Semi-Plenary Lecture

Wednesday, August 31, 09:00, Room H112

Stochastic Decomposition Algorithms for Stochastic Linear Programs

Suvrajeet Sen, University of Arizona

This lecture will summarize progress on Stochastic Decomposition (SD) algorithms for stochastic linear programs. SD is a randomized version of Benders' decomposition which combines a recursive sampling scheme within a decomposition-coordination framework. The resulting class of algorithms raise several novel issues related to convergence and statistical verification of optimality. We shall summarize some of the key results and discuss extensions for the multi-stage case. We shall also present an application of this methodology to telecommunications network planning. (This lecture is based on joint work with Julie Higle)

Wednesday, August 31, 10:00, Room H112

On Stability in Stochastic Programming - Probability Measures Depending on the Decision

Silvia Vogel, Technische Universität Ilmenau

The talk deals with approximations to stochastic programming problems and considers sufficient conditions for the (semi)convergence of the optimal values and the solution sets. Special emphasis is put on the investigation of problems in which the distribution of the underlying random variable depends on the initial decision.

Wednesday, August 31, 10:30, Room H112

Differentiability of Solutions of Two-Stage Stochastic Programs

Darinka Dentcheva, Humboldt-Universität zu Berlin
Werner Römisch, Humboldt-Universität zu Berlin

We consider linear-quadratic stochastic programs with complete recourse and study the behaviour of solution sets if the underlying probability distribution is subjected to perturbations. As a prerequisite for differentiability properties of solution sets we first show the uniform second order directional differentiability of the marginal value if the expected recourse function is perturbed into convex directions. This result together with a uniform second-order grouth condition leads to directional derivatives of optimal sets and to semi-differentiability of the solution-set mapping into convex directions. The semi-derivative consists of the solutions of a certain convex program with polyhedral cone constrains, which is shown to be solvable. The main result does not require unique solvability of the original program, but the expected recourse function is assumed to be twice continuously differentiable and strongly convex (with respect to the tender variable). As a consequence, we show how this result can be employed to derive asymptotic distributions of solution sets if smooth nonparametric estimators are used.

Wednesday, August 31, 14:00, Room H112

Integer Stochastic Programming Algorithms of Markov Chain Type

Alexei A. Gaivoronski, ITALTEL, Milano

We consider here the following optimization problem: Find min Ef(x,w) where x is the vector of decision variables which belongs to some set X, w is a vector of random parameters and E denotes expectation. We are specifically interested in the case when the set X contains finitely many number of points. Then the problem mentioned above can be considered an integer programming problem, if not for the difficulty of computing expectations which makes impossible exact calculation of the objective function values. We present here an algorithm which on each iteration generates a point y in the vicinity of the current point x, makes one or more observations f(y,w) and on basis of these observations either moves to the new point y or remains at the point x with some probability. The behavior of the algorithm is described by nonhomogeneous Markov chain which puts it into the same algorithmic family as other Metropolis type algorithms, like simulated annealing. We study convergence of proposed techniques and present results of numerical experiments.

Wednesday, August 31, 14:30, Room H112

A Class of Stochastic Optimization Algorithms Applied to Some Problems in Bayesian Statistics

Alexei A.Gaivoronski, Italtel, Milan
Fabio Stella, University of Milan

In this paper we consider interworking between statistical procedures for recovering distribution of random parameters from observations and stochastic programming techniques, in particular stochastic gradient (quasigradient) methods. The proposed problem formulation is based upon a class of statistical models known as Bayesian networks. The reason for the latter choice is that Bayesian net is a powerful and general statistical model which emerged recently within a more general framework of Bayesian statistics which is specifically designed for cases when the vector of random parameters can have considerable dimension and/or it is difficult to come up with traditional parametrical model of the joint distribution of random parameters. The proposed approach is applied to reliability optimization of Integrated Circuit (IC) manufacturing. We define optimization problem on Bayesian network. For solution of this problem we develop algorithms for sensitivity analysis of such net and present combined optimization and sampling techniques.

Wednesday, August 31, 15:00, Room H112

On the Discrete Approximation of Probability Functionals

Riho Lepp, Universität Zürich

Probabilistic or chance constrained stochastic programming problems form a quite uncomfortable class of extremum problems. The function $w(x) = P[f(x,s) < t]$ has some unpleasant properties: it is never convex, its differentiability conditions are hard to handle e.t.c. Especially complicated to handle are stochastic programming problems with the probability functional, where the solution x itself depends on the random parameter s. In this report we will present one possibility for the approximation of the probability functional $v(x) = P[f(x(s), s) < t]$ by a sequence of finite dimensional (discretized) functions if the solution $x(s)$ belongs to reflexive Lebesgue spaces $L^p, 1 < p < \infty$.

Wednesday, August 31, 15:30, Room H112

Nonparametric Estimators in Chance-Constrained Programs

Nicole Gröwe, Konrad-Zuse-Zentrum für Informationstechnik Berlin

We study the numerical treatment of chance-constrained stochastic programs with random right hand sides :

$$\begin{array}{rl} \max & c^T x \\ \text{subject to} & Ax = b \\ & P(Tx \leq h) \geq p \\ & x \geq 0 \end{array}$$

where $c \in R^m, b \in R^d$ are known vectors, $A \in \mathcal{L}(R^d, R^m)$ and $T \in \mathcal{L}(R^s, R^m)$ are given matrices, $h = (h_1, \ldots, h_s)$ is a random vector with probability distribution $P \in \mathcal{P}(R^s)$ (the set of Borel probability measures on R^s) and p is a specified probability level, $0 < p < 1$.

In most applications we do not know the probability distribution P of the random vector h, but we are given i.i.d. observations $h_1, \ldots, h_n$. We replace the (true) marginal distributions by a new class of smooth nonparametric estimates. The resulting chance-constrained programs are convex and can be solved using linear programming.

We report on statistical and numerical properties of the estimators and of the approximated chance-constrained programs.

Wednesday, August 31, 16:30, Room H112

Ein stochastisches Optimierungsmodell zum marktorientierten Zielkostenmanagement

Peter Abel, USU Softwarehaus Unternehmensberatung GmbH

Strategisches Zielkostenmanagement wurde unter dem Betriff Target Costing ursprünglich von japanischen Unternehmen entwickelt und angewendet. In westlichen Industrieunternehmen wird mit Target Costing Ansätzen seit etwa 5 Jahren gearbeitet. Die bisher übliche Orientierung an den technisch möglichen Lösungen wird erweitert, um die Berücksichtigung der (subjektiven) Kundenanforderungen und -wünsche zu erfüllen. Im Mittelpunkt von Zielkostenmanagement Ansätzen steht die Frage: "Welchen Preis ist der Kunde bereit für ein Produkt zu bezahlen und welche Qualität des Produkts erwartet der Kunde?

Die ersten Erfahrungen in deutschen Target Costing Projekten zeigen, daß es in der Regel nicht möglich ist, alle subjektiven Kundenwünsche mit exakten Daten zu beschreiben. Zumindest einige Informationen liegen nur in Form von Zufallsvariablen vor. Damit sind die traditionellen Target Costing Werkzeuge nicht mehr einsetzbar. Stochastische Modelle z. B. basierend auf dem Kompensationsmodell sind in dieser Situation mögliche Werkzeuge zur Bestimmung der notwendigen Entscheidungsgrößen.

Wednesday, August 31, 17:00, Room H112

An Approach to the Maximization of the Probability Function

Oleg Khamisov, Siberian Energy Institute (Russia, Irkutsk)

We consider the wellknown problem of the maximization of the probability function. The proposed approach is based on a reduction of the initial problem to some multiextremal one. The reduction technique can be applied to rather wide class of the probability functions. An algorithm for solving the reduced multiextremal problem is described.

Wednesday, August 31, 17:30, Room H112

Discrete Stochastic Model for Optimization Equipment of Enterprise (for Example Optimization Quantity Harvester in Agriculture).

Jroslave Lutin, Irkutsk agricultural Institute (Russia, Irkutsk)

For solution problem we form this model: find max

$$F(R) = [\sum_{i=n}^{N} p(X_i) \cdot A + \sum_{i=1}^{n-1} p(X_i) \cdot X_i \cdot R \cdot D] \cdot (U - C) - K \cdot R,$$

if $Y \cdot R \cdot D = A$ and $X_{n-1} < Y \leq X_n$, where $F(R)$-difference probit from the salefarm product and expenditure on harvesting; X_i-quantity days fit for harvesting in result number i; $p(X_i)$-probability of result number i; A-area sown; R- quantity harvester; D-productivity harvester; U-probit from sale farm product of one hectore; C-expenditure on harvesting one hectore; K-expenditure on unit harvester per annually; Y-quantity days for completion harvesting area sown.
Model have wide use and easy adapt to any conditions of production. Model used for optimization equpment of agriculture and food enterprises.
References.

1. Lutin I.A., Determination optimum standard equipment farming with harvester in consideration of stochastic weather conditions.- Mathematical methods and computer techniques in organization and planning of agricultural production. Novosibirsk, Novosibirsk agricultural institute, 1985 (in Russian).

Wednesday, August 31, 18:00, Room H112

Bounding in Multi-Period Stochastic Programming Problems

Olga Fiedler, Freie Universität Berlin
Andras Prekopa, RUTCOR, Rutgers University

We assume that the random variables corresponding to the subsequent periods are all discrete with finite supports. We also assume that the problem is written in the form of a λ-representation. Starting from the last period, and proceeding in the backward direction, we create first a dual feasible basis which provides us with a lower bound. Next, a primal feasible basis is created which gives us an upper bound. These steps are repeated several times.

If the bounds are not satisfactorily close, then a few dual steps are performed. The proposed bounding technique is very simple in the case of a multiperiod simple recourse problem. In this case, the dual steps are executed effectively by careful selections of the incoming and outgoing vectors.

Thursday, September 1, 09:00, Room H112

On Dynamic Programming for Multistage Decision Problems under Uncertainty

Paolo Dai Pra, Universitá di Padova, Italy.
Cristina Rudari, Universitá di Padova, Italy.
Wolfgang J. Rungaldier, Universitá di Padova, Italy.

We consider the problem of determining an optimal solution for a finite horizon multistage decision problem under uncertainty : the decisions affect the uncertain evolution of a given system; optimality is with respect to a cost criterion involving an additive running cost as well as a terminal cost; the uncertainty is due to disturbances that prevent a complete knowledge of the evolution of the system. The purpose of the study is to investigate the possibility to obtain a solution , in particular by means of the Dynamic Programming algorithm, for three possible ways of modeling the disturbances. The first level corresponds to the classical (stochastic) case when the disturbances are random variables and the criterion is minimizzation of the expectation of the actual cost. On the second level the disturbances are known only to belong to certain sets and the criterion is the minimization of the supremum of the actual cost. On the third level the disturbances belong to random sets and the criterion is the minimization of a combination of supremum and expectation of the actual cost; in our dynamic context this combination admits several possible variants, of which two are being analyzed. The last level contains the previous ones as particular extreme cases and is motivated by the so-called mathematical theory of evidence (mathematical theory of hints).

Thursday, September 1, 09:30, Room H112

On the Implementation of Barycentric Approximation

Karl Frauendorfer, Hochschule St. Gallen, Switzerland
Frank Härtel, Hochschule St. Gallen, Switzerland
Michael F. Reiff, Hochschule St. Gallen, Switzerland

Barycentric Approximation (B.A.) is a solution technique for stochastic multistage programs that provides the user with scenarios and policies, which serve as approximations for probability space and optimal policy. In the convex case, the goodness of the scenarios and the associated policies can be quantified, and further information on how significant improvements are achievable can be elicited via duality analysis.

Currently, we are working on the implementation of the barycentric approximation on a SUN SPARC-System20 (512 MByte memory, Solaris 2.3). We illustrate the encountered numerical effort. In particular, we focus on cyclical interactions between primal and dual solutions associated with the scenario trees, the evaluation of the error bounds and refinements. First numerical results will be presented.