A novel sorting approach under uncertainty: A Monte-Carlo simulation with temporal evaluations

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Abstract

In recent years, the Quebec government has highlighted the importance of making decisions that are both sustainable and robust under climate change uncertainties. This paper aims to answer the following question: *How to sort the alternatives according to their degree of sustainability achievement while evaluations are uncertain and temporal*? The general objective of the paper is to propose a first temporal sorting method under stochastic uncertainty. The proposed method, called TSMAA-Tri, will assign each alternative to a predefined category based on a generalization of SMAA-Tri to a temporal context (multi-period evaluation of alternatives) where alternative evaluations are stochastic. The method starts performing Monte Carlo simulations to generate stochastic evaluation values. Each simulation (scenario of uncertainty) will generate a specific value for each criterion using the corresponding probability distribution. Then, aggregation consists in applying SMAA Tri at each period and performing a triple aggregation: i) uncertainty aggregation; ii) multi-criteria aggregation; and ii) temporal aggregation. Multi-criteria aggregation consists in applying the SMAA-TRI method at each period. Then, two ways of temporal aggregation are proposed, based either on acceptability index or on outranking index of boundary profile. The proposed method is illustrated for sustainable forest management to show its applicability.

Keywords
Multi-criteria decision aid, sorting methods, temporal evaluations, Monte Carlo simulations, SMAA-TRI.

Biographies

Dr. Anissa Frini is professor in quantitative methods and production in the department of management science of *Université du Québec à Rimouski*. She holds a Ph.D in operations and decision support systems in 2006, an MBA in Information Systems in 1999, both from Laval University. She has expertise with multiple criteria decision aid, dynamic decisions, temporal MCDA, and uncertainty modelling. Her research is applied for sustainable development, project selection, healthcare, flood risk management, sustainable forest management and corporate sustainability.

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