified picture of the system (farm production), and technical data necessary for the preparation of enterprise budget can be subsequently calculated using the model developed. The main objective of this paper is to explore opportunities of simulation modelling techniques during the decision making process in farm management. Possibility of upgrading simple production model into decision support systems on the farm level is also discussed here.

Wissensrevision in einer MaxEnt/MinREnt-Umgebung

Wilhelm Rödder
Elmar Reucher

Tu 17:00 - 17:30, Room HS 10

Im Zusammenspiel konditionaler Logik [CAL, 1991] mit dem Prinzip Maximaler Entropie bzw. Minimaler Relativer Entropie MaxEnt/MinREnt [KIS, 1998] entsteht ein leistungsfähiger Inferenzmechanismus, über den in verschiedenen Arbeiten berichtet wurde; siehe z.B. [RME, 1996], [ROD, 2000]. Die Grundidee des Wissenserwerbs liegt im Aufbau der MaxEnt-Verteilung auf dem Wertebereich einer endlichen Menge endlichwertiger Variabler, bei Respektierung vorgegebener probabilistischer Konditionale. Durch Wahrung des MaxEnt-Prinzips werden die vorgegebenen "Wissenshappen" erlernt, jedoch keine nicht intendierten Abhängigkeiten zwischen den Variablen erzeugt: Das MaxEnt-Prinzip ist informationstreu. Das Ergebnis dieses Wissenserwerbs ist die Wissensbasis. Soll die Wissensbasis zur Beantwortung von Fragen herangezogen werden, so geschieht dies in zwei Schritten: In der Anpassung des Basiswissens an eine für die Frage evidente Situation nach dem MinREnt-Prinzip und in der anschließenden Auswertung des Fragekonditionales. Für eine genauere Beschreibung der Vorgänge vergleiche man wiederum [RME, 1996], [ROD, 2000]. Daß der skizzierte Inferenzmechanismus nicht rein akademisch ist, belegt Kulmann schlüssig in [KUL, 2002]; dort wird über eine Wissensbasis mit über 80 Variablen und über 1.300 probabilistischen Konditionalen berichtet, mit der ein großer deutscher Anlagenbauer das Problem der Anfragebewertung im Großanlagengeschäft bewältigt. Nun ist Wissenserwerb keine einmalige Angelegenheit, sondern vollzieht sich in immer wiederkehrenden Lernphasen. Gelegentlich ist neueres Wissen mit älterem kompatibel, gelegentlich nicht. Im ersten Fall ergänzt das neuere älteres Wissen, im zweiten Fall müssen frühere Wissensinhalte relativiert werden; beide Formen fassen wir unter dem Begriff Wissensrevision zusammen. Die Fähigkeit insbesondere zur zweiten Form der Wissensrevision ist für menschliches Denken wesentlich: Erst unsere Bereitschaft, angesichts einer Straußenfamilie die (kindliche) Überzeugung aufzugeben, daß Vögel stets fliegen, macht uns zu erfolgreichen Denkern. Eine künstliche Form der Wissensverarbeitung muß solch eine nicht-monotone Wissensanreicherung ebenfalls erlauben, soll sie menschliches Denken nachempfinden. Nach einer kurzen Wiederholung des gesamten Wissensverarbeitungsprozesses stellen wir anhand eines ökonomischen Beispiels mittlerer Größe beide Formen der Wissensrevision dar. Die Vorgehensweisen werden dann formalisiert und zu allgemeingültigen Vorschriften erweitert. Alle Beispielrechnungen werden mittels der Expertensystem-Shell SPIRIT durchgeführt, die MaxEnt/MinREnt-Inferenzen in einer komfortablen Umgebung gestattet.

Literaturverzeichnis

[CAL 1991] P. G. Calabrese: Deduction and Inference Using Conditional Logic and Probability, in: Conditional Logic in Expert Systems, I. R. Goodman, M. M. Gupta, H.T. Nguyen and G. S. Rogers (editors). Elsevier Science Publishers B. V. , 71-100, (1991).

[KIS, 1998] G. Kern-Isberner: Characterising the principle of minimum cross-entropy within a conditional-logical framework, Artificial Intelligence, Vol. 98, 169 - 208, (1998).

[KUL 2002] F. Kulmann: Wissen und Information in konditionalen Modellen – zur Entscheidungsvorbereitung im Anfrage- und Auftragsmanagement, Deutscher Universitätsverlag, Gabler, Wiesbaden, (2002).

[RME, 1996] W. Rödder and C.-H. Meyer: Coherent knowledge processing at maximum entropy by SPIRIT, Proceedings 12th Conference on Uncertainty in Artificial Intelligence, E. Horvitz and F. Jensen (editors), Morgen Kaufmann, San Francisco Cal., 470 - 476, (1996).

[ROD, 2000] W. Rödder: Conditional Logic and the Principle of Entropy, Artificial Intelligence, 117, 83 - 106, (2000).

Fuzzy Multiple Objective Suppliers Selection in SCM Systems

Soroosh Saghiri
M.H. Fazel Zarandi

Mo 17:00 - 17:30, Room HS 10

Utilizing the concepts of Supply Chain Management (SCM) approach, this paper focuses on the appropriate selection of suppliers. Assigning order quantities to suppliers in the case of multiple sourcing with multiple objective and their related constraints is the main challenging subject in this study. Considering real world situation leads the authors using fuzzy decision making approach in modeling such an SCM system. In the proposed model, goals, constraints, variables and coefficients are all fuzzy. It is shown that with the application of the fuzzy methodology, the multi-objective problem is converted to a single one that can be solved easily.

Key words: Supplier Selection, Fuzzy Logic, Single Objective and Multiobjective Programming

---

Decision Support for Telecommunications Pricing

Cornelia Schoen

Mo 14:00 - 14:30, Room HS 2

Pricing is one of the most important keys to success for mass market telecommunications in a competitive environment. However, offering tariffs attractive to the customer and profitable to the provider is a very complex task in view of different profit drivers. Carriers need to develop segment-specific pricing strategies with price structures and levels reflecting

the willingness-to-pay of different customer segments. Incumbents should identify the attractive, high-volume customer segments endangered by alternative carriers. Optional tariff plans target customers with specific usage patterns and try to exploit the segment- specific willingness-to-pay. Such plans give extra discounts on usage, such as international calls to different countries. To enable innovative price management, a highly developed database with sophisticated analytical tools is essential, as well as a systematic way to use information about different customers. We present models and methods forming the basis for a decision support system for designing profitable, segment-tailored tariff plans. We identify, analyze and model all important profit drivers and use these results as the building blocks of an optimization model. The most important factors to be taken into account are the segment-specific consumer behavior concerning usage and tariff choice, costs, competitive retaliation and the regulatory framework.

Keywords: marketing, decision support, pricing, telecommunications

References:

HAUSMAN, W.H. / CHEN, K.D. (2000): 'Technical Note: Mathematical Properties of the Optimal Product Line Selection Problem Using Choice-Based Conjoint Analysis', in: Management Science 46 (2), S. 327ff

NEUMANN, K. / MORLOCK, M. : Operations Research, Carl Hanser-Verlag, München, Wien, 1993

SCHÖN, C.: Relevante Einflußgrößen von Preisentscheidung in der Telekommunikation, WIOR-Report-584, Institut für Wirtschaftstheorie und Operations Research der Universität Karlsruhe, 2000

SCHÖN, C. : 'Preisbildung in der Telekommunikation', erschienen in: Arnold, Franz (Hrsg.): Handbuch der Telekommunikation, Deutscher Wirtschaftsdienst, Oktober 2000

SCHÖN, C.: 'Entscheidungsunterstützung des TK-Preismanagement – Teil I: Ein Modell zur Gestaltung klassischer Tarife', WIOR-Report-613, Institut für Wirtschaftstheorie und Operations Research der Universität Karlsruhe, 2001

SKIERA, B.: Mengenbezogene Preisdifferenzierung bei Dienstleistungen, Gabler Verlag /Deutscher Universitätsverlag, Wiesbaden (zugl. Habilitationsschrift, Universität Kiel), 1999

SPELLUCCI, P.: Numerische Verfahren der nichtlinearen Optimierung, Birkhäuser, 1993

TAYLOR, L.D.: Telecommunications Demand in Theory and Practice, Kluwer Academic Publishers, Dordrecht/Boston/London, 1994

Präferenzmessung mit Conjoint-Analyse und AHP

Armin Scholl
Roland Helm, Laura Manthey, Michael Steiner

Mo 14:30 - 15:00, Room HS 10

In der empirischen Präferenzforschung sind Conjoint-Analyse (CA) und Analytic Hierarchy Process (AHP) gängige Methoden, wobei in der Marketingforschung und -praxis Conjoint-Analysen dominieren, während in der Entscheidungsanalyse zunehmend Varianten des AHP Bedeutung gewinnen.

Der wichtigste Unterschied beider Ansätze besteht darin, dass AHP eine kompositionelle und CA eine dekompositionelle Methode darstellt. Bei AHP werden auf Basis einer Hierarchie relevanter Kriterien anhand von Paarvergleichen Nutzwerte verschiedener Alternativen bzw. ihrer Ausprägungen für die einzelnen Kriterien sowie Kriteriengewichte bestimmt. Bei der CA werden aus erfragten Gesamtpräferenzen für verschiedene, den Entscheidungsträgern präsentierte Alternativen Teilnutzenwerte der Kriterien (-ausprägungen) berechnet. Vielfach wird in der Marketingliteratur eine generelle Überlegenheit der dekompositionellen Methoden propagiert. Mit AHP liegt allerdings eine Methode vor, die anspruchsvoller als die üblicherweise im Marketing verwendeten kompositionellen Ansätze ist.

Das Ziel der Studie besteht darin, einen Vergleich der Methoden durchzuführen. Dabei wird darauf geachtet, dass die konkrete Ausgestaltung beider Methoden eine bestmögliche Vergleichbarkeit hinsichtlich der Anforderungen an die Entscheidungsträger und des Ablaufs der Erhebung gewährleistet. Zusätzlich werden die Präferenzen anhand realer Alternativen direkt erhoben, um einen realitätsnahen Vergleichsmaßstab für die Methoden zu gewinnen.

Erste Ergebnisse belegen, dass die beiden Methoden in der betrachteten Ausgestaltung eine hohe Prognosevalidität aufweisen. Aufgrund der Befunde kann weiterhin konstatiert werden, dass AHP auch für Präferenzmessungen im Rahmen der Marktforschung eine echte Alternative zur CA darstellen kann. Der Vergleich der Methoden erlaubt überdies eine kritische Einschätzung der üblichen Vorgehensweise zur Bestimmung von Bedeutungsgewichten bei der CA.

Covering population areas by railway stops

Michael Schröder
Anita Schöbel

We 14:00 - 14:30, Room HS 3

We study the installation of new stops (or stations) along existing links in public transportation, e.g. railway systems. This improves the coverage level of the system, i.e. the number of people living near some stop. On the other hand additional cost is incurred and travel times tend to increase. Therefore we want to achieve a certain coverage level with as few stops as possible.

We model this as a network location problem, where the network corresponds to the transportation links. Further, population distribution is modelled by a system of compact subsets of the plane, the population areas. We ask for conditions that guarantee a finite optimal solution and for methods to compute it.

Fuzzy scheduling for the dismantling of complex products

Frank Schultmann
Otto Rentz

Th 11:30 - 12:00, Room HS 6

Due to extended producer responsibility and stricter environmental regulations an increasing amount of spent products, e.g. electronic equipment, vehicles or buildings, will have to be dismantled in the near future. Consequently, the management of dismantling and the subsequent recycling cannot not only focus on the genuine aim of profitability, but will also have to meet criteria of sustainability, e.g. limitating the discharge of pollutants to the environment. However, the rapid devleopment of ideas for the end-of-life treatment of spent products resulted in only few concepts for dismantling planning in this final phase of the product life cycle so far.

To anticipate an integrated dismantling and recycling procedure, numerous different objectives in environmental, technical and economic means have to be taken into account. Thus, alternative scenarios for the end-of-life treatment need to be considered on strategic, on tactical and on operational level. While objectives in short-term planning are usually modelled using extended time-based objective functions, different alternatives to meet certain targets in the field of sustainability can be modelled using multiple modes. Mathematically, both aspects can be realized by using project-scheduling models. However, even when using multiple modes, one major problem in modelling dismantling processes is the fact that data is not always available to put mathematical models at work. In particular, the duration of dismantling tasks involving human labor as well as sophisticated technologies is seldom precisely known due to uncertainties in the composition of returned materials. The use of fuzzy sets proves to be a powerful tool for modeling this weak data. Fuzzy techniques have been well established in mathematical theory; however, fuzzy programming is still hardly used for dismantling tasks.

In this paper, an approach will be illustrated to the solution of decision-making problems in short-term dismantling planning that consists of fuzzy-scheduling models. The information provided by the model serves for deriving optimal work plans, taking into account weak data resulting from different conditions of spent products. A case study will illustrate the application of the approach.

Fischer SKI: Bessere Prognosen durch Softwareunterstützung

Hans-Hartwig Schulz

We 9:00 - 9:30, Room HS 1

Grundproblematik bei Fischer SKI: Die Prognosen veralten schnell

Die Firma Fischer muss immer schon ein Jahr im voraus erahnen, welche Skier im nächsten Jahr von den Händlern bestellt werden. Bei einer weltweiten Produktion von 1,35 Mio. Paar Skiern ist dies eine große Herausforderung. Zu Beginn des Produktionsjahres im November werden, basierend auf den Prognosen, erste Modelle für die nächste Saison hergestellt. Die ersten Aufträge gehen im Januar ein, die letzten werden im Mai angenommen. Während dieser Zeit fließen ständig neue Prognosen in die Produktion mit ein.

Mit einer neuen Supply Chain Management-Software will Fischer den Planungsprozess verbessern, damit schneller, früher und mit weniger Aufwand verlässliche Aussagen bezüglich Formen, Anlagen und Personal getroffen werden können.

In einer weiteren Ausbaustufe werden Kunden und Lieferanten Zugriff auf das System bekommen.

Durch den Einsatz der Software-Werkzeuge sollen rund 300.000 Euro pro Jahr gespart werden.

Fischer Ski setzt im Bereich Supply Chain Management auf zwei Module von J.D. Edwards:

- Strategic Network Optimisation, SNO

  In dem stark vom Saisongeschäft geprägten Business von Fischer Ski gehört Forecasting zu den kritischen Erfolgsfaktoren. Mit dem Modul SNO von J.D. Edwards können u. a. unter Einbeziehung vielfältiger Variablen verschiedene Szenarien evaluiert werden.

- Production Scheduler Discrete, PSD

  Durch die Vielfalt bezüglich Größen und Varianten bei der Produktion von Skiern ist die Feinplanung von Produktionsressourcen eine Herausforderung. Durch eine optimierte Feinplanung sind erhebliche Effizienzgewinne möglich. Das Supply Chain Management-Modul PSD von J.D. Edwards wird bei Fischer Ski für diese Aufgabe zum Einsatz kommen.

A Branch-and-Bound Algorithm for the Capital-Rationed Net Present Value Problem

Christoph Schwindt Mo 14:30 - 15:00, Room HS 4

In this paper we address the problem of maximizing the net present value of a project with scarce investment capital. This problem arises for instance in civil engineering where the receipts from completed subprojects serve to finance succeeding subprojects. The activities of the project are linked by generalized precedence relationships given by minimum and maximum time lags between start times. The start or completion of an activity is either associated with a nonnegative paying out or a positive payment. The funds available for investment equal the sum of initial capital and the difference of all past payments and paying outs. The objective is to find a feasible assignment of start times to the project activities such that the net present value of the project is maximized. It is shown that the feasibility-variant of this problem is NP-complete. We propose an efficient branch-and-bound procedure, which is based on the relaxation of the capital constraint. Excessive disbursement is settled by introducing precedence relationships between payments and paying outs. The relaxations are solved by a dual mildest descent algorithm. Computational experience comparing this approach to a standard time-indexed MIP problem formulation from literature is reported.

Optimization models for the delay management problem

Anita Schöbel Mo 14:00 - 14:30, Room HS 3

Suppose, a train will reach a station with delay. At the station there is a bus ready to depart. Should the bus wait for the connecting passengers of the delayed train or should it depart in time?

Clearly, this decision depends on the amount of delay, the number of customers who want to change, the number of customers who will be annoyed if the train waits, and on the time period until the next bus of the same type arrives at the station. Furthermore, the effects of a delay of the bus on other vehicles later on have to be taken into consideration.

Finding good wait-depart decisions in case of a delay in a complex public transportation network is the subject of this talk. We will show how this delay management problem can be modelled, discuss its complexity, and present mixed integer programming formulations. Based on these results, solutions methods are developed and applied within a practical application.

Ein Verfahrensverbund zur Lösung des Pickup-And-Delivery-Selection-Problems

Jörn Schönberger
Herbert Kopfer, Dirk Mattfeld Tu 12:00 - 12:30, Room HS 3

Pickup-And-Delivery-Selection-Probleme stellen eine Erweitung der in der Literatur behandelten Pickup-And-Delivery-Probleme dar. Aus den verfügbaren Transportaufträgen werden nur die erfolgversprechendsten tatsächlich zur Ausführung ausgewählt. Jeder ausgewählte Transportauftrag führt zur Realisierung von Erlösen. Somit stellt die Maximierung des Deckungsbeitrags das anzustrebende Ziel dar. Bei der Auswahl und Einplanung der Aufträge müssen sowohl auftragsbezogene Zeitfenster als auch die insgesamt verfügbare Transportkapazität (die i.A. geringer als die nachgefragte ist) berücksichtigt werden. Eine exakte Lösung dieser Art von Problemstellungen ist nicht zu erwarten. Desweiteren erschweren die verschiedenen Charakteristiken der konkurrierenden Restriktionen den Einsatz spezialisierter Lösungsverfahren. Aus diesem Grunde haben wir uns für die Konfigurationen eines Genetischen Algorithmus (GA) entschieden, der den Einsatz von lokal-arbeitenden Basis-Heuristiken steuert. Wir beschreiben eine Repräsentation, die eine Codierung der drei Freiheitsgrade Auswahl (der zu bedienenden Aufträge), Zuordnung (der Aufträge zu den Fahrzeugen) und Reihenfolge (der Besuche) ermöglicht. Dabei werden Vorrang-Beziehungen syntaktisch garantiert, nicht jedoch Zeitfenster- und Kapazitätsbedingungen, so dass die Zulässigkeit eines Individuums durch die Anwendung von Spezial-Heuristiken sichergestellt werden muss. Die Heuristiken manipulieren die Lösungen und geben die neue genetische Information anschließend in die Population zurück, so dass diese Information in nachfolgenden Generationen weiterverwendet und die Suchrichtung des Verfahrens positiv beeinflußt wird. Zur Verifizierung unseres Ansatzes haben wir umfassende Experimente mit Probleminstanzen unterschiedlicher Schwierigkeitsgrade (Fahrzeugzahl, Auftragszahl, Zeitfenstergröße) durchgeführt. Die beobachteten Ergebnisse belegen die Eignung des hybriden Verfahrens zur Erzeugung qualitativ guter Lösungen.

Optimale Belegungsplanung von Stranggießanlagen mittels 2-dimensionaler Bin-Packing-Modelle

Oliver Seefried
Th. Spengler Mo 14:30 - 15:00, Room HS 1

In integrierten Hüttenwerken wird in der Produktionsstufe Stranggießen Rohstahl, der in der Konvertermetallurgie in determinierten Pfannenmengen produziert wurde, zu kontinuierlichen Strängen vergossen. Durch nachgeschaltete Längs- und Querteilprozesse werden diese Endlosstränge in ihren Maßen auf einzelne Fertigungsaufträge (Brammen bzw. Riegel) zurechtgeschnitten. Die Erzeugungsleistung von Stranggießaggregaten wird hierbei von zwei Einflussfaktoren bestimmt:

der Gießgeschwindigkeit und der Gießbreite. Während die Gießgeschwindigkeit aufgrund gütenspezifischer Anforderungen als wenig beeinflussbar angesehen werden muss, kann die Gießbreite innerhalb anlagentechnisch determinierter Grenzen verändert werden. Im Rahmen der operativen Produktionsplanung und -steuerung gilt es, einen Kompromiss zwischen Leistungssteigerung durch Erhöhung der Gießbreiten und dadurch erhöhten Verschnittverlusten einzugehen. Im vorliegenden Beitrag wird das Problem der Belegung einer Stranggießanlage als zweidimensionales Bin-Packing-Problem mit variabler Stranglänge und variabler Strangbreite modelliert. Als zu minimierende Zielfunktion wird hierbei auf die Anlagenleistung/Gießzeit (und damit aufgrund der konstanten Gießgeschwindigkeit die Stranglänge) zurückgegriffen. In Abhängigkeit von der Problemgröße werden unterschiedliche exakte bzw. heuristische Lösungsverfahren entwickelt, die mit kommerzieller OR-Software auf einem Standard-PC implementiert in der Lage sind, für praxisrelevante Problemgrößen gute Lösungen im Minutenbereich zu generieren. Die Modellvalidierung erfolgt anhand eines realen Produktionsprogramms in einem führenden Unternehmen der Eisen- und Stahlindustrie.

AHP Model for Achieving the Minimum of a Burned Area after Forest Fires

Ksenija Segotic
Spanjol Zeljko

Mo 14:00 - 14:30, Room HS 5

The Adriatic islands are usually prone to fires during the summer months. The causes primarily lie in long-lasting dry periods, high atmospheric and soil temperatures and a large increase of island populations. Although these three factors are equally present on all islands, it has been noted that the damage ensuing from fires varies from island to island. We have tried to show that these differences are considered to be the result of differently organized fire control. This can be prooved in the example of the island Rab.

The more money is invested into prevention, the less damage will result from fires. However, how the funds are invested and into what is also important. Which is more useful: expensive Canaders or well-organised surveillance that enables timely intervention? In order to facilitate making a decision about which means are the most efficient in achieving the minimum of a burned area, we have built a model and used the method of Analytical Hierarchy Process - AHP.

In our model we wanted to rank the three available alternatives A1, A2 and A3, which contribute to lessening the damage from fires, in the order of importance.

A1: Surveillance, alarm, and the organisation of fire prevention and suppression measures

A2: Biological-technological measures of forest management

A3: Firefighter's technical equipment.

The Expert Choice software programme then provided alternative priorities in relation to the goal.

Combination of branch and bound algorithm and dynamic programming for project management problem

Vladimir Servakh
Ekaterina Bubnova

Tu 17:00 - 17:30, Room HS 4

We consider a resource-constrained project scheduling problem (RCPSP). Let N activities be given, whose processing requires M kinds of resources. The resources may be both renewable (machines, processors, etc.) and storable (finances, materials, etc.). At time t there are $R^m(t)$ units of resource m. An activity n must be processed in p_n units of time and preemption is not allowed. For an activity n the consumption value $r_n^m(t)$ of resource m is given $(m = 1, 2, \ldots, M; n = 1, 2, \ldots, N; t = 1, 2, \ldots)$. The set of activities has a partial order. The release date and the due date are also given. The objective is to find a schedule, which satisfies resource constraints and the partial order on the set of activities. The optimization criterion can be chosen from a wide class of functions.

We apply the branch and bound algorithm from [1] and a dynamic programming algorithm from [2] to this problem. If the width of the partial order on the set of activities is bounded by a constant, then the dynamic programming algorithm is pseudo-polynomial. We choose special branching rule in the branch and bound algorithm to reduce the width of the partial order, and to apply the proposed dynamic programming algorithm of final stage. This approach had been tested on scheduling problems with the NPV-criterion and $p_n = 1$.

This work was supported by INTAS project 00-217.

References:

[1] Brucker, P., Knust, S., Schoo, A., Thiele, O. A branch and bound algorithm for the resource-constrained project scheduling problem, European Journal of Operational Research 107, 1998, P.272-288.

[2] Servakh V. A dynamic programming algorithm for some project management problems, Proceedings of the International Workshop "Discrete optimization methods in scheduling and computer-aided design", Minsk 2000, P.90-92.

Scheduling Packets and Services in Satellite UMTS

Mara Servilio Th 10:00 - 10:30, Room HS 4
Claudio Arbib, Vincenzo Arvia

The Universal Mobile Telecommunication System (UMTS) is the 3rd generation mobile communication system developed by the European Telecommunications Standard Institute. We report on the European IST project FUTURE, aiming to investigate the integration of multimedia services and to develop enhanced Quality of Service (QoS) strategies for a packet based UMTS to fulfil the requirements of such services as: Voice over IP (VoIP), Web Browsing, File Transfer via ftp. Within these strategies, the main purpose of the Scheduling function is to optimise the radio resources utilisation, and in particular maximise the amount of accepted requests and the data flow throughput, as well as satisfying given QoS parameters. In order to respect the Radio Access QoS sub-contract, the Medium Access Control (MAC) scheduling function assigns W-CDMA codes and radio frames to data packets so that contracted QoS specifications (involving such indicators as delay, jitter, packet loss) are met. We consider a scenario in which different services and/or applications can simultaneously be provided to two mobile users by a unique physical channel per satellite beam. Since the two services may have different QoS requirements, a need arises to coordinate the radio resources utilisation. In this context, we present the main steps of an algorithm that can be used to implement the scheduling function. A fundamental step of this algorithm involves the resolution of a competitive scheduling problem: in such a problem, our objective is to minimize the weighted number of tardy data-packets of one mobile user, provided that the weighted number of tardy data-packets of the other mobile user is not greater than a given threshold. We show that this problem is in general NP-hard but that for unit weights it admits a polynomial-time solution algorithm.

Use Of An Automatic Meter Reading For Optimizing Public Utility Consumption

Kaveh Sheibani Tu 17:00 - 17:30, Room HS 5

Nowadays due to the trend of consumption energy generation is in need of accurate planning. This is due to the increasing growth of energy consumption and the wide geographic spread of consumption points. Thus it is necessary to determine the actual and forecast consumption during a specified period (e.g. one day) accurately. In this paper, an automatic meter reading methods based on fixed network and with a wide area radio frequency examined for accurate control and the detection of unusual consumption and its effect on the optimization of energy consumption as well as the functions and results of installing this system for gas consumption control in a pilot area.

Keywords: Automatic Meter Reading, Energy Consumption, Optimization.

A Method For Generating All Efficient Solutions of Integer and $0-1$ Multi-Objective Linear Programming Problem

Naghi Shoja We 17:00 - 17:30, Room HS 10
G. R. Jahanshahloo, F. Hosseinzadeh Lotfi, G. Tohidi

In this paper a method is proposed to finedall efficient solutions of $0-1$ Multi-Objective Linear Programming (MOLP). These solutions are specified withour generating all feasibla solutions of MOLP problem. Corresponding to which are the values of objective functions. The method consists of a one-stage algorithm. In each iteration of this algorithm, a 0-1 single objective linear programming problem is solved for obtaining some efficient solutions 0-1 MOLP problem. The algorithm is generalized for solving integer problem. For illustration, some numerical examples are proposed.

Keywords: 0-1 and integer MOLP, efficient solution

Determining Feasible Interval For Weights in Data Envelopment Analysis, Using Goal Programmimg With Imperical Stady

Naghi Shoja We 12:00 - 12:30, Room E0.05
A. Memariani, F. Hosseinzadeh Lotfi, N. Shoja

In this paper, a method for imposing restriction on weights is proposed. Imposing restriction on weights in Data Envelopment Analysis (DEA) may results in infeasibility for the problem. To remove this difficulty, by using Goal Programming (GP) technique and exploiting Big-M method a set of weights are obtained for which the corresponding problem is feasible. It has been shown tath the some of deviations of these weights from managerial willingness is minimum. An Imperical study real data of bank shows the robutness of the algorithm.

Keywords: Goal Programming Data Envelopment Analysis, Restriction Weights, Efficiency

---

A Bayesian network model of two-car accidents

Marjan Simoncic Mo 17:00 - 17:30, Room HS 5

We propose a bayesian network model of road accidents involving two car drivers. At the beginning Bayesian networks are introduced. Then some basic statistics are presented for data from the available database on traffic accidents in Slovenia. The Bayesian network on relevant data is then structured and parameters learned from the data for road accidents in the year 1998. In the process of finding the structure of the Bayesian network we use a combination of formal methods and basic knowledge from the domain. Inference results with the estimated network are described at the end.

Key words: road accidents; modelling; Bayesian networks; machine learning

---

Impact of Feedback Loop on Group Decision Process when Applying System Dynamics Simulators

Andrej Skraba
Miroljub Kljajic We 11:30 - 12:00, Room HS 7

The proposed paper would address the influence of feedback information on group decision process supported by the application of system dynamics models. An experimental system enabling the active cooperation of decision subjects was developed, which is user friendly, with regards to visualization and transparency of simulation results. A model of the business system was applied at the experiment with decision groups. The experiment considered the task of strategy determination with an explicitly defined multicriteria function. The criteria function was explicitly defined in order to increase the level of experimental control. Experiment was conducted under different experimental conditions: a1) determination of business strategy without application of formal model, a2) determination of the strategy with application of formal system dynamics model and a3) determination of the strategy with application of formal model with subjects interaction supported by the group feedback information. 147 subjects, senior university students, participated in the experiment. The hypothesis of positive impact of model application and group feedback information on the convergence of the decision process will be tested and analyzed in terms of criteria function values.

Gathered findings have significant importance for development of learning environments and exploration of SD models. Proposed methodology of group model exploration enables exchange of different views in the phase of best strategy search, which is often obstructed in the decision environments. Higher convergence of results represents the higher level of understanding and organizational conciseness, which is the basis for efficient system actualization. Inner view on the group dynamics is enabled by feedback, which is inseparable with biological systems but on the contrary insufficiently present in the organizational systems on account of technological difficulties and interpersonal relationships.

Benchmarking von Krankenanstalten: Analyse des Einflusses von Peers

Margit Sommersguter-Reichmann Tu 12:00 - 12:30, Room HS 5

Im Rahmen von Benchmarking-Analysen wird die eigene Performance basierend auf ausgewählten Indikatoren mit der Performance von Referenzeinheiten verglichen, um im Falle einer suboptimalen Leistung über die Ana-lyse der Aktivitäten von effizienten Referenzeinheiten, sogenannten Peers, Aussagen über künftige Strategien zur Verbesserung der eigenen Leistung ableiten zu können. Die Data Envelopment Analyse (DEA) bietet die Möglichkeit, ein produktionswirtschaftlich orientiertes Benchmarking durchzuführen, bei dem die relative Effi-zienz von Entscheidungseinheiten (EE) über deren Abstand zu einer empirisch ermittelten Randproduktionsfunk-tion, die von den sogenannten “best-practice” EE (Peers) bestimmt wird, definiert wird. Als Ergebnis einer Benchmarking-Analyse mittels DEA werden für ineffiziente EE Peers ausgewiesen, wobei sich diese Peers in ihrer Bedeutung für die ineffiziente EE wesentlich unterscheiden können. Eine detaillierte Analyse der Bedeu-tung von Peers für ineffziente EE ist somit im Hinblick auf die Ableitung künftiger Strategien zur Verbesserung der Performance von großer Bedeutung. Im Rahmen dieser Untersuchung soll für eine ausgewähltes Sample von österreichischen Krankenanstalten eine derartige Peer-Analyse mittels DEA durchgeführt werden. Die Peers werden im Hinblick auf ihre Bedeutung für ineffiziente Krankenanstalten folgendermaßen analysiert: Analyse der Häufigkeit der Nennung als Referenz-krankenanstalt, Berechnung eines Peer-Index (vgl. Torgensen et al. 1996), Berechnung der Supereffizienz (vgl. Andersen/Petersen, 1993) sowie Berechnung von willkürlichen Cross-Efficiency Werten (vgl. Doyle/Green 1994). Über die Analyse der Peers soll neben der Beurteilung des Einflusses einzelner Peers für ineffiziente EE auch untersucht werden, ob über diese Peer-Analyse auch allfällige Ausreisser identifiziert werden können.

Minimizing the Weighted Number of Early and Tardy Jobs in the Stochastic Single Machine Scheduling Problem

H. M. Soroush
T. M. Al-Khamis We 11:30 - 12:00, Room HS 4

We study a static stochastic single machine scheduling problem in which job processing times are random variables, due-dates are deterministic, and fixed individual weights (or penalties) are imposed on the jobs that are completed before

their due-dates (i.e., early jobs) and after their due-dates (i.e., tardy jobs). The objective is to determine an optimal schedule that minimizes the expected total weighted number of early and tardy jobs. We formulate this static stochastic scheduling problem as a combinatorial optimization model. The general problem is NP-hard to solve; however, we develop exact solution approaches for some important cases of the problem when there are special structures on the stochasticity of processing times and job earliness/tardiness weights. Furthermore, for the general problem, we propose efficient heuristics that perform well in identifying optimal schedules. We demonstrate that the scheduling decisions are affected by the stochasticity of job processing times. The proposed research is of significant importance in uncertain just-in-time (JIT) scheduling environments where jobs must be completed on their due-dates, neither earlier nor later.

Bounds for Quadratic Assignment Problems Using SDP and Bundle Methods

Renata Sotirov
Franz Rendl

We 9:30 - 10:00, Room HS C

We describe the construction of the bound for the Quadratic Assignment Problem (QAP) based on the Semidefinite Programming (SDP). To the basic SDP relaxation of QAP we add some equality and inequality constraints. The resulting problem is huge and we solve it effectively by using the Bundle Method. The resulting bounds are competitive with existing bounds in both, computational effort and bound quality.

Decision-aid Methodology for the School Bus Routing and Scheduling Problem

Michela Spada
M. Bierlaire, Th. M. Liebling

We 11:30 - 12:00, Room HS 3

We consider school bus routing and scheduling problems, where transportation demand is known and bus schedules can in principle be planned in advance. Setting up such schedules is an intricate combinatorial optimization problem. We propose a modeling framework in which contrarily to most previously published papers, the number of buses is given, and we consider two different objective functions, involving travel and waiting time of the children. We also allow mixed loads, i.e. children from different schools may travel concurrently in the same bus.

Our approach combines heuristics with human expertise and has two modules. On the one hand we present a Graphical User Interface (GUI)-based decision-aid tool which allows to take advantage of the practitoners' expertise when setting up initial solutions or modifying them at a later phase. On the other hand we present two algorithms for an automatic improvement of the solutions which are based on simulated annealing and tabu search respectively. We illustrate our methodology both on synthetic and real world data.

Middle Term Optimisation of Power Purchase Portfolios

Gorden Spangardt
Michael Lucht, Wilhelm Althaus

We 9:30 - 10:00, Room HS 6

The deregulation of the European power market brings new sales prospects for the power-suppliers as well as an appreciable increase of entrepreneurial risks. In order to handle the novel price- and volume-risks optimisation of decision-making under uncertain boundary con-ditions is of essential interest. The former task of resource management in energy-supply was the minimisation of costs for the fulfilment of a foreseeable power-request at long-ranging conditions of pricing. Now a multicriterial optimisation problem arises: simultaneous minimisation of cost and risk. In the last years a number of power-exchanges have been established, where power is physically traded day-ahead and derivatively as futures contracts. Furthermore financial power-derivatives like options, caps, floors or swaps are traded bilateral in the so called over-the-counter market. A serious question is how to use these financial derivatives in an optimal way to protect a power purchase portfolio against market risks. Facing this question a multicriterial linear stochastic optimisation model has been developed. It is based on scenarios for the market price, generated by monte-carlo-simulation that uses a mean-reversion market model calibrated for the German power spot-market. The different optimisation criteria are merged into a single objective by a weighted summation. Individual risk is considered by the coefficients of the weighted sum. The model structure - especially the number of binary variables - is adapted to resolvability by Benders-Decomposition in a way that even a larger number of optimisations with different coefficients of the weighted sum can be solved in acceptable time generating the Pareto-Curve. Nevertheless all important microeconomic features of the portfolio-components are modelled.

Fallstudie Berger Elektromotoren: Inhalt und Lernziele

Paul Staehly
Christoph Haehling von Lanzenauer We 17:00 - 17:30, Room HS 5

Inhalt der Fallstudie ist Produktionsplanung und Outsourcing. Der Fallstudien-teilnehmer wird mit zwei Vorschlägen für die Berechnung akzeptierbarer Höchstpreise für zusätzliche Kapazitäten konfrontiert und muss diese analysieren und beurteilen. Basierend auf dem Konzept der Dualität wird schließlich das richtige Vorgehen entwickelt. Die Fallstudie eignet sich auch für die ökonomische Analyse, die beim Verkauf eigener Überschusskapazitäten vorzunehmen ist. Schließlich können auch Überlegungen zur Betriebsunterbrechungsversicher-ung angestellt werden.

On the utility of hidden bilevel structures in applied optimization

Oliver Stein Th 9:00 - 9:30, Room HS 8

We introduce a new numerical solution method for semi-infinite optimization problems with convex lower level problems. The method bases upon a reformulation of the semi-infinite problem as a Stackelberg game and the use of regularized NCP functions. This approach leads to central path conditions for the lower level problems, where for a given path parameter a smooth non-linear finite optimization problem has to be solved. The solution of the semi-infinite optimization problem then amounts to driving the path parameter to zero.

We give convergence properties of the algorithm and illustrate it with a number of numerical examples, ranging from design centering and portfolio optimization to batch processing problems in chemical engineering. The presented algorithm is easy to implement, and our examples show that it works well for high dimensional index sets.

Multi-Period Portfolio Selection with Optimal Currency Hedging

Detlef Steiner
Karl Frauendorfer Th 9:00 - 9:30, Room E1.05

Basically, the asset allocation and the currency allocation problem in a multi-period framework can be characterized by the following structure: Investors choose a certain planning horizon. Assume that this time span can be subdivided into periods of possibly varying length. At the beginning of each period, the investor chooses a portfolio. The currency risk of foreign asset holdings is hedged with forward contracts. At the end of each period, the return of the portfolio and the forward contracts held by the the investor materializes. In particular, rebalancing activities that are based on new information are allowed to tune the investment decision. These portfolio revision are subject to transaction costs for buying and selling assets which investor have to pay immediately.

Formally we study the mean-variance criterion in a multi-period setting. The resulting optimization problem is solved by means of stochastic multistage programming. The stochastic programming based on a finite set of scenarios that represent the stochastic evolution of returns.

GPRS users' expectations about UMTS: A consumer poll

Gerald Steiner
J.H. Schuetze Tu 12:00 - 12:30, Room HS 2

Austria has one of the highest levels of mobile phone usage in Europe and market penetration of mobile phones is also high. The number of subscribers also continues to rise. People have become used to communicating anywhere, any time.

However, experienced mobile phone users begin to expect a similar a service to the service available with landline data services. In Europe there are already various mobile data services available (GSM-DATA, WAP, GPRS, HSCSD, I-Mode) and the first auction prices for UMTS licences showed high economic expectations. Prices for auctions at a later time were much lower due to doubts about the costs of the UMTS infrastructure and the increasingly competitive position of other data standards such as I-Mode, HSCSD and GPRS.

The analysis concentrates on the diffusion theory: Users of current "new" techniques are expected to be among the first to test and use future technical products. According to this theory, users of current mobile data services are expected to:

- know about UMTS
- support the introduction of UMTS, including the infrastructure
- be willing to use UMTS sooner than the average consumer

For the analysis we will use data from an ongoing opinion poll project by an Austrian GSM provider which links UMTS knowledge and expectations with internet and mobile usage. We will exclude subjects who do not use mobile data techniques.

Keywords: UMTS, GPRS, high-speed data, mobile phone, opinion poll, Austria
JEL: L96

Probabilistic Subset Selection in Branch–and–Bound Algorithms

Volker Stix We 15:00 - 15:30, Room HS 9
Mirjam Dür

We investigate the Branch-and-Bound method for solving nonconvex optimization problems. Traditionally, much effort has been invested in improving the quality of the bounds and in the development of branching strategies, whereas little is known about good selection rules. After summarizing several known selection methods, we propose to introduce a probabilistic element into the selection process. We describe conditions which guarantee that a Branch-and-Bound algorithm using our probabilistic selection rule converges with probability 1. Furthermore, we relate the corresponding probability measure to the distribution of the optimal solution in the bounding interval. We also show how information on the quality of the upper and lower bounds influences the choice of the subset selection rule.

Path Relinking Strategy for the Resource Constrained Project Scheduling Problem

Artem Stolyar Tu 14:30 - 15:00, Room HS 4

We consider well-known resource constrained project scheduling problem. In this paper we study a hybrid approach joining the tabu search algorithm and path relinking strategy. The strategy is proposed by F. Glover and based on the big valley conjecture. The main idea of the approach lies in utilization of useful information contained in best found local optima. We define a directed graph on the feasible solution set. The nodes are feasible solutions and there is an arc between two nodes if one of them belongs to the neighbourhood of another. The graph is called neighbourhood graph. The neighbourhood is defined in such manner that the correspondent neighbourhood graph be connected. According to the path relinking strategy, a pair of nodes is selected, a path between them is designed and new point on the path is chosen. We study different ways of selecting of pair of nodes, different procedures of path designing and different rules of new point choosing. Computational results for the PSPLib data set and future research directions will be discussed as well.

Experimental Analysis of Algorithms for Goods Transportation Networks with Telematic Services

Giovanni Storchi Tu 11:30 - 12:00, Room HS 3
Paolo Dell'Olmo, Monica Gentili

In the area of e-commerce a new typology of distribution problem arises: optimizing freight flows in a more flexible environment with the possibility to use telematic auctions, opened as soon as transport need rises up, giving transport management to the best offer. In this scenario a transportation agency has to decide, in short time, whether satisfy the new transport demand or not and make a challenging proposal to win the auction. That is, given the pair (p,d) of pick up and delivery points for a new transport, knowing the a priori duties, the actual position of its fleet and the residual capacity of the vehicles, the transportation agency has to evaluate quickly the minimum additional cost to be sustained in order to cover the new demand and make a profitable offer to the auction. For this NP-Hard problem we design a heuristic procedure to solve on-line problems and discuss the algorithm behavior through an extensive set of experimental results derived from a dynamic pick up and delivery environment.

Verfahren zur Risikokapitalallokation im Eigenhandel von Banken

Mario Straßberger Th 9:30 - 10:00, Room HS 3

Das Marktpreisrisiko von Handelsportfolios wird im Rahmen interner Risikomodelle durch den Value-at-Risk quantifiziert. Die Bankenaufsicht fordert, daß durch die Bank ein Limitsystem für Marktpreisrisiken einzurichten ist, daß auf dem internen Risikomodell aufbaut. Der Erfüllung dieser Forderung wird in der Praxis durch noch sehr unbefriedigende Ansätze nachgekommen. Von Seiten der wissenschaftlichen Auseinandersetzung standen bisher vor allem quantitative Methoden zur Value-at-Risk-Schätzung und die Beurteilung der Güte dieser Methoden im Mittelpunkt. Aspekte der Risikosteuerung, der Allokation des Risikokapitals und des Aufbaus eines Limitsystems fanden bisher kaum Beachtung. Die aus dem Value-at-Risk-Konzept bekannten analytischen und simulationsbasierten Verfahren werden deshalb in diesem Beitrag auf neue Fragestellungen angewendet. Das betrifft in erster Linie Fragen der effizienten Allokation von Risikokapital und des Aufbaus eines konsistenten Limitsystems für die hierarchische Portfoliostruktur des Eigenhandels einer Bank.

1. Problemstellung
2. Value-at-Risk-Modelle
   (a) Definition Value-at-Risk
   (b) Analytische Modelle
   (c) Simulationsmodelle
3. Risikokapitalallokation
   (a) Risikotragfähigkeit und Risikokapital
   (b) Risikokapitalallokation auf Basis analytischer Modelle
      i. Optimierungsansatz
      ii. Konsistentes Value-at-Risk-Limitsystem
   (c) Risikokapitalallokation auf Basis eines Simulationsmodells
4. Zusammenfassung

Estimating Multivariate Conditional Distributions - An Application to the Truck Demand Forecast

Eric A. Stützle
Tomas Hrycej

Tu 14:30 - 15:00, Room E0.05

A concept for forecasting the conditional multivariate distribution has been developed. It allows the forecast of the joint distribution of target variables in dependence on explaining variables. The maximum likelihood principle is used to identify the multivariate distribution of forecast variables, conditional on given attributes of the forecast context. The concept can be applied to general distribution families such as stable or hyperbolic distributions.

The conditional distribution parameters are estimated by a global optimization method, using neural networks for functional approximation. The goal is to construct a general attribute-based forecast model, which can be applied to either existing or novel cases with their attribute combinations. The information about a complete distribution of forecasts can be used to quantify the reliability of the forecast, or to determine optimum decisions.

A comparison with conventional forecasting concepts is done and the additional benefit of forecasting conditional distribution in general, and of hyperbolic distribution in particular is shown.

The concept is illustrated on a case study concerning the future truck demand. In this application, the distribution parameters are conditional on properties of the product, economic indices and information about existing orders.

Multiple Criteria Discrete Programming Models for Project Management

Tomas Subrt

Tu 9:30 - 10:00, Room HS C

The aim of the paper is to present one possibility of how to model and solve a critical path problem in an activity on node (AON) networks, where the task duration depends on the amount of available resources. A spreadsheet representation of so defined multiple criteria model is shown and one example is solved using Excel Add In Tools. In the first part a critical path problem for activity on arc (AOA) network is converted into an AON problem. In such AON model two different kinds of variables occur. First of them defines activities (nodes), the second one defines dependencies between them (arcs). Let's assume the dependencies between activities are finish to start and have constant cost in the meaning of minimum time interval between end of the previous activity and start of the next one. Furthermore assume that the activity costs in the meaning of their duration are not constant and that their durations depend on the number of resource units allocated to them. In a single criterion model only one resource influences a task duration and a critical path in a network depends on its availability for each task. A critical path is found using AON discrete (bivalent) programming model. Using optimal solution sensitivity analysis some relationships between the amount of resources for each noncritical task and its slacks is described. Thanks to a structure of so defined bivalent programming model, a standard linear programming formulas for cost stability intervals can be used. In the second part of the paper more criteria functions for this model are defined. Let's assume that each activity needs more than one resource for its completion. If a task uses more then one resource, its duration usually depends on only one of them- other resources are not fully used. The task duration does not depend on only one (maximally used) resource. Theoretically there can be defined as many criteria functions as the number of project's resources. Using weighted criteria function aggregation (where weights have a meaning of relative importance of each resource for the project) a compromise critical path can be found. On this path some resources are overallocated and some are underallocated but the total sum of underallocation and overallocation is minimized.

Ein dynamisches Verhandlungsmodell zur Bestimmung gemeinsamer Bestell- und Produktionspolitiken in Supply Chains

Eric Sucky Th 9:00 - 9:30, Room HS 1

Quantitative Modelle zur Abstimmung von Teilprozessen in Supply Chains haben ihren Ausgangspunkt in der Überlegung, dass in den Entscheidungen über den Material- und Informationsfluss zwischen den Stufen der Supply Chain die ökonomischen Auswirkungen der Entscheidungen auf den betrachteten Stufen zu berücksichtigen sind. Die Abstimmung der Bestell- und Produktionspolitik zwischen Zulieferern und Abnehmern stellt den Untersuchungsgegenstand dieses Beitrags dar. Erfolgt die Koordination der Supply Chain Partner nach dem heterarchischen Prinzip, so treffen die Akteure ihre Entscheidungen durch gegenseitige Übereinkunft im Rahmen von Verhandlungen. Während produktionswirtschaftliche und logistische Planungsansätze durch die Dominanz zentraler bzw. hierarchischer Koordinationsprinzipien gekennzeichnet sind, eignen sich spieltheoretische Ansätze in besonderer Weise, die strategische Interaktion zwischen den Akteuren in der Supply Chain abzubilden. Im Rahmen dieses Beitrags wird der Fall der symmetrisch verteilten Verhandlungsmacht analysiert, wonach keiner der Akteure über die Verhandlungsmacht verfügt, seine individuell optimale Lösung durchzusetzen. Das Problem der Bestimmung einer integrierten Bestell- und Produktionspolitik wird in einem Planungsmodell mit vektorwertiger Zielfunktion abgebildet. Es wird die vollständige Lösung, d.h. alle funktional-effizienten, gemeinsamen Bestell- und Produktionspolitiken ermittelt. Im Rahmen axiomatischer Ansätze zur Bestimmung von Verhandlungslösungen wird vom Verlauf des Verhandlungsprozesses abstrahiert und es werden sogenannte “Schiedsrichterlösungen” ermittelt. Ziel dieses Beitrags ist es, den Verhandlungsprozess bei symmetrisch verteilter Verhandlungsmacht explizit zu modellieren. Auf der Basis des Zeuthen-Harsanyi-Spiels wird ein dynamisches Verhandlungsmodell zur Bestimmung der Bestell- und Produktionspolitik entwickelt und analysiert.

Stochastic PERT modelling

Tamás Szántai
András Prékopa, Jianmin Long Mo 16:30 - 17:00, Room HS 4

A PERT network will be considered. The durations of the activities are supposed to be bounded random variables. We are interested in the probability distribution of the critical path length. Two different approaches will be presented. One of them enumerates all paths between the origin and terminal nodes, eliminates those which may not become critical then approximates the joint probability distribution of the remaining path lengths. The other method determines the earliest starting times of the activities prescribing a joint probabilistic constraint for the lengths of all activities and minimizing the earliest starting time of the last (maybe virtual) activity. Some numerical illustrations and computational results will also be presented.

Bayesian Estimation of the Heston Stochastic Volatility Model

Leopold Sögner
Sylvia Frühwirth-Schnatter Tu 9:30 - 10:00, Room E0.05

Modern option pricing theory demands for models where a closed form expression for the price of an European call option is available and some characteristic features of financial time series can be incorporated into the model. A first yardstick when considering option pricing theory is the Black-Scholes (BS) or Samuelson model. The model implies that aggregate returns are normal; the variance of the returns is constant. Despite the fact that a closed form solution for an European call option is well known, this model suffers from the fact that it does not incorporate important stylized features of financial time series, such as heavy tails, skewness and volatility clustering.

With the goal to improve the BS model, stochastic volatility models have been introduced. These models share the property that the volatility term follows a stochastic process. Volatility is either driven by a diffusion, e.g. a square root processes (Hull and White, 1987) or Ornstein-Uhlenbeck-processes (OU) for the log volatility (Andersen and Lund, 1997), or by a Levy process with jumps, e.g. Barndorff-Nielsen and Shephard (2001).

Regarding to an estimation of the model parameters, the stochastic models suffer from the fact that the likelihood is not available. In the current work we investigate estimation of the Heston (1993) model where volatility follows a square root process. For this model a closed form solution of the characteristic function of a call option is available. By augmenting the parameter space by increments in integrated volatility and volatilities an exact Bayesian analysis becomes possible by applying Markov-Chain Monte Carlo methods (MCMC-sampling). The goal of work is an exact Bayesian analysis of the Heston (1993) stochastic volatility model, where different parameterizations of the latent volatility process and the parameters of the volatility process will be used to improve convergence and the mixing behavior of the sampler.

Ill-conditioned QAP instances

Eric Taillard
Drezner, Hahn

We 9:00 - 9:30, Room HS 2

The quadratic assignment instances frequently used in the literature are relatively well solved by heuristic approaches. Indeed, solutions at a fraction of percent from the best solution values known are rapidly found by most heuristic methods. Exact methods are not able to prove optimality for these instances as soon as the problem size approach 30 to 40. In this talk, we present new QAP instances that are ill-conditioned for many metaheuristic-based methods. However, these new instances are relatively well solved by exact methods.

Scheduling of coupled tasks

Michal Tanas
Jacek Blazewicz, Klaus Ecker, Tamas Kis

We 12:00 - 12:30, Room HS 4

We consider a problem of scheduling of coupled tasks in this paper. A task is called coupled if it contains two operations, where the second has to be processed some time after a completion of the first one. This problem often appears in radar-like devices, where the first operation is the transmission of an electromagnetic pulse and the second is the reception of its echo. The scheduling problems where tasks are coupled are usually hard combinatorial problems. Most of the solved problems are proven to be NP-complete, and polynomial algorithms are found only in few cases. In this paper we consider a problem of coupled tasks scheduling on a single machine, where all processing times are equal to 1, the gap between operations has exact length, precedence constraints are strict an the criterion is to minimise schedule length. We prove NP-completeness of this problem, using a problem of colouring of a particular class of graphs as an intermediate stage of transformation.

Measurement Invariance and Finite Mixture Confirmatory Factor Analysis

Dirk Temme

Mo 14:30 - 15:00, Room HS 2

Measurement invariance (e.g., Meredith 1993) is a key concern in extending theoretical marketing constructs and their associated measurement instruments to other countries. In order to assess measurement invariance in a cross-cultural setting a comprehensive testing procedure based on multigroup confirmatory factor analysis has been proposed (e.g., Steenkamp & Baumgartner 1998). This approach is also useful in intra-country studies when possible sources of heterogeneity can be observed a priori (e.g., buyers vs. non-buyers). An interesting question which follows from this is if the testing procedure is likewise transferable to a finite mixture analysis of populations or samples consisting of several latent groups (e.g., various customer segments) which might differ to a certain degree with respect to the underlying factor model (unobserved heterogeneity). As shown below, in this case specific problems arise which require a modification of the testing procedure.

Basically two different types of factor models in the context of finite mixture structural equation modeling can been distinguished (Yung 1997): In the Shifting Means Model (SMM) factor means are constrained to zero in all groups and the intercepts of the measurement relations are unrestricted across groups. In contrast, the Common Regression Model (CRM) assumes that the intercepts are constrained to be equal across groups and factor means are unrestricted except for one class where the mean is fixed to a constant (e.g., zero). Since in the SMM differences between the group-specific intercepts might result due to either corresponding differences in the means or systematic biases in the way subjects in the segments respond to the measurement items, measurement invariance (scalar invariance to be more specific) cannot be tested by using this type of model. Therefore, only the CRM seems adequate for this task. If this model cannot be rejected by the data, measurement invariance across the latent segments is established. Contrary to the SMM, the CRM, however, is only weakly identified as Lubke, Muthén and Larsen (2001) have shown. In their simulation study this led to serious problems in the identification of the true number of groups and in the parameter recovery. A further important result of their study is that the existence of a few invariant items (i.e. a partially measurement invariant factor model), seems to greatly alleviate this problem.

Against this background a procedure for assessing measurement invariance in finite-mixture confirmatory factor analysis is proposed and applied in an empirical study on the measurement of customer-based brand equity. Data from a large-scale consumer survey on attitudes towards competing brands in the fast-moving consumer goods industry are analyzed using Mplus (Muthén & Muthén 1998).

Regulatory Impacts on Credit Portfolio Management

Ursula Theiler
Stanislav Uryasev

Tu 14:30 - 15:00, Room E1.05

Actual discussions of the new capital adequacy proposals by the Basle Committee on Banking Supervision enlighten the necessity to regard credit risk management from different perspectives, the internal and the regulatory point of view. In this paper we examine which impact the current regulatory risk limitation rules have on credit portfolio management. We optimize a credit portfolio with respect to different constraints. First we conduct a risk-/return portfolio optimization as a generalized risk-/return portfo-lio optimization problem (P), based on the risk measure of the conditional value at risk (CVaR), that has been proved to be appropriate for credit risk measurement [3,5]. This problem is solved by an optimization algorithm by Rockafellar-Uryasev [4,5]. In a next step, we obtain an optimization model (P') by adding further constraints to the model that map the current regulatory capital rules. We compare the efficient portfolios and the resulting risk-/return ratios within the portfolios generated by the optimization prob-lems (P) and (P') [4,5]. By a simplified bank portfolio we visualize how the current regulatory risk limitation rules can lead to inefficiencies of credit portfolio management [7].

References

[1]Bertsimas, Dimitris; Lauprete, Geoffrey J.; Samarov, Alexander, Shortfall as a risk measure: Properties, optimization and applications, Sloan School of Management and Operations Research, Massachusetts Institute of Technology, Cambridge MA (Hrsg.), Working Paper, Cambridge, MA, October 2000.

[2]Patrik, Gary; Bernegger, Stefan; Rüegg, Marcel Beat, The use of risk adjusted capi-tal to support business decision making, in: Casualty Actuarial Society (Hrsg.), Casualty Actuarial Society Forum, Spring 1999 Edition, Baltimore 1999.

[3] Pflug, Georg: Some Remarks on the Value-at-Risk and the Conditional-Value-at-Risk, in: Uryasev, S. (Ed.) Probabilistic Constrained Optimization: Methodology and Applications, Kluwer Academic Publishers, 2000, pp. 272-281.

[4]Rockafellar, T., Uryasev, S. (2000): Optimization of Conditional Value-At-Risk. The Journal of Risk, Vol. 2, No. 4, pp. 21-51.

[5]Rockafellar R.T. and Uryasev. S. (2002): Conditional Value-at-Risk for General Loss Distributions. Journal of Banking and Finance, 27/7.

[6]Tasche, D. (1999): Risk Contributions and Performance Measurement, Working Paper, Technische Universitaet Muenchen.

[7]Theiler, U. (2002): (in German) Optimization Approach for the Risk-/Return-Management of the Bank Portfolio, Wiesbaden, April 2002.

Inventory Management of Products with Short Life Cycles

Ulrich Thonemann
Kaijie Zhu

Tu 14:00 - 14:30, Room E0.05

Short product life-cycles are becoming increasingly common in many industries, such as the PC and mobile phone industries. Traditional forecasting methods and inventory policies can be inappropriate to forecast demand and to control inventory of a product with a short life-cycle because they do not take the characteristics of the demand pattern into account, which can result in inaccurate forecasts, high costs, and low service levels. Traditional forecasting methods also often require a significant demand history, which is only available after the product has been sold for some time. In this paper, we present a forecasting algorithm with two characteristics. First, it uses structural knowledge on the demand to model the demand pattern. Second, it combines knowledge on the demand that is available prior to the launch of the product with actual demand data that become available after the introduction of the product to estimate and adjust the parameters of the demand pattern. Based on our adaptive forecasting algorithm, we develop an optimal inventory policy. Since the optimal inventory policy is computationally expensive, we propose three inventory heuristics and show in a numerical study that one of the heuristics generates near-optimal solutions. The evaluation of our approach is based on demand data from a leading PC manufacturer in the US, where our algorithm has been implemented.

Easy Quantification of Improved Spare Parts Policies

Ulrich Thonemann
Alex Brown, Warren Hausman

We 15:00 - 15:30, Room HS 1

We present approximate analytical models to quantify the expected improvement in inventory investment when using a system approach to control inventory as opposed to a simpler item approach. A system approach ensures that a demand-weighted average fill rate is achieved at low inventory investment by assigning low fill rates to parts with high costs and high fill rates to parts with low costs. An item approach does not vary fill rates by parts but assigns identical fill rates to all parts. Using single-parameter functional representations of the skewness of unit costs and average demand across all parts in the system, simple approximate analytical expressions for the required inventory investment are derived for both approaches. The accuracy of the approximations is validated using data from a distribution center for computer spare parts. For these data, the solutions obtained by the approximations are very close to the exact values. The results show that inventory investments can be well-approximated as a function of only a few cost and demand parameters. These expressions can be used to determine the percentage reduction in inventory investment for a particular target demand-weighted average fill

rate when the superior system approach is used instead of the item approach. For increased ease of use, the percentage reduction in inventory when using a system as opposed to an item approach is computed over a range of realistic values for the key parameters of the model and a quadratic expression is fitted to the data. This fitted expression provides rough guidelines for the anticipated improvement with very limited data needed, prior to detailed modeling or implementation.

Conditional Value-at-Risk in Stochastic Integer Programming

Stephan Tiedemann Mo 17:00 - 17:30, Room HS 9
Andreas Märkert, Rüdiger Schultz

In classical two-stage stochastic programming the expected value of the total costs is minimized. Recently, mean-risk models - studied in mathematical finance for several decades - have attracted attention in stochastic programming.

We consider conditional value-at-risk as risk measure in the framework of two-stage stochastic integer programming. The talk addresses structure, stability and algorithms for this class of models.

In particular, we study continuity properties of the objective function, both with respect to the first-stage decisions and the integrating probability measure. Further, we present an explicit mixed-integer linear programming formulation of the problem when the probability distribution is discrete and finite. Finally, a solution algorithm based on Lagrangean relaxation of nonanticipativity is proposed.

A comparison of heuristic methods for path decompositions of graphs

Peter Tittmann We 15:00 - 15:30, Room HS B
Udo Junghans

Many NP-hard combinatorial optimization problems are solvable in polynomial time in graphs of restricted pathwidth. However, the complexity of the corresponding algorithms incorporates a constant that grows exponentially with the width of the path decomposition. Finding an optimal path decomposition is itself an NP-hard problem. We investigate here different heuristic methods including dynamic programming of restricted search depth, local search techniques, and spectral methods. Many heuristic methods can be controlled by parameters like search depth or number of iterations. Another important factor is the choice of the objective function. The sum of an exponentially increasing function of the sizes of separating vertex sets arising in each step of the algorithm may be in some cases a better choice of an objective function than the width of the path decomposition. The function of separator cardinalities used here is e.g. the Bell number (for partition problems like coloring or network reliability) or simply a power of 2 (in case of subset problems like independent set). Detailed results of numerous examples and different methods are presented.

A New Setup Cost Oriented Resource Leveling Measure for Projects

László Torjai Tu 17:30 - 18:00, Room HS 4

This paper presents a new setup cost oriented resource leveling measure for the single resource case. In the proposed exact model the desired resource usage histogram shape is defined as “appressed concave” one. The model is formulated as a mixed integer LP problem, where the “concave shape” is characterized by the number of interruptions. The LP problem may be solved directly in the case of small-size problem instances. In the case of medium-size projects, the algorithm of the proposed model may be formulated as a tree-search problem with effective pruning rules. According to the NP-hard nature of the problem, the proposed implicit enumeration algorithm provides exact solutions for small to medium size problems. For large-scale problems a simple ‘beam-search’ heuristic may be developed by constraining the size of the searching tree. In order to illustrate the essence of the model computational results for two problems are presented. The first problem is the “largest” resource leveling problem discussed in the open literature, the second problem is a “really hard” instance from the well known Patterson’s set.

Online Dispatching of Automobile Service Units in Real Time

Luis Torres We 9:00 - 9:30, Room HS 3
Martin Groetschel, Sven O. Krumke, Joerg Rambau

Given a set of service requests (events), a set of guided servers (units), and a set of unguided service contractors (conts), the vehicle dispatching problem VDP is the task of finding an assignment of events to units and conts as well as service tours for all units, such as to minimize a certain objective function. The objective measures the service, overtime and driving cost for the units and fixed charge costs for the conts. Whenever an event is served later than its deadline, a linear

penalty charge is added. In the online version of the VDP, events arise continuously during the planning process and must be integrated into the existing dispatch in real time.

The German automobile association ADAC (Allgemeiner Deutscher Automobil-Club), second in size only to the American Automobile Association (AAA), maintains a heterogeneous fleet of over 1600 units (yellow angels) to help people whose cars break down on their way. As part of their daily work at one of the five ADAC help centers distributed over Germany, human dispatchers constantly face large problem instances of the online VDP, which may involve (at a certain snapshot) as many as 215 pending events and 95 available units. We present preliminary results on the development of an online algorithm for automating the dispatching task. Its core consists of the offline module ZIBDIP, which is based on dynamic column generation and set partitioning, and yields solutions within 1% from optimum to heavy-load real-world instances.

DNS Thresholds in Optimal Control of Illicit Drug Use

Gernot Tragler Tu 11:30 - 12:00, Room HS 7

During the last quarter of a century, dynamic optimization models with multiple steady states have been studied in numerous areas of economics. The corresponding history-dependence of optimal paths constitutes a low-level form of complexity. The purpose of the presentation is to illustrate this fact for several models in the control of illicit drug consumption, which are validated with empirical data. In one of the models, the dynamics of the current U.S. cocaine epidemic subject to law enforcement and treatment is studied. Another part augments this model by taking into account the fact that enforcement activities influence not only the drug dynamics but also property crime. In a further application, the influence of methadone maintenance treatment on the spread of HIV/HCV among injection drug users is investigated. In all cases, a positive feedback effect, i.e. state-dependent initiation, seems to be responsible for the occurrence of 'Dechert-Nishimura-Skiba points' separating the basins of attraction of the multiple steady states.

Scheduling of Rolling Ingots Production

Norbert Trautmann We 14:30 - 15:00, Room HS 1

The industrial context of this talk is a scheduling problem arising in aluminium industry. We treat the production of rolling ingots, i.e. ingots of a certain aluminium alloy in rectangular form. These ingots are the starting material for the rolling of sheet, strip, and foil, which are mainly used in the packaging, automotive, printing, and construction industries.

The production flow is as follows: In a potroom, the ingredients composing the alloy are smelted in an electrolytical process. In general, several alternative potrooms are available. One or several casting units belong to each potroom. A casting unit consists of a holding fixture for the mould, a retractable hydraulic cylinder named stool, and a so-called stool-cap, which closes the mould at the lower end at the start of the casting process. The melt is cast through a mould which determines the cross-section of the ingot. As soon as the metal in the mould starts to solidify, the stool is lowered and the ingot thus formed is cooled by spraying it with water. The maximum stroke of the stool determines the maximum cast length, i.e., not every ingot can be produced on each casting unit. However, all casting units belonging to one potroom are of the same height. After the completion of the casting process, the ingot stays some time in the casting unit for cooling. All ingots produced within one casting are of the same alloy and same length. When passing to the casting of an ingot with a different cross-section, the mould of the casting unit has to be changed. The changeover can only be performed when no casting is in process. Moreover, only one mould per potroom can be exchanged at a time.

The production scheduling problem consists of computing a feasible production schedule with minimal makespan for a given set of production orders for ingots characterized by their size and alloy. We will show how to model this production scheduling problem using concepts of resource-constrained project scheduling. The potrooms correspond to so-called batching resources known from machine scheduling. A batching resource is a production facility where operations running in parallel must be started at the same time and must be of the same type. We will briefly present a solution procedure which enumerates the alternative ways of replacing the resource constraints by appropriate time lags between start times of operations.

Berger Elektromotoren: Umsetzung für WWW-basiertes Lernen

Jeannette Trela We 17:30 - 18:00, Room HS 5
Christoph Haehling von Lanzenauer, Paul Staehly

Fallstudien haben sich als besonders effektiv in der Lehre von OR/MS erwiesen, was zu einem ganz wesentlich Teil auf das hohe Maß an Interaktivität zwischen dem Lehrenden und den Lernenden zurückzuführen ist. Angesichts des Trends zu neuen Lehr- und Lernformen, insbesondere WWW basierten Programmen, wird der Versuch unternommen, Fallstudienanalysen indiese Formen einzubeziehen. Die Herausforderung besteht nun darin, diese Interaktivität so gut wie

möglich zu duplizieren. Im Rahmen der Fallstudie Berger Elektromotoren werden hierzu Ideen und Ansätze vorgestellt und deren Umsetzung illustriert.

Multicriterion Analysis based on Multivalued Stochastic Dominance and Probabilistic Dominance in financial analysis

Grazyna Trzpiot We 17:00 - 17:30, Room E1.05

According to the expected utility paradigm, the risk of the investment must be related to the assumed preference of the investor and cannot be objectively defined. A natural quantitative definition of risk is the amount of money one is willing, on average, to pay someone else to assume the risk. In the empirical study we have problem with ranking alternatives in the area of financial issues. Markovitz method for ranking alternatives was comparing means and variances of two alternatives (mean-variance criterion). Rothschild and Stiglitz fine risk for two distributions characterised by the same expected return. They used stochastic dominance rules for definition of risk. In the empirical study when we have not stochastic dominance, we using a concept of the probabilistic dominance. The multicriterion formulation of a decision situation can be defined as a model of three components: the set of attributes, the set of actions and the set of evaluations. Each pair (attribute, action) is described by vector of evaluation, which may be of different nature. In our work this set of vectors have the multivalued random components. In multicriterion analysis under uncertainty we apply Stochastic Dominance and Probabilistic Dominance procedures for help in the decision making process, in the case of multivalued alternatives. We made an empirical application of such a multicriterion multivalued model: evidence from the Warsaw Stock Exchange.

Model and the Latent Class Model - With an Application from Metric Conjoint Analysis

Regina Tüchler
Sylvia Frühwirth-Schnatter, Thomas Otter Tu 9:30 - 10:00, Room HS 2

In this work the general heterogeneity model, which is a model with a mixture of random effects, the random coefficient model and the latent class model are compared in a fully Bayesian framework. Our special interest lies in what is gained by the general heterogeneity model in comparison to the random coefficient model and the latent class model. Our application comes from Conjoint analysis, a procedure that is focused on obtaining the importance of certain product attributes and their significance in motivating a consumer torward purchase from a holistic appraisal of attribute combinations. Our data come from a brand - price trade off study in the mineral-water category. Each of 213 Austrian consumers evaluated their likelihood of purchasing 15 different product-profiles offering five different brands of mineral-water at different prices on 20 point rating scales. The goal of the modeling exercise is to find a model describing consumers' heterogeneous preferences towards the different brands of mineral water and their brand-price trade offs. Estimation of the model is carried out for a fixed number of groups using a MCMC sampling scheme. We estimate various models for our data, the general heterogeneity model, varying the number of groups, the special case of the latent class model, also varying the number of groups and the special case of the random coefficient model. Calculation of the model likelihoods indicates that the general heterogeneity model is most appropriate. We compare to which extent the different models capture heterogeneity. We avoid label switching by introducing an appropriate constraint and estimate group specific parameters from simulations of the permutation sampler. We estimate predictive densities for additional hold out data and compare the different models through their ability to predict. We compare the performance of different models by calculating the standard hold out criterions, mean squared error and first hit choices.

Minimal Covers and Resource Constraints in Scheduling

Marc Uetz
Frederik Stork Mo 14:30 - 15:00, Room HS B

Given an arbitrary independence system, the minimal dependent sets are called the minimal covers of the system. We establish several complexity results related to the computation and enumeration of the minimal covers of an independence system. In particular, we show that minimal covers of an arbitrary independence system cannot be enumerated in polynomial time in terms of the in- and output size of the problem, unless P = NP. This result, however, leaves the possibility of efficient algorithms for special independence systems, in particular those that are explicitly given as the set of feasible $\{0,1\}$-solutions of a linear inequality system $[A,b]$. The latter type of independence systems is ubiquitous in the solution of resource constrained scheduling problems, where the minimal covers correspond to subsets of jobs that must not be scheduled simultaneously. Motivated by applications in scheduling, we propose a backtracking algorithm that generates a complete representation of all minimal covers of a linear inequality system $[A,b]$. For special cases, the algorithm is shown to be polynomial in terms of the in- and output size. For the general case, examples show that the algorithm can

be non-polynomial. In a computational study with instances from the scheduling problem library PSPLIB, the algorithm exhibits improved performance compared to a previously suggested divide-and-conquer approach.

Valuation of Simulation in the field of Operations Research

Heinz Ulrich Mo 17:00 - 17:30, Room HS 8

In academia, there is a relatively clear separation between the simulation and the Operations Research community to recognize. Even if most OR people include Simulation in their set of accepted methods its valuation by their community is rather low. Simulation is regarded as the last resort if there is no exact method available to solve problems. Simulation in comparison with other methods in OR has its particularities. Simulation doesn't provide a solution of a problem; it shows how a system behaves under well-defined conditions. Simulation could therefore be used together with other OR-methods in a complementary way, first a simulation to get to understand the problem and in the following the solution of the problem by traditional OR-methods. This symbiotic way of applying simulation together with other OR-methods is to observe relatively seldom in projects. The reasons may be the following: -In Simulation and in the traditional OR field modeling differs fundamentally. Whereas in Simulation modeling is focused on the real system, modeling is focused already on the potential solution method in traditional OR. - The questions addressed in Simulation projects concern mostly system behavior, system design sensitivity to parameter changes, detection of bottlenecks whereas in traditional OR projects optimal control, optimal design, performance limits are the envisioned targets. - The complexity of real world systems is often so high, that an exact analytical description, as required in traditional OR, is not feasible with reasonable effort. In this situation, Simulation is the only available method. As a result of my participation at several conferences in Simulation as well as in traditional OR in the past 30 years, I identified the following deficits in the respective communities: - In the simulation community I have often missed a thorough investigation of the performance limits of the system as well as of the decision process for system control. - The traditional OR-community often neglects a critical analysis of the practical significance of their achieved results. Finally suggestions to bridge the gap between these two communities are discussed.

Fuzzy approach to the air traffic control

Janez Usenik Tu 14:00 - 14:30, Room HS 10

Development and especially application of fuzzy logic into solving a lot of real problems and jobs is more and more variety and universal. Fuzzy set theory provides a means for representing uncertainties. In reasoning about a complex system humans reason approximately about its behavior thereby maintaining only a generic understanding about the problem. This generality and ambiguity are sufficient for human comprehension of complex systems. The results given by use of fuzzy logic are good and very applicable. In this contribution it will be done an example in fuzzy approach to the solving of traffic problems where the area of usage is very wide and variety but not enough researched. Key words: traffic system, air traffic, fuzzy logic, fuzzy variables, decision.

The Optimal Schedule for the Technological Process of Semiconductor Production

Valerie V. Trofimov
Alex O. Hluhov We 14:00 - 14:30, Room HS 1

Using of a local method follows from two points:

- the space of the task decisions is very large,

- decision space is well structured and can be divided into rather small parts - local decisions.

Set of alternatives of the local decisions is a population, which is growing and destroying on principles of the genetic approach. As the local decision depends on other local decisions, the criterion of selection should take into account the factor of inheritance of the decisions. The inheritance is understood: some other local decisions have the best parameters when they use the given local decisions.

Maximum Principle for Age and Duration Structured Systems: a Tool for Optimal Prevention and Treatment of HIV

Vladimir Veliov We 15:00 - 15:30, Room HS 7
Gustav Feichtinger, Tsvetomir Tsache

We present a general optimal control model that extends the classical McKendrick equation of population dynamics and involves age and duration dependent states. The model consists of first order hyperbolic PDE-s and integral equations that make the dynamics nonlocal. Necessary conditions in the form of global maximum principle are derived. This principle is utilized to analyze a model of the spread of the Human Immunodeficiency Virus (HIV). The model takes into account the age of the individuals, and the duration since becoming infected with HIV. The second time-dimension is particularly important in view of the medication that prolongs the active life of the infected individuals. Utilizing the maximum principle we obtain a number of numerical results which allow to draw some interesting and non-straightforward conclusions about the trade-off between prevention and treatment.

An iterative method for decentralized resource allocation problems with multiple criteria

Rudolf Vetschera Tu 11:30 - 12:00, Room HS 10
Christian Stummer

The problem considered in this paper combines two important aspects of practical planning problems, which have so far been analyzed in different streams of literature: decentralized group decisions in a multi-criteria context on one hand and resource allocation on the other hand. Methods for multi-criteria group decision making proposed so far assume that the set of actions to be taken by the group (or its members) is given and constant. This is no longer true when the decision problem also involves the allocation of resources to group members, which determine the members' action spaces. In contrast, previous approaches to solve resource allocation problems mostly assume a hierarchical structure between decision makers, and also often neglect the presence of multiple criteria. In this paper, we propose an iterative method to solve this class of decision problems. The proposed procedure builds upon interactive multi-criteria decision methods and thus avoids the a priori specification of utility functions. By using a stepwise approach for resource allocation, members of the decision group are allowed to adapt their preferences to the actual resource situation. The proposed method is compared in computational experiments to simpler approaches modeled after earlier theoretical work and practical planing procedures.

Solving Lagrangian relaxations with a proximal analytic center cutting

Jean-Philippe Vial Mo 14:00 - 14:30, Room HS 8
O. du Merle

Lagrangian relaxation, or its dual equivalent "column generation", is often used to generate lower bounds for integer programming problems, but solving the Lagrangian dual efficiently is sometimes an issue in itself. We propose a new cutting plane method, that can be interpreted as a compromise between the Analytic Center Cutting Plane Method (ACCPM, in short) and the Bundle method We analyze the performance of the new method on the p-median problem, a special instance of partitioning problems.

Non-measurable Leading Indicators Model

Robert Volcjak Tu 15:00 - 15:30, Room E0.05
Velimir Bole

In the study, leading indicators are specified and estimated as unmeasurable common components of large pool of economic time series. Vector of economic time series is modelled as a sum of moving average of common factors and idiosyncratic components Some preliminary statistical analysis (spectral analysis, coherence) is used to corroborate such specification of the model. After pre-whitening and simple transformation of time series, model is converted into a standard factor model. Using principal components six factors are extracted which explain 80% of total variance. The factors are rotated to enable easier and more straightforward economic interpretation. It is documented that only three factors incorporate long term dynamics (low frequency peaks in the spectrum). With the help of the rotated factors we finally construct the regression leading indicator model of the reference variable.

On Adaptive Tail Index Estimation for Financial Return Models

Niklas Wagner
Terry A. Marsh

We 15:00 - 15:30, Room E1.05

Estimation of the tail index of stationary, fat-tailed return distributions is non-trivial since the well-known Hill estimator is optimal only under iid draws from an exact Pareto model. We provide a small sample simulation study of recently suggested adaptive estimators under ARCH-type dependence. The Hill estimator's performance is found to be dominated by a ratio estimator. Dependence increases estimation error which can remain substantial even in larger data sets. As small sample bias is related to the magnitude of the tail index, recent standard applications may have overestimated (underestimated) the risk of assets with low (high) degrees of fat-tailedness.

Gestaltung von Stoffstrom-Netzwerken zum Produktrecycling

Grit Walther
Thomas Spengler

Th 9:00 - 9:30, Room HS 6

Vor dem Hintergrund der auf europäischer Ebene vor der Verabschiedung stehenden Richtlinie des Europäischen Parlaments und Rates über Elektro- und Elektronikaltgeräte (WEEE) wird im vorliegenden Beitrag ein Ansatz zur Gestaltung von Unternehmensnetzwerken für die Erfassung und Behandlung von Elektroaltgeräten entwickelt. Dabei werden verschiedene Szenarien entworfen. Das derzeit bestehende dezentrale System von Einzelakteuren ohne Spezialisierung wird verschiedenen künftigen Szenarien - z.B. einem zentral organisierten strategischen Unternehmensnetzwerk und einem dezentral organisierten polyzentrischen Netzwerk mit Spezialisierung einzelner Akteure - gegenübergestellt. Die Szenarien werden anschließend einer ökonomischen Bewertung unterzogen. Dabei finden die für die Erweiterung bzw. Veränderung bestehender Strukturen erforderlichen Investitionen und Fixkosten unter Beachtung der notwendigen Kapazitäten und des innerbetrieblichen Layouts ebenso Beachtung wie die variablen Kosten- und Erlösarten. Letztere werden mit Hilfe eines linearen Optimierungsmodells berechnet, indem eine deckungsbeitragsmaximale Allokation der Stoffströme auf die sich in Größe und Spezialisierung unterscheidenden Unternehmen vorgenommen wird. Die Summe der entscheidungsrelevanten Kosten und Erlöse ermöglicht eine Beurteilung der ökonomischen Effizienz der verschiedenen Szenarien. Die Berücksichtigung derzeit fehlender Informationen bezüglich Menge und Zusammensetzung der zukünftig erwarteten Altproduktströme und der Art des Produktanfalls (zentral/dezentral, sortiert/unsortiert) im Rahmen einer Strukturanalyse ermöglicht Aussagen bezüglich der Robustheit der entworfenen Szenarien. Eine Sensitivitätsanalyse bezüglich der Recyclingquoten im Optimierungsmodell erlaubt eine ganzheitliche Bewertung der derzeit auf europäischer Ebene diskutierten Regelungen. Der entworfene Ansatz zur strategischen Planung wird exemplarisch für das Bundesland Niedersachsen (Deutschland) angewandt.

Some Improvement on the Complexity of Newton's Method for LFCO Problems

Qin Wang
Jianzhong Zhang

We 14:30 - 15:00, Room HS B

T.Radzik showed a strongly polynomial bound on the number of iterations in Newton's method for any linear fractional combinatorial optimization (LFCO) problem. The bound is $O((p \log p)^2)$, where p is the number of the input numbers. We give a lower bound $O(p^2 \log p)$ in this paper, and we discuss the construction of an instance of the LFCO problem which would require $O(p \log p)$ iterations.

A Multiple Attribute Decision Method Using Quasi-fuzzy Computation Model

Chien-Chung Wang

Tu 14:30 - 15:00, Room HS 10

This paper is applying quasi-fuzzy computation model to solve a multiple attribute decision problem. Quasi-fuzzy computation model, proposed by Wang and Ramer in 1997, was trying to compute fuzzy numbers with the membership function of any shapes using a rapid and effective method. For most multiple attribute decision problems, their attributes could be fuzzy in nature, so quasi-fuzzy computation model is applied to solve this kind of problems.

Quasi-fuzzy computation model permits for linear complexity of the arithmetic computations, while retaining a good approximation to their membership functions. For function evaluation each argument is approximated by the membership curve, whose geometric shape is a family of trapezoids, placed one above the other. The heights and the number of trapezoids are the same for all arguments. The computation is performed by the point-wise evaluation separately for the corresponding vertices of the multi-trapezoidal curves. The concluding step is to convert resulting multi-trapezoidal shape to a fuzzy number of the type matching that of the arguments. This model is universal, in that it can be applied to any fuzzy numbers. In particular, it serves well in arithmetic on mixed type arguments – a continuous and discrete ones.

In this paper, quasi-fuzzy computation model is applied to solve a multiple attribute decision problem - a personnel selecting example. The attributes for selecting a suitable person for a certain position could be crisp or fuzzy. The

solution of this example indicates that quasi-fuzzy computation model could give a good result for solving multiple attribute decision problems.

Combining bottom-up and stochastic modelling for integrated risk assessment in the electricity market

Christoph Weber We 14:30 - 15:00, Room HS 6

The high price volatility observed on liberalised electricity spot markets poses extreme challenges for risk management and strategic decision making as illustrated by the recent developments in the U. S. and in Germany. In order to cope with this volatility, price models are needed which reflect the particularities of the electricity market, notably the non-storability of electricity. On the other hand, also the experience from other commodity markets has to be integrated in any model for electricity prices. Modelling prices as the outcome of the expected equilibrium of supply and demand, certainly offers the advantage of coping with the non-storability of electricity and the specific production conditions. But this does not allow to cope with the volatility induced by trading operations, which exceeds considerably the one implied by the fluctuations in demand and plant outages. Therefore, an integrated approach has been developed, which combines a stochastic model of the primary energy market, a fundamental model of electricity generation (LP-model) and another stochastic model of electricity trading. Thereby it can be shown, that characteristics of the fundamental model, such as the gradient of the merit-order curve, provide good explanatory factors for the price level and volatility described by the stochastic processes. The model has been applied to the German electricity market including its interconnections with the rest of Europe. Both, price and volatility forecasts are compared to the actual prices observed at the power exchange.

Bend Minimization in Graph Drawing Using Mixed Integer Programming

René Weiskircher
Petra Mutzel Th 11:00 - 11:30, Room HS B

We consider the problem of minimizing the number of bends in an orthogonal planar graph drawing. While the problem can be solved via network flow for a given planar embedding of a graph G, it is NP-hard if we consider the set of all planar embeddings of G. Our approach combines an integer linear programming (ILP) formulation for the set of all embeddings of a planar graph with the network flow formulation for fixed embeddings. We report on computational experiments on a benchmark set containing hard problem instances that was already used for testing the performance of a previously published branch & bound algorithm for solving the same problem. Our new algorithm is about twice as fast as the branch & bound approach for the graphs of the benchmark set.

Fast Cactus Construction for Support Graphs of TSP-Related Problems

Klaus Wenger
Gerhard Reinelt Tu 11:30 - 12:00, Room HS B

A new algorithmic approach to the construction of the cactus representation of the set of all global minimum weight cuts of a graph is presented. The representation due to Dinits, Karzanov and Lomonosov stores the set of all mincuts of an n-vertex graph in $O(n)$ space and mirrors the inclusion- and intersection-structure of the set.

A cut in a graph is defined as a non-empty proper vertex subset. The input of the new algorithm is a connected undirected graph with strictly positive edge weights and a special property: Every vertex is a mincut. Support graphs in the branch-and-cut approach to traveling salesman, vehicle routing and similar problems have these properties. Such graphs are, for instance, encountered in connection with the ATSP, STSP and CVRP. Support graphs of these problems deserve special treatment. The ideas presented also apply to more general graphs. Several cutting-plane generation approaches can benefit from fast cactus construction. Often an elegant representation of all mincuts in terms of access time and storage space is desirable.

Unlike most previous cactus construction approaches, the new algorithm does not follow the so-called Karzanov-Timofeev framework or a variation of it. The idea of the new deterministic algorithm is intuitive and based on mincuts that do not properly contain any other material mincut. We repeatedly search such mincuts, construct the corresponding part of the cactus representing them, and finally shrink them in the input graph.

Fleischer's approach [J. Algorithms, 33(1):51-72, 1999] to build cacti using the Hao-Orlin mincut algorithm is among the fastest proposed to date. We use this state-of-the-art approach as benchmark. The new algorithm shows an average speed-up factor of 20 for preprocessed TSP support graphs. We report computational results. Compared with the benchmark, we reduce the space required during construction for n-vertex graphs with m edges from $O(n^2)$ to $O(m)$.

Gas Pipeline Optimization under Uncertainty

Markus Westphalen
Tobias Heidenreich, Rüdiger Schultz

Tu 15:00 - 15:30, Room HS 9

Gas transmission and distribution in a pipeline system is modeled by means of linear mixed-integer optimization. We develop a stochastic integer program for maximizing revenue in the presence of uncertain consumer demand. A decomposition method based on Lagrangian relaxation of nonanticipativity and branch-and-bound is employed to solve the stochastic program. Some first computational experiences are reported.

Nonlinear Optimization in CHP Applications

Michael Wigbels
M. Lucht, W. Althaus

We 11:30 - 12:00, Room HS 6

At the Fraunhofer Institute UMSICHT a nonlinear model has been developed facilitating the dynamic optimization of combined heat and power production systems. The strategy called “dynamic supply temperature optimization” is a very promising approach to use the DH-network itself as a large heat storage at no additional investment cost. The pipeline system of a district heating system has a huge potential for the storage of energy. Especially for the application of renewable energies the optimal use of this storage capabilities will increase the overall efficiency. In particular for CHP systems with fixed heat coupling (back pressure turbines), this approach could enable a reduction of active heating plants and the displacement of expensive peak power plants. It will reduce electrical power peaks and enables a better utilization of tariffs. Target of the supply temperature optimization is it to find the operating point at which the power requirements (heat and electrical energy) of the consumers can be covered with minimum operating cost as the objective function in the mathematical optimization model. To determine the optimal values of the variables, the system performance as well as the technical and contractual restrictions have been considered. These are e.g. the energy purchase contracts, the characteristics of the energy conversion plants, the power requirement of the consumers and the dynamic behavior of the DH network. On the basis of configuration and calculation data an optimization model has been formulated under application of modern EDP supported optimization procedures. As results of these optimization model the optimal courses of the supply temperatures of the individual suppliers, the electrical and thermal input powers as well as the storage powers etc. can be received.

Efficient LU Factorization of the Hawkins-Simon Condition

Reiner Wolff

Mo 13:30 - 14:00, Room E0.05

An input-output technology with intermediate inputs is said to be productive or viable if it allows for positive net amounts of every commodity. Each division or sector will then contribute less than one unit of direct and indirect intermediate inputs to the making of one unit of its own output. Equivalently, the leading principal minors of the technology’s associated Leontief matrix are all positive (Hawkins-Simon condition). We demonstrate that the minors can be checked efficiently in the course of a triangular factorization of this matrix.

Using Multicriteria Decising Making in Loss Reserve Calculation Process in Insurance Company

Alicja Wolny

Tu 9:00 - 9:30, Room E1.05

The loss reserve calculation is a very important problem in insurance corporations because this determines the future financial standing. Nowadays there are some numbers of statistical methods which can be used to calculation the level of loss reserve. But it is not easy to say which method is the best in particular situation and which one should be applied in practice.

We propose to consider loss reserve calculation as a multicriteria decision making problem. Such approach enables to take into consideration two asoects: results obtained by various actuarial methods, individual decision maker’s (DM’s) preferences which come from corporation financial standing and market strategy. In the first part of this paper we shortly define the loss reserve and present main actuarial methods of calculating this reserve. In the next part we propose the multicriteria model for loss reserve’s level selection in which we consider two type of objectives: describing the financial standing of insurance company and describing the loss development process. This model support the DM according to DM’s preferences. After that we apply Interactive Multiple Goal Programming (IMGP) in the decision support process to solve the problem. Finally we present some concluding remarks.

Modelling the interaction between operational and financial decisions in the inventory pooling of repairable spare parts problem

Hartanto Wong Th 9:30 - 10:00, Room HS 1
Dirk Cattrysse, Dirk Van Oudheusden

The typical problem in the repairable inventory systems is to determine the optimal stocking level of spare parts. An insufficient stock of spare parts can lead to an excessive downtime cost. On the other hand, maintaining an excessive number of spare parts increases the inventory holding cost. An effective way to reduce a company's inventory cost without negatively impacting its performance is inventory pooling, an inter-company cooperation in which companies share their inventories. Previous research in the area of inventory pooling mainly focused on cooperation among "bases" which are assumed to be owned by a single "parent-firm" whose objective is to minimize the total system cost. Little research has been done to capture the story of inventory pooling in the context where the cooperating companies work independently and are rationally interested in maximizing their own performance. This research fits in this context. There are two main classes of decisions within a pooling mechanism : (a) operational decisions dealing with the optimal inventory level and lateral transshipment policy, and (b) financial decisions dealing with the allocation of joint cost/profit to each pooling member. Obviously, cooperation through inventory pooling allows all members to gain profit. At the same time, however, each member is also put in a position of conflict with the other members to maximize his own profit. Our interest is to model the existence of both the cooperative and the competitive behavior. Operational decisions involve interaction, i.e. each member reacts optimally to the other's decision and they are influenced by the financial decisions. In general, the Nash equilibrium of the resulting game doesn't maximize the joint profit. Therefore, it is important to design the financial decisions such that they give an incentive to each member to have the Nash equilibrium with the highest joint profit. Several pooling mechanisms are tested and compared in this research.

Stochastic Optimal Control of Infinite-horizon Non-autonomous Problems

David W. K. Yeung Tu 17:30 - 18:00, Room HS 7

In this paper, randomly fluctuating and non-autonomous payoffs are incorporated in the standard infinite-horizon stochastic control problem (of Fleming 1965) to reflect complex uncertain environments over time. Important examples of this kind of problems include renewable resources extraction, environmental management, and the pricing of corporate equities. The introduction of this stochastic specification lead to a novel approach to solve dynamic problems in terms of properties and solution concepts not explored in the literature before. New and significant mathematical results are obtained. An application of the technique in solving an infinite-horizon stochastic differential game is presented.

Solving discrete minimax location problems on networks

Gennady Zabudsky We 12:00 - 12:30, Room HS C
Dmitry Filimonov

The problems of optimal location of connected objects on networks with minimax goal functions are considered. The existing objects and the new objects being located are assumed to be in vertices of the network (discrete problem). The upper bounds on distances between new and existing objects and between distinct pairs of the new objects are given. Determining a feasible solution on arbitrary network is an NP-hard problem. Continuous location problem when the new objects may be located on arcs too on tree network are described in [1]. A necessary and sufficient conditions, termed separation conditions, for the distance constraints to be consistent are present [1]. We obtain some necessary conditions for the distance constraints to be consistent for the discrete problem on arbitrary networks. We present polinomial time algorithm which constructs a feasible solution when one exists. We propose polinomial time algorithm for solving the minimax problem on tree network. A branch and bound algorithm for solving the problem on arbitrary network is proposed. The mentioned above necessary conditions, separation conditions [1] and the optimal solutions to a set of supplementary 1-center problems are used for construction lower bounds on goal function. Results of computational experiment are described.

References:

1. E.Erkut, R.L.Francis, A.Tamir. Distance-constrained multifacility minimax location problems on tree network // Networks. 22. 1992. P.37-54.

This research was supported by grant INTAS number 00-217.

Group Decision Making versus Expert Opinion in the Multiobjective Analysis of Ecosystem Management

Lidija Zadnik Stirn Mo 17:30 - 18:00, Room HS 5

Ecological issues with demands for preserving the nature, and multipurpose use of land have, along with existing economic criteria, become a key part of the modern concept of ecosystem management. Therefore, on one hand, the land

owners and experts are faced with the land use decisions which maximize the profit, refer to ecological and social objectives, and respect the public¿s acceptance of decisions; while on the other hand, the public, who benefits from the amenity value of the ecosystem, specifically derives its own scenario of decisions. As such, an ecosystem management problem is a satisfactory attainment of multiple but conflicting objectives. This problem has precipitated a decision support model to determine the multi-objective ecosystem management decisions under achieving the goals from both, owners/experts and public aspects.

In the model, the ecosystem management alternatives are first evaluated from a single decision maker (owner/expert) point of view. The management process is defined in terms of decisions, constraints and objectives. For each decision, the objectives are given through the multidimensional objective function, viewed as a separable and additive decomposition of the linear utility function. The public participation in decision making is expressed through group decision making under multiple criteria. An ordinal agreed criteria approach and conjoint analysis are used. These methods produce a complete ordering of decisions for the public goals of ecosystem management. The results of the both methods are compared. The stability of the results specified by the ordinal agreed criteria approach so as by conjoint analysis is analyzed. Finally, knowing the optimal decisions of owners/experts and public, the best compromised decision is investigated.

Numerical applications are given to illustrate the properties of the methods and some further problems are discussed.

A Practical Approach to a Multifunctional Managerial Problem of a Small Farm in Slovenia

Janja Zagar Mo 14:30 - 15:00, Room HS 5

Metka Žan, Lidija Zadnik

In private sector of Slovenia, the agricultural production is traditionally accomplished on family farms which are, in comparison to West-European farms, very small. On one hand, this small farm size originates from disadvantageous natural conditions, and is, on the other, a result of historical and socio-economic circumstances. On such small-scale farms, especially in mountainous areas, a disproportionately large number of holdings are run as part-time farms, i.e., their owners hold a full- or part-time job elsewhere, however, the production on the farm is exclusively performed with the family labor force. Therefore, they dispose with some additional nonagricultural financial sources. This money can be transferred when needed in agricultural production and vice versa. One such small-scale farm is analyzed by the support of a multi-objective model for optimal farm management.

In the model, the farming operation is chosen by taking into account that the land owner's basic principle is to maintain a reasonable level of cultivation and yet to achieve as high income as possible. Further, to achieve adequate financial yield, the products should be processed on a farm as a supplementary activity. Because this is the situation in which ideas, feelings, and emotions are quantified to provide a numeric scale for prioritizing decision alternatives, the farm-owner's preference is determined by the Analytic Hierarchy Process (AHP). On the basis of the results achieved by the AHP, the appropriate combination of supplementary activities on the farm is chosen using the parametric linear programming and goal programming. The most effective relationship among the proportions of various types of processing is derived according to the farm production limitations and financial benefits.

Incident Management based on Real Time Simulation

Jürgen Zajicek Tu 9:00 - 9:30, Room HS 3

The main function of a traffic simulation which is used to evaluate the current traffic situation is reflected in the spatio-temporal interpolation of the situation between the stationary detector points of any road network. Today the traffic information systems are mainly based on traffic data from fixed metering points using technologies like induction loops, radar or infra red sensors, etc. Due to this static information current traffic information systems feature no or only meager spatio-temporal portability. The following figure will show how simulation helps to fill up the scopes without traffic information using the Floating Car Data (FCD) method to get area-wide traffic information. To be able to employ a dynamic traffic metering method a redesign of simulation algorithms has to take place in the near future. The Floating Car Data method will for the first time enable the creation of area-wide traffic information without expensive infrastructure and allow a rapid reaction onto current incidents on the road network regarded. But this method presupposes simulation algorithms using variable time steps instead of constant time steps like the prevalent software offered today. Only online simulation software (macro simulation software) can evaluate traffic data sent by moving vehicles at different times and positions. This ability of simulation software should not be reserved to the macro layer because of the great influence of incidents onto the traffic situation that can only be registered in the micro layer. To prepossess this requirement interfaces between both layers must be realised to enable a bi-directional data exchange. However there is a lot of research work required to solve these specified problems. This lecture should help to understand the existing problems and show the possibilities opening by using this new simulation method in combination with Floating Car Data in incident management.

Modelling and Optimization of Cutting Problems in the Paper Industry

Christian Zelle Tu 14:30 - 15:00, Room HS B

In production process of paper one of the central problems is the following: The paper comes out of production in units which are called master reels or jumbo reels. The task is now to cut these master reels efficiently into the final products, smaller reels and sheets. The efficiency is determined by various criteria. The main objective is to keep the amount of wasted paper, the trim loss, as small as possible. The cutting is done by machines with knives which can be set up at different positions; each change of the knife positions incurs a certain cost. Thus a further criterion is the number of changes of knife positions. Moreover, the degree of fulfillment of the customer order demands and the technical feasibility of the cutting plans play a role. As the technical feasibility is regarded, parameters like the number of available knives and the minimal and maximal width of waste paper have to be taken into account. The talk considers two cases separately. The first case concerns only the cutting of reels and in the second case, the reel and sheet cutting is combined. For both cases models are proposed. For the solution of the resulting optimization problems various tools are applied, including column generation techniques and iterative exchange based heuristics. Among others, a heuristic has been developed to calculate fast near-optimal solutions to the one dimensional cutting stock problem and its extensions with respect to the given objectives. This heuristic turns out to be easily adaptable to different production lines. Finally, results from computational experiments based on bin-packing test instances from the OR-LIB as well as on real world problems from paper industry are presented.

Simulated Annealing type metaheuristics – to cool or not to cool

Janez Zerovnik Th 10:00 - 10:30, Room HS B

In the last twenty years, randomized heuristics have been widely used for computing near optimal solutions of NP-hard problems in combinatorial optimization. A popular class of metaheuristics is called the hill-climbing algorithms. In some variants, moves to higher cost solutions are accepted only with a certain probability which depends on the parameter, usually called the temperature. Sometimes very good solutions are found, but it is also well known that SA can be extremely time consuming. Furthermore, the best known convergence results hold only if the so-called cooling schedule is very slow. An important part of implementation is the choice of a good temperature schedule. Among various temperature schedules, a constant temperature schedule for simulated "annealing" was found competitive or at least worth consideration.

We will report on some recent experiments with constant time implementations of SA-like algorithms for coloring and maximal independent sets. The results include improvements of the best upper bounds for chromatic numbers of some graphs and improvement of the best known upper bound for the Shannon capacity of C_7. Furthermore, we will discuss results of a recent experimental study comparing various temperature schedules and ideas on learning the temperature on-line.

External Centers Method for Lipschitz Programming on Unit Simplex

Vitaly Zhadan We 17:00 - 17:30, Room HS 8

The problem of minimization of the Lipschitz function on the unit simplex under linear inequality constraints is considered. For solving this problem the method is proposed which is a combination of the cutting angle method and a special version of external centers method. In this method the auxiliary (Lagrange-type) function is constructed which depends on a lower estimate of the optimal value in the problem. The lower estimate is updated at each iteration. It is shown that under some conditions the auxiliary function is exact. It means that the solution set of constrained optimization problem coincides with the set of minimizers of the auxiliary function on the unit simplex when the lower estimate exceeds a certain threshold value. Some properties of proposed method are studied and its convergence is proved. Some results of numerical experiments are also presented.

Multi-Agent Modeling of Financial Markets

Hans-Georg Zimmermann
Christoph Tietz, Ralph Neuneier, Ralph Grothmann Mo 13:30 - 14:00, Room E1.05

The talk is about a bottom-up model of financial markets with many interacting agents. The market-price dynamics result from a superposition of the decision-taking processes of the agents.

In order to model the agents' decision-taking, we introduce two concepts:

The first concept is based on feed-forward neural networks. A single neuron can be seen as an elementary decision-taking model of a single agent. Under this interpretation, a neural network of many neurons represents the interaction of many decisions and can thus be seen as a market process.

In the second concept, the decision-taking processes of the agents are based on elementary cognitive systems with three basic features: perception, internal processing and action. A cognitive system is structurally represented by a neural network with time-delayed recurrent error correction.

The introduced features are necessary conditions of a cognitive system. Merging the economic theory of the multi-agent market model with neural networks, our models concern semantic specifications instead of being limited to ad-hoc functional relationships. As an advantage, our multi-agent models allow the fitting of real-world financial data. In an empirical study of the US-Dollar vs. German Mark foreign exchange market, it turns out that our approach is superior to traditional econometric forecasting techniques.

Undershooting: Modeling Dynamical Systems by Time Grid Refinements

Hans-Georg Zimmermann Tu 12:00 - 12:30, Room E0.05
Christoph Tietz, Ralph Neuneier, Ralph Grothmann

Modeling dynamical systems, the relationship between the model and the data time grid is an important prestructuring element for the modeling. Regarding time discrete systems, the model time normally corresponds to that of the data. Alternatively one may choose a wider-meshed time grid than that of the observed data. As we will show, recurrent neural networks allow to use a finer model time grid than the data grid.

This talk consists of two parts: First, we introduce the concept of uniform causality, which allows us to refine the model time grid relative to the data. Undershooting is a neural network based approach of this principle. Second, we combine error correction neural networks and undershooting. As we will show in two empirical studies (forecasting business rentals and foreign exchange rates), the performance of our models can be improved by this novel approach.

From Climate Predictions to Socio-Economic Forecasts

Hans-Georg Zimmermann We 9:00 - 9:30, Room HS 10
Martin Fischer, Ralph Grothmann

Large scale climate variability influences economics worldwide. Recognizing and understanding relationships between climate and economics hence may provide a valuable source of information. Combining this knowledge with nowadays available long range climate forecasts would substantially help companies operating in climate sensitive fields.

The transformation of climate forecasts into useful information, however, is far away from being straight forward. First of all, the noisy character of both, climate and economics makes it extremely difficult to identify dominant links, to understand the dynamics, and to exploit them. Further more, long range climate forecasts are not easy to interpret. Advanced transformation algorithms are needed. This includes the transformation of climate information into socio-economic predictions, methods to deal with imperfect forecasts in a probabilistic way, forecasting complex dynamical systems, and comprehensive cost benefit analyses.

The forecast model is a time-delay recurrent error correction neural network (ECNN), which includes the last model error measured as an additional input. Hence, the learning can interpret the models misfit as an external shock which can be used to guide the model dynamics afterwards. To enforce the autoregressive part of the model we introduce a concept called overshooting. This extention to the ECNN improves for the identification of partially autonomous / externally driven dynamical systems. Climate data and forecasts are addtional inputs to the recurrent neural network.

Results from a feasibility study are very promising. The system successfully predicts potential damages in South-East-Asia over a period of 5 years.
