Robust Water Resources Management by Using Fuzzy-Stochastic OWA Operator

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Abstract

All realistic multi criteria decision making (MCDM) problems face various kinds of uncertainty. One of these uncertain parameters is the optimism degree of the Decision Maker (DM), which has an important effect on the results. Fuzzy linguistic quantifiers will be used to obtain the values of this parameter and then, it will be assumed to have stochastic nature. A new approach will be introduced for the fuzzy-stochastic modeling of MCDM problems by merging the stochastic and fuzzy approaches into an improved OWA operator.

The results of the new approach give the expected value and the variance of the combined goodness measure for each alternative. In order to combine these two characteristics a composite goodness measure will be introduced. The theoretical results will be illustrated in the Sefidrud watershed management problem. By using this measure more sensitive decisions are given to the stakeholders whose optimism degrees are different than that of the decision maker.

Keywords: Multi criteria decision making; Watershed management; Ordered weighted averaging; Fuzzy linguistic quantifiers; Stochastic uncertainty;

Introduction

In real decision making problems multiple criteria have to be usually considered. The resulting MCDM models face different kinds of uncertainty, which generally arise from two sources: stochastic uncertainty related to environmental, economic or technical data, and fuzzy uncertainty related to subjective judgments and the characteristics of the DM. Earlier works on MCDM models under uncertainty did not utilize the mixture of the different types of uncertainty for a given problem and they assumed the existence of either stochastic or fuzzy uncertainty.

Stochastic nature: One of the benchmarking works in stochastic MCDM is PORTRADE introduced by Goicoechea et al. (1982). This method requires an assessment of the DM's multi-attribute utility function and uses chance constraints to find a tradeoff between expected levels of the objective functions and their respective probabilities of achieving desired levels. STRANGE, introduced by Teghem et al. (1986) is a progressive articulation scenario-based technique that assumes given discrete sets of model parameters, each with its own subjective probability of occurrence. Stancu-Minasian (1984) gives a survey of earlier methodologies developed in stochastic MCDM. Changchit and Terrell (1993) proposed a model for stochastic goal programming to be used in water resources management. Ben Abdelaziz et al. (1999) analyzed the efficiency of stochastic MCDM problems when the random variables are discrete. Solutions of stochastic MCDM problems are usually obtained by using two transformations: the

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