Interval Valued Fuzzy Matrix in Interview Selection Process

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Abstract – In this paper introduces the concept of interval valued fuzzy matrix for solving decision making problem. During Decision making process , we introduce geometric mean of an interval valued fuzzy matrix as the geometric mean of its lower and upper limit matrices and propose a method to study, sanchez's approach of selection interview process through the geometric mean of an interval valued fuzzy matrix. Finally the proposed algorithm is illustrated using a numerical example.

Index Terms – Fuzzy set, Fuzzy matrix, Interval valued fuzzy matrix, Geometric mean, Interval valued geometric mean.

1. INTRODUCTION

The concept of fuzzy matrix [10] is one of the recent topics developed for dealing with the uncertainties present in engineering, agriculture, science, social science and also in the most of our real life situations. Thomason [12] published the first work on fuzzy matrices and this work based on the max-min operation.

The parameterization tool of interval-valued fuzzy matrix enhances the flexibility of its applications. Most of our real life problems in medical sciences, engineering, management environment and social sciences often involved data which are not necessarily crisp, precise and deterministic in character due to various uncertainties associated with these problems. The most useful representation of fuzziness is by membership function. Depending upon the nature and shape of the different forms, such as triangular fuzzy number, trapezoidal fuzzy number etc. The concept of Interval-Valued Fuzzy Matrix (IVFM) [6] as a generalization of fuzzy matrix was introduced and developed by Shyamal and Pal [11].

An IVFM is represented as $A = [a_{ij}] = \{[a_{ijL}, a_{ijU}]\}$, Where each a_{ij} is a subinterval of the interval [0,1], as the interval matrix $A = [A_L, A_U]$, Whose ij^{th} entry is the interval $[a_{ijL}, a_{ijU}]$, Where the lower limit matrix $A_L = [a_{ijL}]$ and the upper limit matrix $A_U = [a_{ijU}]$ are fuzzy matrices such that $a_{ijL} \leq a_{ijU}$ for all i,j (ie) $A_L \leq A_U$ [3].In this paper , by using the representation of interval valued fuzzy matrix, we provide the techniques to study Sanchez's approach of interview selection of IVFMs.

2. PRELIMINARIES

In this section, some basic definitions of FMs, IVFMs and operations on IVFM are given .Let IVFM denote the set of interval – valued fuzzy matrices, that is fuzzy 0matrices whose entries are all subintervals of the interval [0, 1].

2.1 Fuzzy Matrix [10]

A fuzzy matrix A of order m x n is defined $A=[\langle a_{ij}, a_{ij\mu}\rangle]_{mxn}$, where $a_{ij\mu}$ is the membership value of the element $a_{ij\mu}$ in A and $a_{ij\mu} \in [0, 1]$.We write A as

$A=[a_{ij\mu}]_{mxn}$.

2.2 Interval Valued Fuzzy Matrix (IVFM)[6]

An IVFM A over F_{mxn} is defined as $A=[a_{ij}] =\{[a_{ijL}, a_{ijU}]\}_{mxn}$. Let us define

$A_L=[a_{ijL}]_{mxn}$ and $A_U = [a_{ijU}]_{m \times n}$. Clearly A_L and A_U belong to F_{mn} such that

$A_L \leq A_U$. A can be written as

$$A=[A_L, A_U]$$

Where A_L and A_U are called the lower and upper limits of A respectively. We write IVFM as $A= \{[a_{ijL}, a_{ijU}]\}_{m\ n}$ with condition $0 \leq a_{ijL} \leq a_{ijU} \leq 1$.

2.3 Operations on IVFM: [7]

Addition:

Let $A = [a_{ij}] = \{[a_{ijL}, a_{ijU}]\}$ and $B = [b_{ij}] = \{[b_{ijL}, b_{ijU}]\}$ be two IVFMs of order

mxn, their sum is A + B is defined as

$$A + B = \{ \max [a_{ij}, b_{ij}] \} = \{ \max [a_{ijL}, b_{ijL}], \max [a_{ijU}, b_{ijU}] \}.$$

Product:

Let $A = [a_{ij}] = \{[a_{ijL}, a_{ijU}]\}$ and $B =[b_{ij}] = \{[b_{ijL}, b_{ijU}]\}$ be two IVFMs of order m x n, Product of two IVFMs $A =[a_{ij}]_{m \times n}$ and $B = [b_{ij}]_{n \times p}$ denoted by AB is defined as

$AB = [\ C_{ij}] = \{\ \max_{k} \min [\ a_{ikL} b_{kjL}]\ ,\ \max_{k} \min [a_{ikU},\ b_{kjU}]\ \}$

3. APPLICATION OF IVFMS IN INTERVIEW SELECTION

Suppose S is a set of skills of certain posts ,P is a set of posts and C is a set of candidates, construct an IVFM (F , P) over S, Where F is a mapping F: P→ (S),$\tilde{F}$(S) is a set of all interval valued fuzzy sets of S. A relation matrix say, R_1 is constructed from the IVFM

(F , P) and called skill – post matrix . Similarly its compliment (F , P)^c gives another relation matrix say, R_2 called non skill posts matrix . Analogous to Sanchez's notion of interviewing knowledge , we refer to each of the matrices R_1 and R_2 as interviewing knowledge of an IVFM . Again we construct another IVFM (F_1 , S) over C, Where F_1 is a mapping given by $F_1 : S \rightarrow \tilde{F}$ (C). This IVFM gives another relation matrix Q called candidate – skill matrix . Then we obtain two new relation matrices T_1= Q.R_1 and T_2=Q.R_2 called skill candidate matrix and non skill candidate matrix respectively.

4. GEOMETRIC MEAN METHOD

In this section, we apply Sanchez's method for the interview selection of the company for geometric mean of IVFM.

4.1 Definition

Let A=[A_L , A_U]. Geometric mean of IVFM A = geometric mean of A_L and A_U denoted as gm (A) is defined as gm (A) =$\sqrt{(A_L . A_U)}$ =$\sqrt{(a_{ijL}.a_{ijU})}$ is the fuzzy matrix.

5. WORKING RULE

Step 1:To find relation matrices

$R1 = [\ R_{1L} , R_{1U}\ ]$, $R2 = [\ R_{2L} , R_{2U}\ ]$ and $Q = [\ Q_L , Q_U\ ]$.

Step 2:By using geometric mean definition, to find

gm (R_1) =$\sqrt{(R_{1L} . R_{1U})}$

gm (R_2) =$\sqrt{(R_{2L} . R_{2U})}$

gm (Q) =$\sqrt{(Q_L . Q_U}$

Step 3: combining the relation matrices gm (R_1) and gm (R_2)separately with gm (Q) under the max.min composition of fuzzy matrices we get

T_1 = gm(Q) .gm (R_1)

T_2 = gm(Q) .gm (R_2)

T_3 = gm(Q) .[J - gm (R_1)]

T_4 = gm(Q) .[J - gm (R_2)]

Where J is the matrix with all entries '1'.

Step 4: By using Sanchez's technique ,we calculate the candidate score S_{T1} and S_{T2} for and against the post respectively .$S_{T1} = \max_{i,j} [\ T_I (c_i , p_j)\ ,\ T_4 (\ c_i , p_j)\ ]$, ∀ i=1,2,3,4 and j=1, 2,3

$S_{T2} = \max_{i,j} [\ T_2 (c_i , p_j)\ ,\ T_3 (\ c_i , p_j)\ ]$, ∀ i=1,2,3,4 and j=1, 2,3

Step 5: Result:

i) if $\max_{j} [\ S_{T1} (c_i , p_j) - S_{T2} (\ c_i , p_j)]$

Occurs for exactly (c_i , p_i) only , then we conclude that the acceptable selection hypothesis for candidate c_i is the post p_k .

ii) If there is tie , the process has to be repeated for candidate c_i by retesting the skills .Let us illustrate the Geometric mean method by considering the case study in the numerical example.

6. NUMERICAL EXAMPLE

Suppose there are four candidate's c_1 , c_2 , c_3 and c_4 in an Interview of a company with skills aptitude, communication Skill and personal analysis . Let the possible posts relating the above skills be manager , supervisor and assistant. We consider the set S = { s_1 ,s_2 , s_3 } as universal set, where s_1 ,s_2 and s_3 represent the skills aptitude, communication skill and personal analysis respectively and the set P = { p_1 , p_2 , p_3 }, where p_1 , p_2 and p_3 represent the parameters manager, supervisor and assistant respectively . Suppose that

F (p_1) = { < s_1 , [.8 , .9] > , < s_2 , [.2 , .5] > , < s_3 , [.7 , .4] > } ,

F (p_2) = { < s_1 , [.3 ,. 1] > , < s_2 , [.6 , 1] > , < s_3 , [.7 , .9] > } ,

F (p_3) = { < s_1 , [.7 , .8] > , < s_2 , [.3 , .5] > , < s_3 , [.2 , .4] > } .

The IVFM (F,P) is parameterized family [F(p_1), F(p_2)] of all IVFM over the set S and are determined from expert interviewers. Thus the fuzzy matrix (F,P) gives an approximate description of the IVFM interviewing knowledge of the three posts and its skills . This IVFM(F ,P) and its complement (F,P)^c are represented by two relation matrices R_1 and R_2 called skill–post matrix and non skill–post matrix respectively given by

P_1 P_2 P_3

$$R_1 = \begin{matrix} S_1 \\ S_2 \\ S_3 \end{matrix}\begin{pmatrix} [.8, & .9] & [.3, & .1] & [.7, & .8] \\ [.2, & .5] & [.6, & 1] & [.3, & .5] \\ [.7, & .4] & [.7, & .9] & [.2, & .4] \end{pmatrix}$$ and

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$R_2 = \begin{matrix} S_1 \\ S_2 \\ S_3 \end{matrix}\begin{pmatrix} [.1, & .2] & [.9, & .7] & [.2, & .3] \\ [.5, & .8] & [0, & .4] & [.5, & .7] \\ [.6, & .3] & [.1, & .3] & [.6, & .8] \end{pmatrix}$$

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$R_{1L} = \begin{matrix} S_1 \\ S_2 \\ S_3 \end{matrix}\begin{pmatrix} .8 & .3 & .7 \\ .2 & .6 & .3 \\ .7 & .7 & .2 \end{pmatrix}$$ and

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$R_{1U} = \begin{matrix} S_1 \\ S_2 \\ S_3 \end{matrix}\begin{pmatrix} .9 & .1 & .8 \\ .5 & 1 & .5 \\ .4 & .9 & .4 \end{pmatrix}$$ and

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$R_{2L} = \begin{matrix} S_1 \\ S_2 \\ S_3 \end{matrix}\begin{pmatrix} .1 & .9 & .2 \\ .5 & 0 & .5 \\ .6 & .1 & .6 \end{pmatrix}$$ and

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$R_{2U} = \begin{matrix} S_1 \\ S_2 \\ S_3 \end{matrix}\begin{pmatrix} .2 & .7 & .3 \\ .8 & .4 & .7 \\ .3 & .3 & .8 \end{pmatrix}$$

Again we take C = { c_1, c_2, c_3, c_4 } as the universal set, where c_1, c_2, c_3 and c_4 represent candidates respectively and

S = { s_1, s_2, s_3 } as the set of parameters Suppose that ,

$F_1(s_1)$ = { < c_1, [.7 , .8] > , < c_2 , [.2 , .6] > , < c_3, [.9 , .7] > , < c_4 , [.3 , .5] > } ,

$F_2(s_2)$ = { < c_1, [.9 , 1] > , < c_2 , [.1 , .4] > , < c_3, [.8 , .6] > , < c_4 , [.6 , .8] >},

$F_3(s_3)$ = { < c_1, [.5 , .4] > , < c_2 , [.5 , .8] > , < c_3, [.5 , .7] > , < c_4 , [.1 , .5] >} .

The IVFM (F_1,S) is another parameterized family of all IVFMs and gives a Collections of approximate description candidate–skills in the interview of the company. This IVFM (F_1,S) represents a relation matrix Q called candidate–skills matrix given by

$$\begin{matrix} S_1 & S_2 & S_3 \end{matrix}$$

$$Q = \begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{matrix}\begin{pmatrix} [.7, & .8] & [.9, & 1] & [.5, & .4] \\ [.2, & .6] & [.1, & .4] & [.5, & .8] \\ [.9, & .7] & [.8, & .6] & [.5, & .7] \\ [.3, & .5] & [.6, & .8] & [.1, & .5] \end{pmatrix}$$

we have , Q = [Q_L , Q_U]

$$\begin{matrix} S_1 & S_2 & S_3 \end{matrix}$$

$$Q_L = \begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{matrix}\begin{pmatrix} .7 & .9 & .5 \\ .2 & .1 & .5 \\ .9 & .8 & .5 \\ .3 & .6 & .1 \end{pmatrix}$$ and

$$\begin{matrix} S_1 & S_2 & S_3 \end{matrix}$$

$$Q_U = \begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{matrix}\begin{pmatrix} .8 & 1 & .4 \\ .6 & .4 & .8 \\ .7 & .6 & .7 \\ .5 & .8 & .5 \end{pmatrix}$$

We shall calculate the average skill post matrix gm(R_1),average skill post matrix gm(R_2) and average candidate skill matrix gm (Q) for the matrices R_1 , R_2 and Q respectively .

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$gm(R_1) = \begin{matrix} S_1 \\ S_2 \\ S_3 \end{matrix}\begin{pmatrix} .85 & .17 & .75 \\ .32 & .77 & .39 \\ .53 & .79 & .28 \end{pmatrix}$$

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$gm(R_2) = \begin{matrix} S_1 \\ S_2 \\ S_3 \end{matrix}\begin{pmatrix} .14 & .79 & .24 \\ .63 & 0 & .59 \\ .42 & .17 & .69 \end{pmatrix}$$

$$\begin{matrix} S_1 & S_2 & S_3 \end{matrix}$$

$$gm(Q) = \begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{matrix}\begin{pmatrix} .75 & .95 & .45 \\ .35 & .2 & .63 \\ .79 & .69 & .59 \\ .39 & .69 & .22 \end{pmatrix}$$

Then combining the relation matrices gm(R_1) and gm (R_2) separately with gm (Q) , we have

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$T_1 = gm(Q).gm(R_1) = \begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{matrix}\begin{pmatrix} .75 & .77 & .75 \\ .53 & .63 & .35 \\ .79 & .69 & .75 \\ .39 & .69 & .39 \end{pmatrix}$$

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$T_2=gm(Q).gm(R_2)=\begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{matrix}\begin{pmatrix} .63 & .75 & .59 \\ .42 & .35 & .63 \\ .63 & .79 & .59 \\ .63 & .39 & .59 \end{pmatrix}$$

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$T_3=gm(Q).(J-gm(R_1))=\begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{matrix}\begin{pmatrix} .68 & .75 & .61 \\ .47 & .35 & .63 \\ .68 & .79 & .61 \\ .68 & .39 & .61 \end{pmatrix}$$

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$T_4=gm(Q).(J-gm(R_2))=\begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{matrix}\begin{pmatrix} .75 & .95 & .75 \\ .58 & .63 & .35 \\ .79 & .69 & .76 \\ .39 & .69 & .41 \end{pmatrix}$$

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$S_{T1}=\begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{matrix}\begin{pmatrix} .75 & .95 & .75 \\ .58 & .63 & .35 \\ .79 & .69 & .76 \\ .39 & .69 & .41 \end{pmatrix}$$

$$\begin{matrix} P_1 & P_2 & P_3 \end{matrix}$$

$$S_{T2}=\begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{matrix}\begin{pmatrix} .68 & .75 & .61 \\ .47 & .35 & .63 \\ .68 & .79 & .61 \\ .68 & .39 & .61 \end{pmatrix}$$

We have, the difference for and against the posts by Geometric method $\mathbf{S_T}$

$S_{T1}-S_{T2}$	p_1	p_2	p_3
c_1	0.07	0.2	0.14
C_2	0.1 1	0.28	0.28
c_3	0.1 1	- 0.1	0.15
c_4	-0.29	0.3	-0.2

We conclude the candidate $c_{1,}$ c_2 and c_4 are selected for the post p_2 and candidate c_3 selected for the post p_3.

7. CONCLUSION

We have applied Sanchez's approach to study interview selection process by using the representation of an interval valued fuzzy matrix as an interval matrix of two fuzzy matrices in geometric method which can be used in various field to get solutions to the problems.

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