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LINGUISTIC LABELS BASED METHODOLOGY FOR FUZZY GROUP DECISION MAKING

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ABSTRACT

In this paper, we review our research works on gradual improvements to fuzzy group decision-making methodologies. Firstly, a single-level semi-numeric method, i.e., linguistic labels representation with fuzzy sets computation, and a fully non-numeric method, i.e., linguistic labels representation with labels manipulation for solving pairwise fuzzy group decision making problems are discussed. Secondly, the extension of these methods into a hierarchical semi-numeric and a hierarchical non-numeric methods are described. Finally, the methods are verified and applied to solving some real cases of fuzzy group decision-making problems such as a waste disposal methods selection problems.

Keywords : group decision making, fuzzy logic, linguistic label, preference modeling, multiple criteria hierarchical analysis

Our research works discussed here are devoted to gradually revising and improving the previously developed fuzzy group decision-making methodologies. For this purpose, linguistic labels based methodologies which are more flexible and suitable to be applied to solving real cases of pairwise fuzzy group decision-making problems are developed.

We propose a semi-numeric method [1], i.e., linguistic labels representations with fuzzy sets computation, and a fully non-numeric method [2], i.e., linguistic labels representations with non-numeric computation for pairwise fuzzy group decision making. These methods can be used to identify the preferred alternatives. Satisfaction degree to each alternative preference is accommodated into the proposed methods [3]. These methods deal with single-level structure problems.

For dealing with a large and a more complex problem, the semi-numeric and non-numeric methods are extended into a hierarchical semi-numeric method [4], [5] and a hierarchical non-numeric method [6], respectively. These methods are able to solve multiple criteria hierarchical structure problems. The methods are verified and applied to solving some cases of fuzzy group decisi making problems, e.g., advertising media selection, waste disposal method selection, and agricultural bas industries project selection problems. The hierarchic semi-numeric method is compared to the Saaty's meth of AHP [7]. The possibility to improve the methods a also discussed.

Fuzzy Preference Relations

In the numeric method for pairwise fuzzy gro decision making [8], an element of a fuzzy preferen relation matrix R^k on a set of alternatives S, for individu decision maker k is expressed by a membership functi $\mu_R k$ (Si,Sj) : S x S $\rightarrow$ [0,1] as follows:

$$\mu_{R}k=(s_i,s_j)\begin{cases}1 & \text{if } s_i \text{ is definitely preferred to } s_j,\\ c\in(0.5,1) & \text{if } s_i \text{ is slightly preferred to } s_j,\\ 0.5 & \text{if } s_i \text{ is indifference to } s_j,\\ d\in(0,0.5) & \text{if } s_j \text{ is slightly preffered to } s_i,\\ 0 & \text{if } s_j \text{ is definitely preffered to } s_i.\end{cases}$$

This direct single-point numerical representati is impractical to be implemented, because the decisi makers tend to give linguistically more natural evaluati values. Moreover, the computation models are rigid a some information may be lost in the computation proces The numeric single-point representation and computati are extended in [1] by using linguistic lab representation and with fuzzy sets computation. T decision-makers may express their fuzzy preferer relations in 13 labels according to the following equatio

$$R^k(s_i,s_j)=\begin{cases}DP & \text{if } s_i \text{ is preferredto } s_j \text{ in definite degree,}\\ VHP & \text{if } s_i \text{ is preferredto } s_j \text{ in very high degree,}\\ HP & \text{if } s_i \text{ is preferredto } s_j \text{ in high degree,}\\ MP & \text{if } s_i \text{ is preferredto } s_j \text{ in moderate degree,}\\ LP & \text{if } s_i \text{ is preferredto } s_j \text{ in low degree,}\\ VLP & \text{if } s_i \text{ is preferredto } s_j \text{ in very low degree,}\\ AS & \text{if } s_i \text{ aboutthe same as } s_j,\\ VLD & \text{if } s_j \text{ is preferredto } s_i \text{ in very low degree,}\\ LD & \text{if } s_j \text{ is preferredto } s_i \text{ in low degree,}\\ MD & \text{if } s_j \text{ is preferredto } s_i \text{ in moderate degree,}\\ HD & \text{if } s_j \text{ is preferredto } s_i \text{ in high degree,}\\ VHD & \text{if } s_j \text{ is preferredto } s_i \text{ in very high degree,}\\ DD & \text{if } s_j \text{ is preferredto } s_i \text{ in definite degree.}\end{cases}$$

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