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Compromise Fuzzy Multi-Objective Linear Programming (CFMOLP) heuristic for product-mix determination ☆

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ABSTRACT

This paper models a crisp Linear Programming (LP) as a Compromise Fuzzy Multi-Objective LP (CFMOLP). The application of CFMOLP has been focused on an industrial engineering problem that seeks profit maximisation by optimising product-mix. Imprecision of the large volume of industrial data and the conglomerated decision from all levels of management lead fuzzication of the identified constraints and the objective functions as well. The crisp model described is in the form of crisp-Multi-Objective Linear Programming (MOLP) with objective functions, functional constraints and non-negativity constraints. This model is formulated as a fuzzy-MOLP and subsequently converted into an equivalent compromise-MOLP model. The paper describes the development process for the CFMOLP model and its application along with appropriate interpretation.

1. Introduction and background

Many problems in economics, operations research, decision sciences, engineering and management sciences have mainly been studied from the optimisation point of view. As the decision-making is influenced by the disturbances of social and economical circumstances, straight forward optimisation approach is not always the best. It is because under such influences, many problems are ill-structured. In real-world situations, as reaching to the ideal solution is practically unattainable, a decision-maker considers best feasible solutions closest to the ideal solution instead of ideal solution (Zeleny, 1982). Under this situation, a satisfaction approach is much better than an optimisation one.

Literature reveal variants of Multi-Objective Linear Programming (MOLP) models and their use in decision-making. For example, Karsak and Kuzgunkaya (2002) propose a fuzzy MOLP approach as an alternative to the classical mathematical programming formulation. Their proposal uses triangular fuzzy numbers and does not consider the compromise approach during evaluation of candidate-alternatives. Further, Gao and Tang (2003) propose a MOLP model for purchasing of raw materials of a large-scale steel plant. 'Point estimate weight-sums method' has been used in their work to solve the set of equations. The method converts the MOLP into a general LP problem and the solution is obtained by assigning positive weights only. Their method does not embed a fuzzy technique so as to deal with vagueness of the problem. Further, the efficacy of MOLP has been justified by Downing and Ringuest (1998). They use Excel® and Visual Basic® to implement four different algorithms for MOLP. It has been demonstrated that explicit and effecting modelling of any decision-making process with MOLP algorithms improves the effectiveness of the processes. Interactive "fuzzy linear programming" (FLP) and "fuzzy MOLP" methods have been proposed by Liang (2008, 2006) for solving transportation planning problems considering fuzzy goals, available supply and forecast demand. A mathematical model for the preference-ranking to fuzzy goal of constraints is proposed by Hasuike and Ishii (2009) that considers randomness, fuzziness and flexibility in modelling product-mix decision-support. Tan (2005) proposes the use of symmetric FLP for determining an optimal product-mix solution with multiple objectives is reported. Mathematical models, including a LP model, are proposed by Letmathe and Balakrishnan (2005) in order to estimate an optimal product-mix in presence of multiple constraints. Karakas, Koyuncu, Erol, and Kokangul (2010) report a mathematical model using activity-based costing to determine the optimal product-mix by maximising profit considering fuzziness in demand of the products.

The application arena of the proposed CFMOLP model is "product-mix". Product-mix determination using various models

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