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Research paper

Decision making Approach for Evaluation of Teaching Performance using Octagonal fuzzy number matrix

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Abstract

Decision making method is useful in selecting the best alternatives among the selected alternatives. Under a fuzzy environment, the decision making enable the decision maker to choose their own opinion. The purpose of this paper is to propose a new approach for solving a attribute values of octagonal fuzzy number using decision making problems. We have to use the octagonal fuzzy number and octagonal fuzzy number matrix to select the overall performance of a teacher for the betterment of students, institution & society.

Keywords*: Decision making, Octagonal fuzzy number, Octagonal fuzzy number matrix, Linguistic variable*

1. Introduction

Fuzzy environment has a potential to solve such kind of uncertainty. From the set of feasible alternatives Decision making method provides the best alternatives and ranking according to their priorities. The concept of decision making problem are useful in the fields of social life, scientific, economic and research fields etc., The uncertainty of decision making information in solving of problems in fuzzy numbers are widely adopted . The teacher's performance is very important to the students as well as management, which usually involves crisp and uncertain values to evaluate performance. In this paper, we evaluate teacher's performance on the basis of different factors. The aim of the paper is to evaluate the overall performance of a teacher for betterment of students, institution & society. This paper has been summarized as basic definitions, decision making under octagonal fuzzy number matrix, Illustrative Example.

2. Preliminaries

2.1. Definition (Fuzzy Set)

A fuzzy set A on X is defined to be a function A:X→[0,1] or μ_A: X→[0,1] , the class of objects having the following representation A=$\{(x,\mu_A x):x\epsilon X)\}$, μ_A is called the membership function of A.

2.2 Definition (Fuzzy Number)

The fuzzy number A is a fuzzy set whose membership function $\mu_A(x)$ satisfies the following conditions:

1. $\mu_A(x)$ is piecewise continuous;
2. A fuzzy set A of the universe of discourse X is convex;
3. A fuzzy set of the universe of discourse X is called a normal fuzzy set if $\exists\, x_i \in X, \mu_A(x_i) = 1$.

3. Octagonal Fuzzy Number

An Octagonal fuzzy number is generally denoted by $(a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8)$
where $a_1 \le a_2 \le a_3 \le a_4 \le a_5 \le a_6 \le a_7 \le a_8$ are real numbers , the membership function $\mu_{\tilde{A}}(x)$ is given below

$$\mu_{\tilde{A}}(x) = \begin{cases} 0 & for\ x < a_1 \\ k\left[\frac{x-a_1}{a_2-a_1}\right] & for\ a_1 \le x \le a_2 \\ k & for\ a_2 \le x \le a_3 \\ k+(1-k)\left(\frac{x-a_3}{a_4-a_3}\right) & for\ a_3 \le x \le a_4 \\ 1 & for\ a_4 \le x \le a_5 \\ k+(1-k)\left(\frac{a_6-x}{a_6-a_5}\right) & for\ a_5 \le x \le a_6 \\ k & for\ a_6 \le x \le a_7 \\ k\left(\frac{a_8-x}{a_8-a_7}\right) & for\ a_7 \le x \le a_8 \\ 0 & for\ x \ge a_8 \end{cases}$$

3.1 Definition (Octagonal Fuzzy Number Matrix).

In Octagonal fuzzy number matrix elements are defined as A = $(a_{ij})_{m\times n}$, where $a_{ij} = (a_{ij}L, a_{ij}M, a_{ij}M, a_{ij}M, a_{ij}N, a_{ij}N, a_{ij}N, a_{ij}U))$ is the ij^{th} element of fuzzy number matrix of A.
Then $0 \le a_{ij}L \le a_{ij}M \le a_{ij}M \le a_{ij}M \le a_{ij}N \le a_{ij}N \le a_{ij}N \le a_{ij}U \le 40$, where $a_{ij}L$ is the least element, $a_{ij}M$, $a_{ij}N$ is the middle element, and $a_{ij}U$ is the greatest element.

3.2 Definition (Octagonal Fuzzy Number Matrix into Membership Function).

Let Membership function of
$a_{ij} = (a_{ij}L, a_{ij}M, a_{ij}M, a_{ij}M, a_{ij}N, a_{ij}N, a_{ij}N, a_{ij}U)$
is defined as

$$\frac{a_{ij}\,L}{40}, \frac{a_{ij}\,M}{40}, \frac{a_{ij}\,M}{40}, \frac{a_{ij}\,M}{40}, \frac{a_{ij}\,N}{40}, \frac{a_{ij}\,N}{40}, \frac{a_{ij}\,N}{40}, \frac{a_{ij}\,U}{40}$$

if

$$0 \le a_{ij}L \le a_{ij}M \le a_{ij}M \le a_{ij}M \le a_{ij}N \le a_{ij}N \le a_{ij}N \le a_{ij}U \le 40$$

Where

$$0 \le \frac{a_{ij}\,L}{40} \le \frac{a_{ij}\,M}{40} \le \frac{a_{ij}\,M}{40} \le \frac{a_{ij}\,M}{40} \le \frac{a_{ij}\,N}{40} \le \frac{a_{ij}\,N}{40} \le \frac{a_{ij}\,N}{40} \le \frac{a_{ij}\,U}{40} \le 1$$

is called a Octagonal fuzzy number matrix into its membership function

3.3 Defuzzification

The fuzzy numbers are defuzzified using centroid method .For the octagonal fuzzy numbers, the defuzzified value is A = $\frac{\boldsymbol{a_1+a_2+a_3+a_4+a_5+a_6+a_7+a_8}}{\boldsymbol{8}}$

3.4 Definition (Relativity Function)

Let X be universal set, x and y be the variables defined on Universal set. Then $f(x/y)$ is a relativity function defined as

$$f(x/y) = \frac{\mu_y(x)\,(-)\,\mu_x(y)}{\max\{\mu_y(x), \mu_x(y)\}}$$

The membership function of x with respect to y is $\mu_y(x)$, the membership function of y with respect to x is $\mu_x(y)$ and max $\{\mu_y(x) - \mu_x(y)\}$ is maximum operation on Octagonal fuzzy number.

3.5 Definition (Comparison Matrix)

Let A = $\{x_{1,}x_{2,}x_{3,}\ldots,x_{i-1,},x_{i,}x_{i+1,},\ldots,x_n\}$ be a set of n variables defined on $\times$. Then form a matrix of relativity values $f\left(\frac{x_i}{x_j}\right)$, where x_i's for i = 1 to n, where n is the number of variables defined on $\times$. The matrix C = (C_{ij}) is a square matrix of order n is called the comparison matrix.

$$AM\,(f\,(xi\,/\,yj)) = \frac{AM\,(\mu_{xj}(x_i)\,(-)\,\mu_{xi}(x_j))}{AM\,(\max\{\mu_{xj}(x_i), \mu_{xi}(x_j)\})}$$

3.6 Definition (Linguistic Variable)

The universe of discourse of the variable is represented by the set of all possible values of a linguistic variable. For example, the universe of discourse of the linguistic variables overall teacher's performance might have the range between 0 and 40.For present study, various linguistic variables used for very good, satisfactory & outstanding.

4. Working Rule

Step 1: We can find membership function for Octagonal fuzzy number matrix by using relativity function.
Step 2: We shall calculate all the relative values of the function.
Step 3: In the comparison matrix, the upper triangular part and lower triangular part are same with opposite sign.
Step 4: In comparison matrix the maximum value in each row of the matrix will have the maximum possibility for ranking purpose.

5. Numerical Example

For evaluating Teacher's performance at the end semester. By discussing with teachers and experts various factors have been considered on which teacher's performance is based on Result (last 3 Years), Students feedback, Research& Development. A Questionnaire is constructed for comparing these factors. Then collected expert's opinion and constructed pair-wise comparison matrices. For present study, various linguistic variables used for very good, satisfactory & outstanding. Scaling of these linguistic variables in done by Octagonal fuzzy number.

Input Variable	Linguistic Variable
p- Result (last 3 Years)	x -Very good
q- Students feed back	y -satisfactory
r – Research & Development	z -Outstanding

Step 1 The form of Octagonal fuzzy number matrix A is

$$\begin{array}{c} \\ p \\ q \\ r \end{array}\begin{array}{c} \begin{array}{ccc} x & y & z \end{array} \\ \begin{pmatrix} (2,4,8,10,20,22,40) & (10,14,16,18,20,32,36,40) & (2,8,16,20,24,26,30,32) \\ (4,6,10,30,34,36,38,40) & (6,12,18,20,22,26,28,30) & (2,4,8,10,12,14,16,18) \\ (0,14,18,20,22,26,30,32) & (4,8,12,16,20,24,28,32) & (0,2,8,16,20,22,28,30) \end{pmatrix} \end{array}$$

Step 2
$(A)_{mem}$ =

$$\begin{pmatrix} (2,4,8,10,20,22,40) & (10,14,16,18,20,32,36,40) & (2,8,16,20,24,26,30,32) \\ (4,6,10,30,34,36,38,40) & (6,12,18,20,22,26,28,30) & (2,4,8,10,12,14,16,18) \\ (0,14,18,20,22,26,30,32) & (4,8,12,16,20,24,28,32) & (0,2,8,16,20,22,28,30) \end{pmatrix}$$

$\mu_p(x)$ = (0.05,0.1,0.2,0.25,0.3,0.5,0.55,1)
$\mu_p(y)$ =(0.25,0.35,0.4,0.45,0.5,0.8,0.9,1)
$\mu_p(z)$ =(0.05,0.2,0.4,0.5,0.6,0.65,0.75,0.8)
$\mu_q(x)$ =(0.1,0.15,0.25,0.75,0.85,0.9,0.95,1)
$\mu_q(y)$ = (0.15, 0.3,0.45, 0.5,0.55,0.65,0.7,0.75)
$\mu_q(z)$ = (0.05, 0.1, 0.2,0.25,0.3,0.35,0.4,0.45)
$\mu_r(x)$ = (0, 0.35,0.45,0.5,0.55,0.65,0.75,0.8)
$\mu_r(y)$ = (0.1, 0.2,0.3,0.4,0.5,0.6,0.7,0.8)
$\mu_r(y)$ = (0, 0.05, 0.2,0.4,0.5,0.55,0.7,0.75)

Step 3

$$f\left(\frac{p}{x}\right) = \frac{\mu_x(p)-\mu_p(x)}{\max\{\mu_x(p),\mu_p(x)\}}$$

$$= \frac{((0.05,0.1,0.2,0.25,0.3,0.5,0.55,1)(-)(0.05,0.1,0.2,0.25,0.3,0.5,0.55,1))}{\max\{(0.05,0.1,0.2,0.25,0.3,0.5,0.55,1)(0.05,0.1,0.2,0.25,0.3,0.5,0.55,1)\}}$$

AM ($f(p/x)$ = 0
AM ($f(p/y)$) = 0.05
AM ($f(p/z)$) =0.024
AM ((q/x)) = - 0.06
AM ($f(q/y)$) = 0
AM ($f(q/z)$) = 0.41
AM ($f(r/x)$) = -0.024
AM ($f(r/y)$) = -0.41
AM ($f(r/z)$) = 0

Step 4 The comparison matrix = AM $\left(f\left(\frac{x_i}{x_j}\right)\right)$ is given by

$\boldsymbol{x}$ $\boldsymbol{y}$ $\boldsymbol{z}$.

$$\mathrm{C} = \begin{array}{c} p \\ q \\ r \end{array} \begin{pmatrix} 0 & 0.05 & 0.024 \\ -0.06 & 0 & 0.41 \\ -0.024 & -0.41 & 0 \end{pmatrix}$$

Step 5 In Comparison matrix, Maximum of Ist column = 0.05
Maximum of IInd column = 0.41
Maximum of IIIrd column = 0

Hence, we conclude that Teacher's Performance of Result analysis is satisfactory, Student's feedback is outstanding and Research & Development is outstanding.

5. Conclusion

Fuzzy decision making method is very useful in research, scientific, industrial and economic endeavor,. Hence, In this paper, we have considered here 3 input variables used in the evaluation of teacher's overall performance as per the input from institution which are Octagonal fuzzy number matrix. Using relativity function, Overall performance is evaluated for the betterment of the educational institution.

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