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Linguistic Hesitant Fuzzy Power Aggregation Operators and their Applications in Multiple Attribute Decision-Making

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Abstract As a generalization of hesitant fuzzy sets (HFSs) and hesitant fuzzy linguistic term sets (HFLTSSs), linguistic hesitant fuzzy sets (LHFSs) establish a proper interpretation of the hesitancy, inconsistency and uncertainty of experts in evaluating decision alternatives. In this paper, based on the cloud model, we discuss multiple attribute decision-making problems with linguistic hesitant fuzzy information. To extend the applicability of LHFSs, we introduce the concept of a comprehensive cloud of LHFSs that is based on which form of LHFSs with different length can be unified. Utilizing the comprehensive cloud, we define the distance measure between two LHFSs, which makes the support measure of two LHFSs possible. By extending the power operators to the linguistic hesitant fuzzy environment, a series of linguistic hesitant fuzzy power aggregation operators are established. We also study the properties and applications of these aggregation operators and develop two approaches for linguistic hesitant fuzzy multiple attribute decision-making. Finally, two practical examples are given to demonstrate the applicability and effectiveness of the proposed approach.

Keywords: Multiple attribute decision-making; Cloud model; Linguistic hesitant fuzzy sets; Comprehensive cloud; Power average operator.

1 Introduction

To address group decision-making in which the decision-makers provide their information over alternatives with hesitancy or anonymity, Torra [27] proposed hesitant fuzzy sets (HFSs). The prominent feature of HFSs is that they permit the membership degree of an element to a given set to have a few different values. Since the proposal of these sets, research on hesitant fuzzy decision-making has become an active field and an important branch of multiple attribute decision-making [1, 5, 6, 20–23, 35, 44, 47, 53]. Due to the complexities of the environment and the limitations of human knowledge, most decision-makers would like to give their evaluation in natural language. Based on the linguistic variables initiated by Zadeh [49–51], Rodríguez et al. [25] extended

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