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EDITORIAL

Uncertainty, economics and optimization: recent developments

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This special issue is dedicated to Prof. Dr. Georg Ch. Pflug with the intention to highlight, recognize and value his broad and influential research contributions. Georg Pflug has developed scientific interests which very soon went far beyond his initial expertise in statistics and limit theorems. His scientific output has tremendous impacts in operations research and decision science. Three of the areas where his footprint is particularly visible are uncertainty, economics, and optimization. The title of this special issue reflects these topics. The preselected research articles included here represent state-of-the-art research in the mentioned areas to demonstrate his impact. All of them are inspired by his work.

Indeed, Georg Pflug was among those pioneers who initiated research in decision making under uncertainty, with a special emphasis on stochastic optimization. He contributed to the development of the field, shaped it to its present form and fostered several of its most important applications. Stochastic optimization is of particular importance in economic applications and management science. Insurance and financial engineering are among its major applications, but Georg Pflug's scientific work also strongly influences applied statistics today.

The community of international scientists building on Georg Pflug's results is increasing. We are thankful to the following colleagues who outline their current work and relate it to Georg Pflug in this special issue.

A. Georghiou, D. Kuhn and W. Wiesemann have chosen to present linear decision rules. These authors have significantly influenced this theory. The decision rules have been developed to make large scale and multistage stochastic optimization problems computationally accessible. Here, the authors formulate a stochastic optimization problem subject to probabilistic constraints and develop the understanding

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of decision rules along this application, which they extend even to non-linear decision rules in their present submission.

The contribution by V. Norkin presents a branch-and-bound algorithm for discrete partial order optimization, where the latter is conceived as a generalization of diverse types of decision analysis problems, including multiobjective optimization (with Pareto optimality as the solution concept) as the perhaps most prominent special application. Nevertheless, also other problems such as optimization with respect to (partial) first-order stochastic dominance or problems with an infinite number of criteria fall into the considered range of applications. The algorithm uses a set-valued bound and can be shown to converge to the Pareto front. Extensions to more than one partial order and to the case of partial order constraints are addressed as well.

I. M. Bomze, J. Cheng, P. J. C. Dickinson, A. Lisser and J. Liu address notoriously hard combinatorial optimization problems as the multidimensional quadratic knapsack problem (MQKP) and the quadratic assignment problem (QAP) by techniques from copositive optimization. They start with copositive reformulations of general mixed-binary quadratic optimization problems and study relaxations of them. In addition, they also investigate a technique penalizing diverse classes of constraints. After deriving mathematical results, the authors turn to a numerical comparison of the described relaxations and penalizing relaxations on the MQKP and the QAP and show that especially for large instances, promising results are achieved.

The contribution by W. Hölzl, S. Kaniovski and Y. Kaniovski bridges from stochastic models to business analytics by proposing a tool for exploring trends in survey data. The authors consider the behavior of firms in the areas of manufacturing and construction under two macroeconomic regimes (upturn and downturn). On the microeconomic level, conditional transition probabilities are estimated to represent the responses by the firms. An extension introduces a hidden Markov chain for modelling the dynamics of common tendencies. Data from the Austrian Institute of Economic Research (WIFO) is used for a case study.

S. Hochrainer-Stigler, J. Balkovic, K. Silm and A. Timonina-Farkas provide an approach to risk assessment for draught events, particularly also under conditions of climate change. They argue that traditional methods in this area suffer from four difficulties: (i) extreme droughts are rare events, which hampers probabilistic estimates, (ii) especially considering climate change, events are non-stationary, (iii) neglection of regional dependencies fosters underestimation of risk, and (iv) restriction to averages does not give enough information on the entire risk. The authors propose a copula approach to address tail dependencies and develop a crop yield simulation model based on this approach.

R. Kovacevic presents an application of increasing economic importance: the contribution studies conditions for the absence of arbitrage in electricity markets with energy generation from fuel in the presence of fuel storage possibilities. The paper investigates valuation formulas for physical electricity delivery conditions, which insure absence of arbitrage in electricity markets.

The title “Robustness Analysis of Generalized Jackson Network” of the paper by J. Berkhout, B. Heidergott, J. Sommer and H. Daduna gives the program. It is a deep

study of risk in Jackson networks, where risk is understood as the possible impact from an insecure parameter. Risk is investigated here from a robustness perspective. The paper also provides a framework to evaluate the value at risk numerically.

T. Flynn and F. Vázquez-Abad address a network problem as well, but they consider it from the modern perspective of data science. The Little or Boltzmann network carry stochastic components and this additional feature is of further interest. These networks admit a stationary distribution which the authors study, also by means of measure valued derivatives and by perturbations. In addition, the authors provide a complexity analysis so that comparisons with other methods are possible.

The concept of the "value of the stochastic solution" is an essential tool in understanding the specific structures of importance within stochastic optimization. As well, it is evident that distribution of random components is of intrinsic importance for optimization under uncertainty. Georg Pflug has essentially contributed to this topic. F. Maggioni, M. Cagnolari, and L. Bertazzi now complement this issue by introducing the "value of the right distribution", which they study in this new contribution.

Georg Pflug has served the operations research and management science community in national and international functions mainly from his position in Vienna, from which he is about to retire formally now. However, we know that he is aware that many very interesting research topics are still open. For this and other reasons we hope that he will continue enriching the international community by his broad knowledge, which goes significantly beyond scientific topics.