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ON SOLVING INCOMPLETE BIPOLAR FUZZY SOFT SET IN DECISION MAKING PROBLEM

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Abstract

In this paper, we develop the concept of bipolar soft set having incomplete data with suitable example. We have given some new definitions and algorithm for solving the decision making problem to overcome the deficient data sets. Finally, an illustrative example is presented for the proposed approach.

I. Introduction

In 1999, Molodtsov [8] initiated the novel concept of soft set, and is a generalization of fuzzy set theory. In the year 2000, Lee [5] introduced bipolar fuzzy set and its membership value lies between $[-1, 1]$. In 2012, Qin et al. [7] proposed a data filling approach for incomplete soft set in which missing data is filled in terms of the association degree between the parameters. Florentin Smarandache et al. [3] introduced a data filling approach to Neutrosophic Soft sets applied on incomplete data. In this paper, we have introduced the concept of bipolar fuzzy soft set with insufficient data with the help of an example. Then we have introduced few definitions and at last we have presented a data filling algorithm supported by an illustrative example to

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validate our algorithm.

II. Some Basic Definitions

Definition 2.1 [4]. Let (F, A) be a bipolar fuzzy soft set, $\mu^{+}_{e_j}(x_i)$ and $\mu^{-}_{e_j}(x_i)$ are the membership and non-membership degrees of each element x_i to $[0, 1]$ and $[-1, 0]$ respectively. Then the score of positive and negative membership degrees for each e_j, $(j = 1, 2, 3, \ldots, m)$ is defined as,

$$(sp)^{+}_{e_j}(x_i) = \sum_{t=1}^{n}(\mu^{+}_{e_j}(x_i) - \mu^{+}_{e_j}(x_t))$$

$$(sp)^{-}_{e_j}(x_i) = \sum_{t=1}^{n}(\mu^{-}_{e_j}(x_i) - \mu^{-}_{e_j}(x_t)).$$

Definition 2.2 [4]. Let (F, A) be a bipolar fuzzy soft set, and then the score of the membership degrees for e_j is defined as, $(sp)_{e_j}(x_i) = (sp)^{+}_{e_j}(x_i) + (sp)^{-}_{e_j}(x_i)$.

Where $(sp)^{+}_{e_j}(x_i)$ and $(sp)^{-}_{e_j}(x_i)$ are the scores of positive and negative membership degrees for each e_j, respectively.

Definition 2.3 [4]. Let (F, A) be a bipolar fuzzy soft set, and then the final score for each x_i is defined as

$$S_i = \sum_{e_j \in E}(Sp)_{e_j}(x_i).$$

III. Bipolar Soft Set with Incomplete (insufficient) Data

Suppose that a pair (f, E) is a bipolar fuzzy soft set over U, such that $x_i \in U$ and $e_j \in E$. So that none of $\mu^{+}_{f(e_j)}(x_i)$ and $\mu^{-}_{f(e_j)}(x_i)$ is known. In this case, in the tabular representation of the bipolar fuzzy soft set over

(f, E), we write $(\mu^{+}_{f(e_j)}(x_i), \mu^{-}_{f(e_j)}(x_i)) = *$. Here, we say that, $f(e_j)$ is missing and the bipolar fuzzy soft set (f, E) over U has incomplete data.

Example 3.1. Suppose a CBSE school recruiting some new teachers. Let us consider $U = \{T_1, T_2, T_3, T_4, T_5, T_6, T_7\}$ be the set of candidates and $E = \{e_1, e_2, e_3, e_4, e_5, e_6\}$ be the set of parameters, where e_1 = good communication, e_2 = knowledge, e_3 = experience, e_4 = young, e_5 = highest educational degree, e_6 = attitude.

U	e_1	e_2	e_3	e_4	e_5	e_6
T_1	(0.4, –0.7)	(0.3, –0.5)	(0.8, –0.3)	(0.2, –0.9)	(0.1, –0.2)	(0.8, –0.3)
T_2	(0.6, –0.1)	(0.8, –0.2)	(0.5, –0.6)	(0.6, –0.1)	*	(0.2, –0.8)
T_3	(0.3, –0.4)	*	(0.3, –0.2)	(0.3, –0.7)	(0.9, –0.3)	(0.6, –0.7)
T_4	(0.8, –0.2)	(0.6, –0.4)	(0.9, –0.1)	(0.7, –0.5)	(0.7, –0.5)	(0.4, –0.6)
T_5	(0.6, –0.3)	(0.4, –0.8)	(0.4, –0.8)	*	(0.4, –0.8)	(0.1, –0.5)
T_6	(0.4, –0.9)	(0.8, –0.8)	(0.6, –0.5)	(0.8, –0.8)	(0.7, –0.6)	*
T_7	(0.7, –0.5)	(0.5, –0.8)	(0.7, –0.4)	(0.4, –0.1)	(0.3, –0.4)	(0.5, –0.8)

Definition 3.2. Let $e_i, e_j \in E$ be the set of parameters. Then $CANP_{ij}$ be consistent association number between parameters e_i and e_j and is defined as

$$CANP_{ij} = |\ \{x \in U_{ij} / \mu^{+}_{f(e_i)}(x_i) = \mu^{+}_{f(e_j)}(x_i),\ \mu^{-}_{f(e_i)}(x_i) = \mu^{-}_{f(e_j)}(x_i)\}\ |.$$

Definition 3.3 [3]**.** Let $e_i, e_j \in E$ be the set of parameters. Then $CADP_{ij}$ be consistent association degree between parameters e_i and e_j and is defined as $CADP_{ij} = \dfrac{CANP_{ij}}{|\ U_{ij}\ |}$.

4. Data filling Algorithm for Bipolar Fuzzy Soft Set

Step 1. Input the bipolar fuzzy soft set (f, E) which has insufficient data.

Step 2. Compute e_i for which data is missing.

Step 3. Calculate the association degree between the parameters.

Step 4. Calculate $MADP_i$.

Step 5. Find all e_j for which the maximal association degree with the parameter e_i.

Step 6. Find consistent association and inconsistent association values.

Step 7. Fill all the missing data.

Step 8. Rank the alternatives using final score.

4.1. Numerical example

Consider the bipolar fuzzy soft set given in example 3.1.

The association degree table for the bipolar fuzzy soft set (f, E) is given below:

	e_1	e_2	e_3	e_4	e_5	e_6
e_2	1	–	1	0.8	0.8	.8
e_4	0.833	8	1	–	.8	1
e_5	1	8	1	.8	–	1
e_6	1	8	0.833	1	1	–

The tabular representation of the filled bipolar fuzzy soft set is given in the below table:

U	e_1	e_2	e_3	e_4	e_5	e_6
T_1	(0.4, –0.7)	(0.3, –0.5)	(0.8, –0.3)	(0.2, –0.9)	(0.1, –0.2)	(0.8, –0.3)
T_2	(0.6, –0.1)	(0.8, –0.2)	(0.5, –0.6)	(0.6, –0.1)	(0.6, –0.1)	(0.2, –0.8)

T_3	(0.3, –0.4)	(0.7, –0.8)	(0.3, –0.2)	(0.3, –0.7)	(0.9, –0.3)	(0.6, –0.7)
T_4	(0.8, –0.2)	(0.6, –0.4)	(0.9, –0.1)	(0.7, –0.5)	(0.7, –0.5)	(0.4, –0.6)
T_5	(0.6, –0.3)	(0.4, –0.8)	(0.4, –0.8)	(0.4, –0.5)	(0.4, –0.8)	(0.1, –0.5)
T_6	(0.4, –0.9)	(0.8, –0.8)	(0.6, –0.5)	(0.8, –0.8)	(0.7, –0.6)	(0.8, –0.6)
T_7	(0.7, –0.5)	(0.5, –0.8)	(0.7, –0.4)	(0.4, –0.1)	(0.3, –0.4)	(0.5, –0.8)

The final score of the membership degrees are.

U	T_1	T_2	T_3	T_4	T_5	T_6	T_7
T_i	– 4	8.3	– 1.5	11.1	– 11.6	– 2	– 0.6

It is clear that, T_4 has the maximum score. Hence we conclude that T_4 is the best candidate.

5. Conclusion

In this paper, we have proposed the data filling approach for incomplete bipolar fuzzy soft set where missing data is filled in connection with the association degree between the parameters. The proposed algorithm is useful to solve the applications of decision making problem involving incomplete data. It results; the candidate T_4 is the best among all.

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