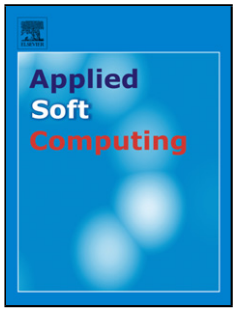

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Some Muirhead Mean operators for Probabilistic Linguistic Term Sets and Their Applications to Multiple Attribute Decision-Making

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Abstract: Archimedean t-conorm and t-norm (ATT) consists of t-conorm (TC) and t-norm (TN) families, which can develop the general operational laws for some fuzzy sets (FSs). Linguistic scale functions (LSFs) generate different semantic values for the linguistic terms (LTs) based on the different usage environments. Muirhead mean (MM) aggregation operators have a prominent advantage of capturing interrelationship among any number of arguments. So it is essential to combine MM operators with probabilistic linguistic term sets (PLTSs) on the basis of the ATT and LSFs. In this paper, we firstly propose the general operational laws for PLTSs by ATT and LSFs. Then, we develop the probabilistic linguistic Archimedean MM (PLAMM) operator, probabilistic linguistic Archimedean weighted MM (PLAWMM) operator, probabilistic linguistic Archimedean dual MM (PLADMM) operator and probabilistic linguistic Archimedean dual weighted MM (PLADWMM) operator, and further explore their special examples. Moreover, we provide two multiple attribute decision-making (MADM) methods built on the proposed operators. Finally, some numerical examples are proposed to validate the proposed methods, which are compared to other existing methods to denote their effectiveness.

Keywords: Fuzzy sets; Probabilistic linguistic term sets; Muirhead mean; ATT; Linguistic scale functions

1. Introduction

Decision-making is a frequent behavior in daily life [1-6]. Owing to the fuzziness of human thinking and the complexity of objective things, people may tend to describe evaluation information by LTs instead of the quantitative form in fuzzy decision-making. For example, the comfort or safety of a car can be evaluated by LTs such as “good”, “poor”, or “medium”. Therefore, the researches on various linguistic models have attracted much more widespread attention by researches. Zadeh [7] proposed the fuzzy linguistic approach to model qualitative evaluation information. However, this approach has shortcomings in the evaluation information modeling and computing processes. Then many linguistic models have been developed, involving 2-tuple linguistic model [8], virtual linguistic model [9], type-2 representation model [10] and so on. These linguistic models have a general character, i.e., they only give a single LT to express evaluation information. But, decision makers (DMs) may be hesitant in several terms when they assess an object. In order to deal with this situation, Rodriguez et al. [11] developed hesitant fuzzy LT sets (HFLTSs). Up to now, lots of extensive researches on HFLTSs have made many achievements [12-15]. Because the HFLTSs neglect the importance degree of each possible LT, there is an assumption that all possible LTs have the same weight which is unrealistic in real decision. Actually, DMs have different preference about several possible LTs so that they should have different weights. Based on this, Pang et al. [16] firstly proposed the probabilistic LT sets (PLTSs), which are composed of possible LTs and their corresponding probabilities. PLTS can be regarded as the extension of HFLTS, which considers the weights of possible LTs so that it can obtain more reasonable results [16-19].

Aggregation operators are important tools to aggregate evaluation information under different kinds of fuzzy environment. Although both aggregation operators and classical decision-making methods are able to rank finite alternatives, however, aggregation operators can get comprehensive values and then rank them. Obviously, it can be found that the methods based on aggregation operators are superior to classical decision-making methods. Therefore, aggregation operators have attracted increasing attention in the field of decision-making. However, under probabilistic linguistic environment, many experts and scholars mainly focused on the extensions of traditional decision-making