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Managing consistency and consensus in group decision making with hesitant fuzzy linguistic preference relations

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Abstract

The use of hesitant information in pairwise comparisons enriches the flexibility of qualitative decision making and allows for hesitant fuzzy linguistic preference relation (HFLPR). This paper develops separate consistency and consensus processes to deal with HFLPR individual rationality and group rationality. First, a possibility distribution approach and a 2-tuple linguistic model are introduced as support tools. Then, a new consistency measure is defined and a convergent algorithm described to aid the consistency improvement process in a given HFLPR. The algorithm adopts a local revision strategy and can be easily interpreted. Further, a direct consensus reaching process is presented to solve the HFLPR consensus problems. A prominent characteristic of this consensus reaching process is that the feedback system is based directly on the consensus degrees, thereby reducing the proximity measure calculations. Finally, the proposed consistency and consensus processes are applied to an investment project selection problem. The results and an in-depth comparative analysis verify the potential use and effectiveness of the proposed methods.

Keywords:

Group decision making, Hesitant fuzzy linguistic term set, Consistency, Consensus, Hesitant fuzzy linguistic preference relation.

1. Introduction

In decision making, a decision group is invited to agree on a common set of attributes and alternatives. In group decision making (GDM), preference relations are popular and powerful techniques for decision maker preference modeling [1], of which linguistic preference relations are one of the most commonly used [2–5]. However, techniques for computing with words (CWW) are needed to deal with the linguistic preferences given by the decision makers [6–9]. In previous research, various linguistic models have been presented, such as the 2-tuple linguistic model, the symbolic model, the fuzzy number based model, the type-2 fuzzy sets based model, and the granular method [5, 10–14]. Although these models have been popular, they have proved to be inadequate when dealing with situations in which the decision makers are hesitant about the linguistic variables needed to express their preferences. Recently, Rodriguez et al. [15] proposed the hesitant fuzzy linguistic term set (HFLTS) concept to deal with the above situation. This new approach, based on a fuzzy linguistic approach and the use of context-free grammar, increases the flexibility and richness of the linguistic elicitation. Since its introduction, some scholars have revised the HFLTS definition in their context [16, 17].

HFLTS has garnered considerable attention from researchers. The traditional fuzzy linguistic approach uses only one linguistic term to represent the value of a linguistic variable [5, 11]. In cases of high uncertainty, experts may hesitate between the several linguistic terms, and may

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