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Application of Generalized Fuzzy Soft Sets in Selection of Appropriate Vendor

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ABSTRACT:

In every step of our real life we have to take decision. So, choice of right decision is very important to a management. There are processes and techniques to improve decision-making and the quality of decisions. Soft Set theory is one of the recent topics gaining significance in finding rational and logical solutions to various real-life problems which involve uncertainty, impreciseness and vagueness.The purpose of this paper is to use soft set theory in decision making in vendor selection to a retailer. The retailer sets a preference on parameters for selection of vendor. We emphasizehere to select best choice of vendor to a retailer by calculating scores of membership and non-membership based on the model of Borah et al[1].

KEYWORDS: Decision Making, Fuzzy Soft Set, Complement, Membership Score, Non-membership Score.

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1. INTRODUCTION

In today's business scenario competition among the vendors for selling their product is increasing very fast. Vendors enlighten their strong points and provide various opportunities to retailers to attract themso that theycan increase orders from retailers to sell their products. But it is a great problem to a retailerto select a vendor properly. They become confused in making right choice. There are methods and techniques to improve decision-making and the quality of decisions.

Concept of fuzzy sets is first introduced by Zadeh[2] in 1965.Then several researches have been done on fuzzy sets and at present it plays a vital role in real life situation. In 1999 Molodtsov[3] has introduced the concept of Soft Set as a new mathematical tool for dealing with uncertainties.

The soft set theory has been applied to many different fields with great success. Detailed studies on soft sets have been done by Maji et al[4,5] and they applied this in the decision making using the reduction of rough sets. In 2010, Majumdar et al[6] introduced the notion of generalized fuzzy soft sets and successfully applied their notion in a real-life problem.They continuously work in this field and try to apply it in decision making problems. Borah et al applied the generalized fuzzy soft in the process of teaching evaluation.Abdullah et al[7] and Ho et al[8] used multi-criteria decision-making approaches

To select a better supplier. Bharadwaj et al[9] applied generalized soft set in teaching evaluation. Cagman et al[10,11] focused on the applications of fuzzy soft set. Pal[12] and Kalaiselvi et al[13,14] applied fuzzy soft relations to solve the decision-making problem.Danjuma et al[15] illustrated elaborately a review about the uses of soft set-in decision-making problem. Gagoi et al[16] had shown how soft set could be applied in day to day problem. Neog et al[17] used Fuzzy soft set in a new perspective.Nagarjuna et al[18] and Salkia et al[19] applied fuzzy soft set matrix in the solution of decision-making problem. Nasef et al[20] focused on Modotsov's[3] soft set theory.Application of soft set relation in decision making problem is proposed by Sut[21].

At present, soft set theory is applied widely in every sphere of life i.e.in economics, engineering, environment, social science, medical science, etc where uncertainties are present. In this paper adecision-making problem have been derived for the selection of right vendor on the basis of some parameters. The proposed model is based on the paper of generalized fuzzy soft set developed by Borah et al[1].

2. PRELIMINARIES:

In this section, we present the basic definitions of fuzzy set theory and soft set theory that are useful for subsequent discussions.

2.1 Fuzzy set:

Fuzzy sets providedegrees of membership of its elements introduced by Zadeh et al. Classical sets only consider 0& 1 but Fuzzy sets generalize the classical sets by considering the membership.

Definition: Let X be a space of points generated by x. Thus X = {x}. A fuzzy set A in X is characterized by a membership function $f_A(x)$ which associates with each point in X a real number in the interval [0,1], with the values of $f_A(x)$ at x representing the "grade of membership" of x in A. Thus, the nearer the value of $f_A(x)$ to unity, the higher the grade of membership of x in A.

2.2 Soft set:

Soft set theory is a generalization of fuzzy set theory which was firstintroduced by Molodtsov in 1999 to deal with uncertainty in a non-parametric manner. Molodtsov [9] defined the soft set in the following way.

Definition: Let *U*be an initial universe set and E be a set of parameters. Let *P* (*U*) denotes the power set of *U* and. A pair (*F*, *E*) is called a soft set (over *U*), where *F* is a mapping given by: $F{:}E \rightarrow P(U)$. In other words, a soft set over *U* is a parameterized family of subsets of the universe *U*.
Thus a soft set over U can be represented by the set of ordered pairs $F_A = \{(f_A(x),x) : x \in E,$
$f_A(x) \in P(U)\}$ the set of all soft sets over U will be denoted byS(U).

2.3 Fuzzy Soft Set

In this section we briefly explain the concept offuzzy soft set which is certain extensions of the crisp soft set. The fuzziness or vagueness deals with uncertainty inherent in the decision-making problems of the real world. The definition of fuzzy soft set is followed by an example

2.4 Property

For two fuzzy soft sets (*F*, *A*) and (*G*, *B*) in a fuzzy soft class (*U*, *E*), we say that (*F*, *A*) is a fuzzy soft subset of (*G*, *B*), if

(i) $A \subseteq B$

(ii) For all $\varepsilon \in A$, $F(\varepsilon) \subseteq G(\varepsilon)$ and is written as $(F, A) \tilde{\subseteq} (G, B)$.

2.5 Complement of fuzzy soft set

The complement of a fuzzy soft set (*F*, *A*) is denoted by $(F,A)^c$ and is defined by $(F,A)^c = (F^c,A)$ where $F^c : \rightarrow \tilde{P}(U)$ is a mapping given by $F^c(\alpha) = [F(\alpha)]^c$, $\forall \alpha \in A$.

2.6Definition

Let F_μ be two generalized fuzzy soft set over (*U, E*). Then F_μ^c is said to be complement of and is defined as $F_\mu^c(e) = (F^c(e), \mu^c(e)), \forall e \in E$.

3. An application of generalized fuzzy soft set in vendor selection

An application of generalized fuzzy soft set theory in selecting an appropriate vendor is developed here. It is assumed that at least five of six parameters viz. on time delivery, maintaining quality, providing service, right selling price, good behaviour, maintaining carbon emission index are the basis for satisfactory level.

e_1 = on time delivery

e_2 = maintaining quality

e_3 = providing service

e_4 = right selling price

e_5 = good behaviour

e_6 = maintaining carbon emission index (green product)

Let V= $\{v_1,v_2,v_3,v_4,v_5,v_6,v_7,v_8\}$ be the set of eight vendors.

The retailer has to select the right vendor appropriate for him. But it is not an easy task.

Let A= $\{e_1,e_2,e_3,e_4,e_6\} \subseteq$ E be the standard parameters for selecting an appropriate vendor.

Let F_μ be a fuzzy subset of *A* defined by μ (e_1) = 0.4, μ (e_2) = 0.5, μ (e_3) = 0.3, μ (e_4) = 0.7, μ (e_6) = 0.6

Consider the generalized fuzzy soft sets as below

$$F_\mu(e_1) = \left(\left\{ \frac{v_1}{0.2}, \frac{v_2}{0.3}, \frac{v_3}{0.4}, \frac{v_{41}}{0.2}, \frac{v_5}{0.4}, \frac{v_6}{0.5}, \frac{v_7}{0.2}, \frac{v_8}{0.4} \right\}, 0.4 \right)$$

$$F_\mu(e_2) = \left(\left\{ \frac{v_1}{0.0}, \frac{v_2}{0.1}, \frac{v_3}{0.3}, \frac{v_{41}}{0.2}, \frac{v_5}{0.4}, \frac{v_6}{0.3}, \frac{v_7}{0.1}, \frac{v_8}{0.5} \right\}, 0.5 \right)$$

$$F_\mu(e_3) = \left(\left\{ \frac{v_1}{0.2}, \frac{v_2}{0.4}, \frac{v_3}{0.1}, \frac{v_4}{0.6}, \frac{v_5}{0.5}, \frac{v_6}{0.3}, \frac{v_7}{0.2}, \frac{v_8}{0.5} \right\}, 0.3 \right)$$

$$F_\mu(e_4) = \left(\left\{ \frac{v_1}{0.8}, \frac{v_2}{0.3}, \frac{v_3}{0.5}, \frac{v_{41}}{0.4}, \frac{v_5}{0.0}, \frac{v_6}{0.4}, \frac{v_7}{0.2}, \frac{v_8}{0.1} \right\}, 0.7 \right)$$

$$F_\mu(e_6) = \left(\left\{ \frac{v_1}{0.2}, \frac{v_2}{0.4}, \frac{v_3}{0.5}, \frac{v_{41}}{0.6}, \frac{v_5}{0.4}, \frac{v_6}{0.3}, \frac{v_7}{0.4}, \frac{v_8}{0.1} \right\}, 0.6 \right)$$

Finally, we find the highest value from the final score table, which would correspond to the best choice of vendor.

Comparison table is obtained by multiplying each entry of the table representing the generalized fuzzy soft set by corresponding values of $\mu(e)$.

4. ALGORITHM:

Step 1**:** Input the generalized fuzzy Soft Set F_μ .

Step 2**:** Represent F_μ in tabular form.

Step 3**:**Compute the comparison table by multiplying each entry of the table by corresponding values of

$\mu(e)$.

Step 4: Set preference table based on choice of retailer.

Step 5**:** Compute the next table by multiplying elements of comparison table with the elements of preference table row wise.

Step 6**:**Compute the membership score (*m*).

Step 7**:** Compute the complement F_μ^c

Step 8**:**Write F_μ^c in tabular form.

Step 9**:**Compute the non- membership score (*n*).

Step 10**:**Compute the final score by "*m* + *n* - *mn*".

Step11**:** Determine the highest score.

It can be represented in the tabular form as follows

Fuzzy Soft Set in tabular form

Table-1

A / V	e_1 e_2	e_3	e_4	e_5	
v_1	0.2	0.0	0.2	0.8	0.2
v_2	0.3	0.1	0.4	0.3	0.4
v_3	0.4	0.3	0.1	0.5	0.5
v_4	0.2	0.2	0.6	0.4	0.6
v_5	0.4	0.4	0.5	0.0	0.4
v_6	0.5	0.3	0.3	0.4	0.3
v_7	0.2	0.1	0.2	0.2	0.4
v_8	0.4	0.5	0.5	0.1	0.1

0.4 0.5 0.3 0.7 0.6

Comparison table

Table-2

A / V	e_1	e_2	e_3	e_4	e_5
v_1	0.08	0.00	0.06	0.56	0.12
v_2	0.12	0.05	0.12	0.21	0.24
v_3	0.16	0.15	0.03	0.35	0.30
v_4	0.08	0.10	0.18	0.28	0.36
v_5	0.16	0.20	0.15	0.00	0.24
v_6	0.20	0.15	0.09	0.28	0.18
v_7	0.08	0.05	0.06	0.14	0.24
v_8	0.16	0.25	0.15	0.07	0.06

Suppose that retailer emphasizes on different parameters as follows

Preference table

	e_1	e_2	e_3	e_4	e_5
P	0.15	0.35	0.1	0.2	0.2

Suchthat the sum of the preference set by retailer is 1.0.

Multiplying elements of Table-2 with the elements of preference table row wise we get table-3 as follows

Table-3

A / V	e_1	e_2	e_3	e_4	e_5
v_1	0.012	0.00	0.006	0.112	0.024
v_2	0.018	0.0175	0.012	0.042	0.048
v_3	0.024	0.0525	0.003	0.070	0.060
v_4	0.012	0.035	0.018	0.056	0.072
v_5	0.024	0.00	0.015	0.000	0.048
v_6	0.030	0.0525	0.009	0.056	0.036
v_7	0.012	0.0175	0.006	0.028	0.048
v_8	0.024	0.0875	0.015	0.014	0.012

Table-4 **Membership score table**

Vendors	Row sum(m)
v_1	0.1540
v_2	0.1375
v_3	0.2075
v_4	0.1930
v_5	0.0870
v_6	0.1835
v_7	0.1115
v_8	0.1525

Table-5 : Complement table i.e. F_μ^c

A / V	e_1	e_2	e_3	e_4	e_5
v_1	0.8	1.0	0.8	0.2	0.8
v_2	0.7	0.9	0.6	0.7	0.6
v_3	0.6	0.7	0.9	0.5	0.5
v_4	0.8	0.8	0.4	0.6	0.4
v_5	0.6	0.6	0.5	1.0	0.6
v_6	0.5	0.7	0.7	0.6	0.7
v_7	0.8	0.9	0.8	0.8	0.6
v_8	0.6	0.5	0.5	0.9	0.9

Table-6 Non-membership score table

Vendors	**Row sum**
v_1	3.6
v_2	3.5
v_3	3.2
v_4	3.0
v_5	3.3
v_6	3.2
v_7	3.9
v_8	3.4

Table-7 Selection score table

Vendors	Membershi Score (m)	Non - Membership Score (n)	Deterministic Score (m + n-mn)
v_1	0.1540	3.6	3.1996
v_2	0.1375	3.5	3.1562
v_3	0.2095	3.2	2.7391
v_4	0.1930	3.0	2.614
v_5	0.0870	3.3	3.0999
v_6	0.1835	3.2	2.7963
v_7	0.1115	3.9	3.5766 *
v_8	0.1525	3.4	3.034

The highest score is 3.5766 and it corresponds to vendor number seven (v_7).Hence v_7 is the fittest vendor to the retailer under the basis of above parameters.

5. CONCLUSION:

The use of a preference fuzzy soft is taken into consideration. The model proposed through this work is evaluated on hypothetical data. In this paper, we have developed a model of choosing the right vendor by the retailer by calculating membership and non-membership score.

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