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On qualitative multi-attribute group decision making and its consensus measure: A probability based perspective

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Abstract

This paper focuses on qualitative multi-attribute group decision making (MAGDM) with linguistic information in terms of single linguistic terms and/or flexible linguistic expressions. To do so, we propose a new linguistic decision rule based on the concepts of random preference and stochastic dominance, by a probability based interpretation of weight information. The importance weights and the concept of fuzzy majority are incorporated into both the multi-attribute and collective decision rule by the so-called weighted ordered weighted averaging operator with the input parameters expressed as probability distributions over a linguistic term set. Moreover, a probability based method is proposed to measure the consensus degree between individual and collective overall random preferences based on the concept of stochastic dominance, which also takes both the importance weights and the fuzzy majority into account. As such, our proposed approaches are based on the ordinal semantics of linguistic terms and voting statistics. By this, on one hand, the strict constraint of the uniform linguistic term set in linguistic decision making can be released; on the other hand, the difference and variation of individual opinions can be captured. The proposed approaches can deal with qualitative MAGDM with single linguistic terms and flexible linguistic expressions. Two application examples taken from the literature are used to illuminate the proposed techniques by comparisons with existing studies. The results show that our proposed approaches are comparable with existing studies.

Keywords: Linguistic MAGDM; Random preference; Weights; Stochastic dominance; Consensus measure.

1. Introduction

A group decision making (GDM) problem is defined as a decision problem where several experts (judges, decision makers, etc) provide their judgments over a set of alternatives (options, candidates, etc). The aim is to reconcile the differences of opinions expressed by individual experts to find an alternative (or set of alternatives) that is most acceptable by the group of experts as a whole [58, 66]. As an important branch of GDM, multi-attribute GDM (MAGDM) deals with decisions where several experts express their opinions on a set of possible options with respect to multiple attributes and attempt to find a common solution. In practice, both GDM and MAGDM require subjective assessments by a set of experts to solve complex and unstructured problems [19], which are often vaguely qualitative and cannot be estimated by exact numerical values. Such phenomena may arise from the following two facts [3]: first, the information may be qualitative due to its nature, and can be stated only in linguistic terms (for example when evaluating the comfort

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