Comput Manag Sci (2012) 9:1–2
DOI 10.1007/s10287-011-0136-9

EDITORIAL

Optimal decision making under uncertainty

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Published online: 5 October 2011

Preface

This special issue consists of a carefully selected collection of papers, which were presented within the stream on *Optimal Decision Making under Uncertainty* at the 6th International Conference on Computational Management Science in Geneva in May 2009. All papers extend the existing methodologies of optimization under uncertainty and provide numerical results that demonstrate improvements over classical methods. The first four papers address pertinent financial decision problems, while the fifth and sixth papers focus on topical decision problems in the areas of energy economics and network design, respectively.

Xu and Zhang extend the popular sample average approximation (SAA) to mean-variance optimization problems arising in risk management. They use a penalty function technique and recent results on uniform exponential convergence of sample average random functions to prove that the optimal solution of the SAA problem converges to the solution of the original mean-risk problem at an exponential rate. The approach is illustrated in the context of a portfolio management problem with taxation costs. The authors also report on extensive numerical results.

Fonseca, Wiesemann and Rustem present an international portfolio optimization model, which takes two dimensions of uncertainty into account—uncertain returns as well as uncertain exchange rates. Robust optimization techniques are applied to

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solve the decision optimization model by reformulating the model to a semidefinite programming formulation, which can be solved efficiently. A set of numerical results is presented and an extension of the base formulation using quanto options to provide additional guarantees for the respective decision taker is provided.

Fastrich and Winker overcome the problems of estimation errors of expected returns and the covariance matrix within the Markowitz framework by applying robust techniques. In addition, oversimplifications of Markowitz' portfolio theory are eliminated by incorporating a more realistic model of the financial investment environment. These extensions require heuristics to solve the resulting optimization problems. Their novel hybrid heuristic algorithm replaces standard local search steps with the threshold accepting algorithm. Numerical results using DAX 100 stocks shows improved portfolio composition stability as well as lower risk and less volatility without sacrificing returns.

Maringer and Ramtohul present a regime-switching recurrent reinforcement learning model and its application to investment problems. Thereby, a recurrent reinforcement learning algorithm is extended to use regime-switching. It is shown, that this extension is more able to capture all intricacies of financial time series. Two variants of the new method are proposed, a threshold version and a smooth transition version, and both are compared to the basic model in automated trading and portfolio management applications. Especially when volatility is considered as the performance measure, the regime-switching extension proves successful.

Heydari, Ovenden and Siddiqui develop an analytical real options model for choosing the best emissions-reduction technique for a coal-fired power plant, taking into account uncertainty in electricity, CO_2 and coal prices. The authors first determine the option value of investing in any particular emissions-reduction technique, and in a second phase they assess the option value of investing in any one of several techniques. They conclude that the optimal choice is mainly driven by the characteristics of the CO_2 price. The authors also provide insightful numerical examples based on real market data.

Thapalia, Wallace, Kaut and Crainic study single-source single-commodity network design problems under uncertainty. Given a set of demand and transshipment nodes, the task is to establish capacitated network links such that a stochastic demand pattern can be served reliably at minimum cost. Problems of this type are computationally challenging even in a deterministic setting. The authors describe the characteristics of stochastic solutions and contrast them to the corresponding deterministic solutions. The insights gained from this study will enable decision makers to recognize robust network designs and promise to be highly valuable for the development of new and efficient algorithms.

Acknowledgments We are grateful to the authors for presenting their work in the stream on Optimal Decision Making under Uncertainty and for submitting their papers to this special issue. Furthermore, we wish to thank all the referees who thoroughly reviewed the initial manuscripts and greatly contributed to the quality of the final papers. Finally, we are indebted to the Editor-in-Chief, Prof. Berg Rustem, for providing the opportunity for this special issue in Computational Management Science.