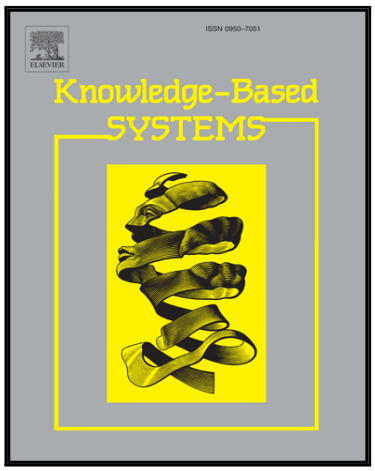

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Fanyong Meng , Jie Tang , Pei Wang , Xiaohong Chen

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A programming-based algorithm for interval-valued intuitionistic fuzzy group decision making

Fanyong Meng[1], Jie Tang[1], Pei Wang[2*], Xiaohong Chen[1,3]

[1]School of Business, Central South University, Changsha 410083, China

[2]School of mathematics and statistics; Guangxi Universities Key Lab of Complex System Optimization and Big Data Processing, Yulin Normal University, Yulin 537000, China

[3]School of Accounting, Hunan University of Commerce, Changsha 410205, China

Abstract: Interval-valued intuitionistic fuzzy preference relations (IVIFPRs) are powerful to express the uncertain preferred and non-preferred judgments of decision makers simultaneously. After reviewing previous researches about IVIFPRs, we find that several limitations exist. Especially, previous methods are insufficient to address inconsistent and incomplete cases. Considering these issues, this paper first analyzes the limitations of the previous consistency concepts for IVIFPRs and then introduces a new one that avoids the disadvantages of previous ones. 0-1 mixed programming models are built for judging the multiplicative consistency of IVIFPRs. Subsequently, several multiplicative consistency-based 0-1 mixed programming models are constructed for determining missing values that can address the situation where ignored objects exist. For group decision making, a distance measure on IVIFPRs is defined, by which the weights of the decision makers are derived. Meanwhile, a consensus index is offered. A multiplicative consistency and consensus based algorithm to group decision making with IVIFPRs is proposed. Finally, two practical decision-making problems are offered to show the application of the new algorithm, and theoretical and numerical analysis of several related methods is made.

Keywords: group decision making; IVIFPR; multiplicative consistency; 0-1mixed programming model; consensus

1. Introduction

Preference relations are powerful tools to decision making that only need decision makers (DMs) to compare two objects at one time. Since Saaty [18] first introduced the concept of multiplicative preference relations, researches about decision making with preference relations have been largely developed. At present, it is still one of the most important decision-making methods. According to elements in preference relations, it can be roughly classified into two types: crisp preference relations [17, 18, 22] and fuzzy preference relations [3, 12, 19, 21, 27]. The former uses exact values to represent the comparisons between objects, while the latter adopts fuzzy numbers, such as interval values, triangular fuzzy numbers, hesitant fuzzy variables, and uncertain linguistic variables. Crisp preference relations are simpler than fuzzy preference relations to rank objects, while fuzzy preference relations are more powerful than crisp preference relations to express the judgements of the DMs.

All of the above-mentioned preference relations can only represent the preferred information of the DMs for the comparison objects. In some times, this might be insufficient, and the DMs may want to express their non-preferred judgements too. Considering this situation, intuitionistic fuzzy sets (IFSs) [1] are good choices that can express the preferred and non-preferred judgements simultaneously. Later, Xu [28] introduced IFSs for preference relations and proposed the concept of intuitionistic fuzzy preference relations (IFPRs). In past ten years, many researchers [5, 6, 9, 24, 26, 29] devoted themselves to researching the theory and application of IFPRs. Recently, Meng et al. [13] noted that IFPRs can only express the quantitative judgements of the DMs and put forward intuitionistic linguistic fuzzy preference relations (ILFPRs). This type of preference relations allows the DMs to apply linguistic variables and intuitionistic fuzzy variables to represent the qualitative and quantitative judgements.

Although IFPRs and ILFPRs have some advantages to express the opinions of the DMs, both of them only allow the DMs to use exact variables. This is still too restrictive to denote uncertain preferences. To address this issue, Xu [30] proposed

Corresponding author: wangpei131@sina.com.cn (P. Wang)