Editorial

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Decision making is an omnipresent human activity that often involves making choices between alternatives. Most often we desire to find the best alternative or the best set of alternatives. But as situations become more complex, as the number of criteria to be considered and the number of alternatives grows, humans have a tendency to sometimes make errors, when judgementally selecting the best alternative. This is where mathematical decision support and OR methods for decision supports can aid decision-makers. In fact, mathematical methods and models for multiple criteria decision making (MCDM) and evaluation have a growing influence in modern day decision making and are also an active field of research within operational research and management science. To illustrate the use of mathematical OR methods in supporting decision making this special issue contains eight papers.

The first paper by Ramík deals with pairwise comparison matrices, a powerful tool for expressing the preference structure of experts by providing intensities of preferences for pairs of objects. The paper proposes a general framework for dealing with different types of pairwise comparison matrices through the scope of pairwise comparison matrices over an Abelian linearly ordered group (Alo-group) and thus introduces a general framework, in which the reciprocity and consistency of pairwise comparison matrices can be treated. Special methods for dealing with missing pairwise comparisons are proposed and illustrated with numerical examples. Although the paper remains in the

theoretical level, it provides new insight into pairwise comparison matrices and provides mathematical tools for future real-life applications, where alternatives need to be expertly evaluated and ranked.

In the second paper, Rotterová and Pavlačka explore two possible representations of probabilities of fuzzy events. The first, proposed by Zadeh in 1968, considers crisp probabilities of fuzzy events and the second, proposed by Yager in 1979, deals with fuzzy probabilities. The authors point out some shortcomings of the two approaches by focusing on issues ranging from problematic interpretation of the evaluations obtained using crisp probabilities of fuzzy events, to difficulties in the calculation of a fuzzy expected value with fuzzy probabilities. The authors suggest a novel technique for the calculation of fuzzy expected values for the latter case. They conclude that the issue of finding appropriate representation of the probabilities of fuzzy events remains an unresolved one and constitutes an interesting and relevant course for further research.

In the third paper, Koloseni, Fedrizzi, Luukka, Collan and Lampinen propose a classification method that is based on separately choosing the best fitting distance-measure for each feature of a data-set from a pool of eight possible distance-measures with the differential evolution algorithm. Also, parameters for each distance-measure used are optimised. From the distances chosen separately for each feature, an overall multi-distance is calculated by aggregating with the ordered weighted average (OWA). The presented method performs comparatively well in the classification context as illustrated by the five numerical experiments.

The fourth paper by Tripathi and Mishra presents an EOQ inventory model with an increasing linearly time-dependent demand rate in two modifications – one with exponentially time dependent holding costs and a more general one with time dependent holding costs. Formulas for minimum total inventory costs for both cases are presented and the respective models are discussed. The performance of both models is illustrated on numerical examples. The paper brings the traditional EOQ model closer to the modelled reality by allowing time dependency of the demand, as well as, the holding costs.

The following two papers provide, in the good spirit of OR, case studies and practical applications of mathematical models and methods developed for decision support.

The first of these papers and the fifth paper overall, by Wang and Carlsson, deals with investment decision-making associated with patents and their commercialisation. The paper proposes the use of fuzzy sets in capturing the imprecision connected to the process and shows how they can be used in real option analysis by a number of methods. The paper extends a previously proposed fuzzy-hybrid real option valuation method and illustrates the decision support given by this extended version with a case study of patent application project for a new process for the preparation of a gypsum-fibre composite. Patents are an excellent example of investments under considerable uncertainty that benefit from both the approaches used in the paper, real options and fuzzy logic.

Investment decision making in the uncertain and imprecise environment is also the background of the sixth paper by Talášek, Bohanesová, and Talašová. These authors present a two-step decision support model for investment decision making that utilises linguistic modelling in the fuzzy set theory framework. Investment strategies are determined using several linguistic fuzzy rule bases and Mamdani-type fuzzy inference. The input variables include the desired investment horizon, the available amount of free funds, and the investor expertise. The suggested investment strategy reduces the set of feasible mutual funds to those that comply with this strategy. The most appropriate mutual fund is determined with a fuzzy OWA-based aggregation of evaluations obtained

through fuzzy scorecards. A real life case study is presented to illustrate the advantages of the proposed decision support model. The tool conceived to be used also by inexperienced investors has been implemented in the FuzzME software.

The seventh paper of this special issue, by Holeček, Stoklasa and Talašová departs from the investment decision-making domain towards the field of classification. Human resources management at universities provides the context of this paper – issues such as academic staff performance evaluation, type of worker identification, job assignment, and promotions are addressed. The tools of linguistic fuzzy modelling are applied to construct decision support models for human resources management, that reflect the inherent imprecision of linguistic descriptions of the evaluation process in their outputs. Since these outputs are deliberately imprecise, they leave the responsibility for making exact decisions with the decision-makers. The authors also propose a classification of mathematical classification models, based on the type of the output scale that is used, and discuss possible uses of the models in each of these classes.

The eighth paper by Gavalec and Tomášková closes the circle and returns back to MCDM models based on pairwise comparison matrices. The authors propose a distance-based approach to deal with the inconsistency problem for antisymmetric preference matrices. For an inconsistent preference matrix A, the authors find its optimal consistent approximation (OCA) as a consistent matrix closest to A according to the Chebyschev distance. The problem is formulated as a linear programming task. In case there are more solutions of the LP problem, their average is suggested as the ideal compromise. A modification of the optimal consistent approximation method (MOCA) for incomplete preference matrices is also proposed in the paper. MOCA is suggested as a tool for the identification of suspicious entries (outliers) in the preference matrix that violate the consistency the most within the heuristic for identification of outliers (HIO).

The eight presented papers cover diverse fields of OR modelling for decision support and illustrate the variety of what is mathematics in operational research.

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