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Decision Making Problem Via Fuzzy Soft Set

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ABSTRACT

Decision making is very essential to deal with many complicated problems in various fields involving uncertainties. To obtain the best feasible solution we consider various parameters relating to the solution. In this paper, a decision making problem is discussed using soft fuzzy matrix model and AHP technique.

KEYWORDS : RTD matrix, CETD matrix, AHP technique

INTRODUCTION

Molodtsov [9] presented some applications of the soft set theory in several directions viz. study of smoothness of functions , game theory, operations research, Riemann integration, Perron integration, probability, theory of measurement, etc. Maji et al [7] presented an application of soft sets in decision making problems and studied basic notions of soft set theory. Many researchers have studied this theory and they created models to solve problems in decision making.

The Analytic Hierarchy Process (AHP) is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology. It was developed by Thomas L. Saaty [15]in the 1970s and has been extensively studied and refined since then. It has particular application in making, and is used around the world in a wide variety of decision situations, in fields such as government, business, industry, healthcare, shipbuilding and education.

In this paper, a new dimension is given to the decision making problem using soft fuzzy matrix model and AHP techniques.

PRELIMINARIES

Definition 2.1 [9]

A pair (F,E) is called a soft set (over U) if and only if F is a mapping of E into the set of all subsets of the set U. In other words, the soft set is a parameterized family of sunsets of the set U. Every set F(e),e $\in$ E, from this family may be considered as the set of e-approximate elements of the soft set.

Definition 2.2 [8]

A pair (F, A) is called a fuzzy soft set over U where F: A $\rightarrow \tilde{P}$(U) is a mapping from A into $\tilde{P}$(U).

Definition 2.3 [2]

Let U be a universe and E a set of attributes. Then the pair (U,E) denotes a collection of all fuzzy sets on U with attributes from E and is called a fuzzy soft class.

Definition 2.4 [8]

A soft set (F, A) over U is said to be a NULL fuzzy soft set denoted by Φ, if for all ε A, F (ε) is the null fuzzy set $\bar{0}$ of U where $\bar{0}$(x)=0 for all x $\in$ U.

Definition 2.5 [8]

A soft set (*F, A*) over *U* is said to be absolute fuzzy soft set denoted by $\tilde{A}$ if $\forall$ ε $\in$ A,

F (ε) is the null fuzzy set $\tilde{1}$ of U where $\tilde{1}$ (x) = 1 $\forall$ x $\in$U.

Definition 2.6 [8]

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 ε $\in$ A, F (ε) $\subseteq$ G (ε) and is written as (F,A) $\tilde{\subseteq}$ (G,B).

Definition 2.7 [8]

Union of two fuzzy soft sets (F,A) and (G,B) in a soft class (U,E) is a fuzzy soft set (H,C) where C=A $\cup$ B and for all ε $\in$ C ,

$$H(\varepsilon) = \begin{cases} F(\varepsilon), & if \varepsilon \in A - B \\ G(\varepsilon), & if \varepsilon \in B - A \\ F(\varepsilon) \cup G(\varepsilon), & if \varepsilon \in A \cap B \end{cases}$$

And is written as (F,A) $\tilde{\cup}$ (G,B) = (H,C)

Definition 2.8 [8]

Intersection of two fuzzy soft sets (F,A) and (G,B) in a soft class (U,E) is a fuzzy soft set (H,C) where C=A $\cap$ B and $\forall$ ε $\in$ C,H(ε) =F(ε) or G(ε) (as both are same fuzzy set)and is written as (F,A) $\cap$ (G,B) = (H,C) .

Definition 2.9 [2]

Let (F,A) and (G,B) be two fuzzy soft sets in a soft class (U,E) with A $\cap$ B $\neq \phi$ .Then Intersection of two fuzzy soft sets (F,A) and (G,B) in a soft class (U,E) is a fuzzy soft set (H,C) where C=A $\cap$ B and $\forall$ ε $\in$ C,

H(ε) =F(ε) $\cap$ G(ε)

We write (F,A) $\tilde{\cap}$ (G,B) = (H,C).

SOFT FUZZY MATRIX MODEL

In this Section the problem of recruiting an Eligible candidate for a company is discussed using soft fuzzy matrix model.

Suppose that a company wants to "Recruit an Eligible Candidate" for which there are five candidates who form the Universe U={c_1,c_2,c_3,c_4,c_5}.X={Mr.X,Mr.Y,Mr.Z} be the set of expert committee members. This expert committee consider the set of parameters E={e_1,e_2,e_3} where the parameters e_1 stands for communication skills,e_2 stands for technical skills and e_3 stands for Team Work Skills.

ALGORITHM:

Step 1: Input the soft set (F,E).

Step 2; Choose the set of parameters.

Step 3: Convert the raw data into matrix using mean and Standard deviation

Step 4: Obtain the RTD matrix using

If $a_{ij} \leq (\mu_j - \alpha^* \sigma_j)$ then $e_{ij} = -1$

If $a_{ij} \in (\mu_j - \alpha^* \sigma_j , \mu_j + \alpha^* \sigma_j)$ then $e_{ij} = 0$

If $a_{ij} \geq (\mu_j + \alpha^* \sigma_j)$ then $e_{ij} = 1$

Step 5: The cumulative effect of all the data is calculated.

Step 6: Graph is drawn taking the column sum of the CETD matrix.

Suppose $(F_1,Z)=\{(e_1\{c_1/0.3,c_2/0.5,c_3/0.6,c_4/0.4,c_5/0.8\}),$
$(e_2\{c_1/0.2,c_2/0.4,c_3/0.5,c_4/0.6, c_5/0.6\}),$
$(e_3\{c_1/0.1,c_2/0.2,c_3/0.7,c_4/0.8, c_5/0.3\})\}$

$(F_2,Z)=\{(e_1\{c_1/0.7,c_2/0.6,c_3/0.7,c_4/0.5,c_5/0.4\}),$
$(e_2\{c_1/0.2,c_2/0.4,c_3/0.8,c_4/0.6, c_5/0.5\}),$
$(e_3\{c_1/0.5,c_2/0.9,c_3/0.6,c_4/1.0, c_5/0.7\})\}$

$(F_3,Z)=\{(e_1\{c_1/0.5,c_2/0.4,c_3/0.6,c_4/0.8,c_5/0.5\}),$
$(e_2\{c_1/0.4,c_2/0.7,c_3/0.5,c_4/0.6, c_5/0.6\}),$
$(e_3\{c_1/0.6,c_2/0.6,c_3/0.5,c_4/0.4, c_5/0.5\})\}$

The above soft set is confined in the form of a matrix given below.

$$A = \begin{array}{c} \\ c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \end{array} \begin{array}{c} \begin{array}{ccc} e_1 & e_2 & e_3 \end{array} \\ \begin{pmatrix} 0.3 & 0.2 & 0.1 \\ 0.5 & 0.4 & 0.2 \\ 0.6 & 0.5 & 0.7 \\ 0.4 & 0.6 & 0.8 \\ 0.8 & 0.6 & 0.3 \end{pmatrix} \end{array}$$

Average μ 0.52 0.46 0.42

To find the SD σ :

$\alpha = 0.5$

RTD Matrix is
$$\begin{pmatrix} -1 & -1 & -1 \\ 0 & 0 & -1 \end{pmatrix}$$

c_5 0.4 0.5 0.7

Average μ 0.58 0.50 0.74

The CETD matrix formed with the above obtained RTD Matrix is

$$\begin{pmatrix} 0 & -3 & -3 \\ 0 & -3 & 3 \\ 0 & 3 & -2 \\ 0 & 3 & 3 \\ -1 & 0 & -2 \end{pmatrix} = \begin{pmatrix} -6 \\ 0 \\ 1 \\ 6 \\ -3 \end{pmatrix}$$

The above soft set is confined in the form of a matrix given below.

$$C = \begin{array}{c} \\ c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \end{array} \begin{array}{c} \begin{array}{ccc} e_1 & e_2 & e_3 \end{array} \\ \begin{pmatrix} 0.5 & 0.4 & 0.6 \\ 0.4 & 0.7 & 0.6 \\ 0.6 & 0.5 & 0.5 \\ 0.8 & 0.6 & 0.4 \\ 0.5 & 0.6 & 0.5 \end{pmatrix} \end{array}$$

Average μ 0.56 0.56 0.5

The CETD matrix formed with the above obtained RTD Matrix is

$$\begin{pmatrix} -1 & -3 & 3 \\ -3 & 3 & 3 \\ 1 & -2 & -1 \\ 3 & 1 & -2 \\ -1 & 1 & -1 \end{pmatrix} = \begin{pmatrix} -1 \\ 3 \\ -2 \\ 2 \\ 1 \end{pmatrix}$$

The sum of decisions of the three experts

$$\begin{pmatrix} -9 \\ -2 \\ 4 \\ 3 \\ 4 \end{pmatrix} + \begin{pmatrix} -6 \\ 0 \\ 1 \\ 6 \\ -3 \end{pmatrix} + \begin{pmatrix} -1 \\ 3 \\ -2 \\ 2 \\ 1 \end{pmatrix} = \begin{pmatrix} -16 \\ 1 \\ 3 \\ 11 \\ 2 \end{pmatrix}$$

4. ANALYTIC HIERARCHY PROCESS FOR DECISION MAKING:

The AHP is a powerful and flexible multi criteria decision making tool for dealing with complex problems where both qualitative and quantative aspects are taken into consideration. The problem of "Recruiting an Eligible Candidate" is applied again to verify the result.

The candidates are compared using the pairwise comparison scale for AHP preference. The following tables are framed with Saaty's scale for each parameter ,say e_i (i=1,2,3) (Communication skills, Technical skills , TeamWork Skills).

Comparison Table for e1:

Parameter (e_1)	c_1	c_2	c_3	c_4	c_5
c_1	1	1/3	1/4	1/2	1/5
c_2	3	1	1/2	2	1/4
c_3	4	2	1	3	1/3
c_4	2	1/2	1/3	1	1/5
c_5	5	4	3	5	1

The above table is used to find the eigen vector A_{ij} by dividing the values using the column sum.

Parameter (e_1)	c_1	c_2	c_3	c_4	c_5	Average A_{ij}
c_1	0.066	0.0425	0.0492	0.0434	0.1008	0.06038
c_2	0.2	0.1277	0.0984	0.1739	0.1260	0.1452
c_3	0.266	0.2554	0.1968	0.2608	0.16809	0.2294
c_4	0.133	0.0638	0.0656	0.0869	0.1008	0.4501
c_5	0.333	0.5108	0.5905	0.434	0.5042	0.4745

The corresponding eigen values are for matrix A (1.07103 ,2.6891 ,5.30398,5.4223,7.31514)

The same procedure is followed for the matrix B and C.
The sum of all Eigen values of the matrix A,B and C is
(6.3656 9.01066 12.157 13.189 11.40)
which shows that C_4 is the Eligible candidate to be Recruited.

5. CONCLUSION

Soft set theory is a powerful tool for decision making and drawing conclusions from data, especially in those cases where some uncertainty exists in the data. The process of Recruiting an Eligible candidate for a company is done using soft fuzzy matrix model and the same result is verified using Analytic Hierarchy Process.

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