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An Application for Decision Making Based on Interval Valued Intuitionistic Fuzzy Soft Multi Sets

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The practical application of soft set theory, especially the used of soft set in decision making problems has found paramount importance. In this article we propose an adjustable approach to interval-valued intuitionistic fuzzy soft multi set based decision making by using reduct intuitionistic fuzzy soft multi sets and level soft sets of intuitionistic fuzzy soft sets. Some illustrative example is employed to show the feasibility of our approach in practical applications.

Keywords : Decision Making, Interval Valued Intuitionistic Fuzzy Soft Multi Set, Intuitionistic Fuzzy Soft Sets, Level Soft Set, Reduct Intuitionistic Fuzzy Soft Multi Set, Soft Set.

1. INTRODUCTION

In 1999, Molodtsov [1] initiated soft set theory as a completely generic mathematical tool for modeling vague concepts. In soft set theory there is no limited condition to the description of objects; so researchers can choose the form of parameters as they need, which greatly simplifies the decision making process and make the process more efficient in the absence of partial information. Although many mathematical tools are available for modeling uncertainties such as probability theory, fuzzy set theory, rough set theory, interval valued fuzzy set *etc.*, but there are inherent difficulties associated with each of these techniques. Moreover all these techniques lack in the parameterization of the tools and hence they could not be applied successfully in tackling problems especially in areas like economic, environmental and social problems domains. Soft set theory is standing in a unique way in the sense that it is free from the above difficulties.

Soft set theory has a rich potential for application in many directions, some of which are reported by Molodtsov [1] in his work. Later on Maji *et al.,* [2] presented some new definitions on soft sets such as subset, union, intersection and complements of soft sets and discussed in details the application of soft set in decision making problem. Based on the analysis of several operations on soft sets introduced in [1], Ali *et al.,* [3] presented some new algebraic operations for soft sets and proved that certain De Morgan's law holds in soft set theory with respect to these new definitions. Combining soft sets [1] with fuzzy sets [4] and intuitionistic fuzzy sets [5], Maji *et al.,* [6]-[9] defined fuzzy soft sets and intuitionistic fuzzy soft sets, which are rich potential for solving decision making problems. Alkhazaleh and others [10][11][12][13][14] as a generalization of Molodtsov's soft set, presented the definition of a soft multi set and its basic operations such as complement, union and intersection *etc.*, .

Maji *et al.,* [15] first applied soft sets to solve the decision making problems. Roy and Maji [16] presented a novel method to cope with fuzzy soft sets based decision making problems. Kong *et al.,* [17] pointed out that the Roy-Maji method [16] was incorrect and they presented a revised algorithm. Feng *et al.,* [18], [19] dis-

Table 11
The Tabular Representation of the U_3-Intuitionistic Fuzzy Soft Multi Set Part of $(F_{LU}, A)_2$

U_3	a_1	a_2	a_3	a_4
v_1	(.5,.4)	(.5,.2)	0	0
v_2	(.2,.7)	(.4,.4)	0	0
v_3	(.3,.5)	(.4,.4)	0	0

Table 12
The Mid-Level Soft Set of U_3-Intuitionistic Fuzzy Soft Multi Set Part in $(F_{LU}, A)_2$ with Choice Values

U_3	a_1	a_2	a_3	a_4	Choice value
v_1	1	1	0	0	S_1=2
v_2	0	0	0	0	S_2=0
v_3	0	0	0	0	S_3= 0

making because the final optimal decision is in relation to the opinion weighting vectors and thresholds on membership values or in other words, the decision criteria used by decision makers. For instance, if we choose the NN-topbottom decision rule in the second step of Mukherjee-Das Algorithm, we shall consider the choice value of each object in the $L((F_{NN}, A);topbottom)$, if another decision criterion such as the $LU - mid$ decision rule is used; we shall consider choice values in $L((F_{LU}, A);mid)$.

In general, the choice value of an object in $LU - mid$ decision rule need not coincide with the value in NN-topbottom decision rule. Consequently, the optimal objects determined by the $LU - mid$ decision rule may be different from those selected according to the NN-topbottom rule. As was mentioned above, many decision making problems are essentially humanistic and subjective in nature; hence for decision making in an imprecise environment, there actually does not exist a unique or uniform criterion. This adjustable feature makes Mukherjee-Das Algorithm not only efficient but more appropriate for many real-world applications.

4. CONCLUSIONS

In this study, we propose an adjustable approach to interval-valued intuitionistic fuzzy soft multi set based decision making by using reduct intuitionistic fuzzy soft multi sets and level soft sets of intuitionistic fuzzy soft sets and illustrate this method with some concrete examples. An interval-valued intuitionistic fuzzy soft multi set based decision making problem is converted into a crisp soft set based decision making problem after choosing certain opinion weighting vectors and thresholds. This makes our algorithm simpler and easier for application in practical problems. In addition, a large variety of opinions weighting vectors and thresholds that can be used to find the optimal alternatives make our algorithm more flexible and adjustable. In the future, we can further investigate level soft set approach to decision making based on weighted interval-valued intuitionistic fuzzy soft multi set theory by using reduct weighted intuitionistic fuzzy soft multi sets.

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