Chapter 1
Group-Oriented Multi-Attribute Decision-Making Method Based on Dominance Rough Set Theory

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ABSTRACT

This chapter proposes group-oriented multi-attribute decision-making based on mixed advantage-disadvantage degree (GOMADMMADD) method to deal with group-oriented decision analysis. Based on the strict attribute relationship between group members, this method proposes the concepts of "local advantage-disadvantage degrees" and "advantage-disadvantage degrees," which solves the challenge of group-oriented multi-attribute decision-making (GOMADM). However, this method still has the problem that the number of groups to be evaluated increases exponentially. Therefore, the authors first improved the GOMADMMADD method and proposed decision-making method based on dominance-based rough sets (GMADMDRS). Then, the "advantage" neighborhood operators and "disadvantage" neighborhood operators of groups are introduced to define the "advantage-disadvantage neighborhood degree" (ADND), and the GMADMDRS method is optimized by using ADND. The experimental results show that both GOMADMMADD method and GMADMDRS method effectively evaluate the population, and the optimized GMADMDRS algorithm is consistent in the experimental results, and the time performance has been greatly improved, and the computational performance has been significantly improved, which has practical significance to solve the problem of exponential growth of the number of groups to be evaluated. These methods provide a novel perspective and effective method for group oriented multi-attribute decision-making.

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INTRODUCTION

Problem Background

Group evaluation and ranking have always been required. In the team ranking, it is necessary to evaluate the team as a whole, in financial investment, portfolio investment is a favorable way to avoid risks, portfolio investment needs to evaluate the financial products of the portfolio as a whole, when the feature selection reveals the correlation between the decision variables and the description variables, consider the interaction between the decision variables, and the overall evaluation of the combination decision variables has far-reaching significance. Evaluate and rank groups as a whole, which are widely used in team ranking, portfolio investment, feature selection, group identification, and more.

A Brief Review of DRSA

In real-life scenarios, decision-makers often encounter problems involving imprecise or fuzzy information. To address such Multi-Attribute Decision Making (MADM) problems, Pawlak introduced rough sets (Pawlak, 1982), later extended by various scholars due to its equivalence relationship limitations. In dealing with dual-level hesitant fuzzy language elements (DHHFLTS), Yu et al. proposed a λ-Rough set model, applying it to multi-attribute decision-making (Yu et al., 2019a; Yu et al., 2019b). Gireesha et al. addressed the uncertainty in cloud service provider evaluation by proposing a method based on improved interval-valued intuitionistic fuzzy set weighted aggregation and product evaluation (Gireesha et al., 2020). In the context of bone transplantation selection, Zhang et al. obtained criteria weights using the variable precision intuitionistic fuzzy rough set (CVPIFRS) model and proposed a new MADM method combining CVPIFRS with TOPSIS (Zhang et al., 2020b). Gou et al. introduced an extended probabilistic dual-level language VIKOR method for MCDM in smart healthcare (Gou et al., 2021). Dogan proposed a fuzzy MCDM method based on spherical fuzzy AHP for technology group screening (Dogan, 2021). Zhang et al. addressed the limitations of distance and similarity in DHHFLTS based on algebra and proposed the DHHFL-ELECTRE II method using cosine similarity for financial logistics enterprises' MADM (Zhang et al., 2022). Kang et al. presented a multi-attribute prediction analysis model in fuzzy information systems based on a new fuzzy rough set theory (Kang et al., 2022).

Greco et al. introduced an extension of rough sets called Dominance-based Rough Set Approach (DRSA), where condition attributes are criteria ranked by preference (Greco et al., 1999; Greco et al., 2001). Later, they proposed the dominance rough fuzzy set model by integrating DRSA into the fuzzy neighborhood (Greco et al., 2006). Zhang et al. established a general framework of hesitant fuzzy language rough set, constructing decision rules based on hesitant fuzzy language information (Zhang et al., 2018). In the context of hesitant fuzzy language, they proposed a hybrid model incorporating multi-granularity decision theory rough set into the dual universe framework (Zhang et al., 2020d). Ahmad et al. addressed the key step of calculating upper and lower approximations in DRSA by proposing an effective method that directly computes them without considering irrelevant objects (Ahmad et al., 2020). Huang et al. focused on applying DRSA to process composite ordered decision systems, including categorical, numerical, set-valued, interval-valued, and missing attributes (Huang et al., 2020). Palangetić et al. advanced the theory by considering additional properties and explored the application of Ordered Weighted Average (OWA) operators to fuzzy DRSA (Palangetić et al., 2021). Błaszczyński et al. tested a new dataset for auto loan applications using the Dominance-based Rough Set Balanced Rule Ensemble