Decision Programming for Optimizing Multi-Stage Decision Problems Under Uncertainty

ABSTRACT - Multi-stage problems under uncertainty can be represented as influence diagrams consisting of decision, chance and value nodes connected by arcs. At each decision node, the solution can be derived either by transforming the diagram or by solving the equivalent decision tree with dynamic programming. Both approaches assume that earlier decisions are known when making later ones, which may not always be the case. Moreover, dynamic programming is restrictive in that the optimal strategy in a given branch cannot depend on decisions in other, non-overlapping branches. Thus, the objective function cannot include risk measures such as semi-absolute deviation which would refer to the variability of consequences over all branches. Interdependencies between branches arise in project portfolio selection problems as well, because the use of shared resources implies that the decision to fund one project leaves less resources for others.

In this paper, we develop the Decision Programming approach for solving multi-stage decision problems which can represented as limited memory influence diagrams without the 'no forgetting' assumption and which may involve multiple objectives and several constraint types. This approach can also be viewed as an extension of Contingent Portfolio Programming (Gustafsson and Salo, Oper. Res., 2005) to problems in which the projects can impact the scenario probabilities and there is interest in using the Conditional Value-at-Risk (CVaR) measure to curtail risks. The approach is efficient for problems of realistic size, because solutions can be obtained with mixed-integer linear programming (MILP).

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SPEAKER BIO - Professor Ahti Salo has worked extensively on the development of decision analytic methods and their uses in resource allocation, risk management, and efficiency analysis. He has published widely in leading international journals (including Management Science and Operations Research). In June 2019, he received the Edgeworth-Pareto Award from the International Society of Multiple Criteria Decision Making. In 2013, he won the Publication Award of the INFORMS Decision Analysis Society for the book on Portfolio Decision Analysis which he co-authored and co-edited with Professors Jeffrey Keisler and Alec Morton.

Salo has directed numerous research projects funded by leading industrial firms, industrial federations, and funding agencies. He has worked as visiting professor at the London Business School, Université Paris- Dauphine and the University of Vienna. He has been the President of the Finnish Operations Research Society (FORS) for two biennial terms. In 2010-11, he was the European and Middle East representative on INFORMS International Activities Committee. In 2010-16, he was jury member of the EDDA Doctoral Dissertation Award of the Association of European Operational Research Societies (EURO), and chaired this jury in 2016. In 2015-2019, he has been member of the Foresight Steering Group appointed by the Prime Minister's Office of Finland.

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THURSDAY, OCTOBER 24, 2019
2:30 PM – 3:50 PM
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