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An Application of Pentagonal Fuzzy Number Matrix in Personality Development Index

Jackson.S[1], M.Saratha Devi[2], S.Keerthana[3], S.HariKrishnamoorthy[4]

[1]Assistant Professor, [2,3,4] UG student

[1,2,3,4] P.G&.Research Department of Mathematics, V.O.Chidambaram College, Thoothukudi, India

Abstract- **The fuzzy set theory has been established in 1965 by Lofti A. Zadeh from the University of Berkeley. Under certain conditions the fuzzy set formed in the real numbers is called Fuzzy Number. Due to the uncertainty of information and the complexity of the decision-making problem, it is difficult for decision makers to express their preferences by using exact numbers. So to reduce the complexity we can use the fuzzy numbers in such cases. In this paper we adapted the Pentagonal Fuzzy Number to know the best personality from the values of PersonalityDevelopment Index proposed by Kaliappan and Karthikeyan (1997) whichwas used to assess self awareness, self confidence, emotional adjustment and stress coping ability.**

Keywords: Fuzzy Number, Pentagonal Fuzzy Number, PersonalityDevelopment Index, Decision making.

1. INTRODUCTION

Mathematics is mainly used for computation purposes. Mathematical computation using two-valued logic has become obsolete. This is the age of logical development and its computational efficiency. The logic is being considered as one of the basic and easily applicable tools that can be easily imparted in software programming also. In 1965, L.A. Zadeh [8], an Electronics and Communication Engineer from California University of USA, generalized this logic by adding all values in the unit interval [0, 1] and this is considered as the truth degree set / membership values. This generalized logic is named as 'fuzzy logic' [4]. This has stimulated the minds of the mathematicians and makes them to realize this generalization. The significance of fuzzy variables is that they facilitate gradual transitions between states and consequently, possess a natural capability to express and deal with observations and measurement uncertainties. Decision making is the process of selecting a possible course of action from all the available alternatives. In almost all such problems the multiplicity of criteria for judging the alternatives is pervasive. With regard to such problems, the decision maker wants to attain more than one objective or goal in selecting the course of action while satisfying the constraints dictated by environment; process and resources.

Fuzzy numbers [2] are very special fuzzy subsets of the real numbers. Among various types of fuzzy sets of special significance there are fuzzy sets which are defined on the set R of real numbers. Membership functions of these sets which have the form A: R −! [0, 1] clearly have a quantitative meaning and may under certain conditions, be viewed as fuzzy numbers or fuzzy intervals. To view them in this way, they should capture our intuitive conceptions of approximate numbers or intervals, such as numbers that are close to a given real number or numbers that are around a given interval of real numbers. In this paper we adapted the Pentagonal Fuzzy Number to know the best personality from the values of Personality Development Index proposed by Kaliappan and Karthikeyan (1997)[5] whichwas used to assess self awareness, self confidence, emotional adjustment and stress coping ability.

2.PRELIMINARIES:

Definition2.1[1]: Fuzzy number

A Fuzzy number 'A' is a fuzzy set on the real line R must satisfy the following conditions:

(i) $\mu_A(x_0)$ is piecewise continuous

(ii)There exist at least one $x_0 \in R$ with $\mu_A(x_0) = 1$

(iii) μ_A must be normal and convex.

Definition2.2 [6]: Pentagonal fuzzy number:

A pentagonal fuzzy number of a fuzzy set A is defined as $A = (a_1, a_2, a_3, a_4, a_5)$ and its membership is given by,

$$\mu A(x) = \begin{cases} 0 & for\, x \le a_1 \\ \dfrac{x-a_1}{a_2-a_1} & for\, a_1 \le x \le a_2 \\ \dfrac{x-a_2}{a_3-a_2} & for\, a_2 \le x \le a_3 \\ 1 & for\, x = a_3 \\ \dfrac{a_4-x}{a_4-a_3} & for\, a_3 \le x \le a_4 \\ \dfrac{a_5-x}{a_5-a_4} & for\, a_4 \le x \le a_5 \\ 0 & for\, x \ge a_5 \end{cases}$$

Definition2.3 [6]: Pentagonal fuzzy number matrix

The elements of pentagonal fuzzy number matrix is

$A = (a_{ij})_{n\times n}$ $a_{ij} = (a_{ijL}, a_{ijM}, a_{ijN}, a_{ijR}, a_{ijS})$ be the ij th element of A.

Definition2.4[6]: Pentagonal fuzzy membership matrix

The membership function of $a_{ij} = (a_{ijL}, a_{ijM}, a_{ijN}, a_{ijR}, a_{ijS})$ is defined as

$$\left(\frac{a_i}{10}, \frac{a_{ijM}}{10}, \frac{a_{ijN}}{10}, \frac{a_{ijR}}{10}, \frac{a_{ijS}}{10} \right), \text{ If } 0 \le a_{ijL} \le a_{ijM} \le a_{ijN} \le a_{ijR} \le a_{ijS} \le 1 \text{ where,}$$

$$0 \le \frac{a_{ijL}}{10} \le \frac{a_{ijM}}{10} \le \frac{a_{ijN}}{10} \le \frac{a_{ijR}}{10} \le \frac{a_{ijS}}{10} \le 1$$

Definition2.5[2]: Addition

Let $A=(a_{ij})_{m\times n}$ and $B=(b_{ij})_{m\times n}$ are two pentagonal fuzzy number matrices of same order n×n.

$(A+B) = (a_{ij}+ b_{ij})_{m\times n}$ where $(a_{ij}+ b_{ij}) = (a_{ijL}+ b_{ijL}, a_{ijM}+ b_{ijM}, a_{ijN}+ b_{ijN}, a_{ijR}+b_{ijR}, a_{ijS}+ b_{ijS})$ is the ij^{th} element of (A+B).

Definition2.6[2]: Subtraction

$(A-B) = (a_{ij}- b_{ij})_{m\times n}$ where $(a_{ij}-b_{ij}) = (a_{ijL}-b_{ijL}, a_{ijM}-b_{ijM}, a_{ijN}-b_{ijN}, a_{ijR}-b_{ijR}, a_{ijS}-b_{ijS})$ is the ij^{th} element of (A-B).

Definition2.7[2]: Maximum operation on Pentagonal fuzzy number

The maximum operation is given by max(A,B) = $(\sup\{a_{ij},b_{ij}\})$ where $\sup(a_{ij},b_{ij}) = (\sup(a_{ijL},b_{ijL}), \sup(a_{ijM},b_{ijM}), \sup(a_{ijN},b_{ijN}), \sup(a_{ijR},b_{ijR}), \sup(a_{ijS},b_{ijS}))$ is the ij^{th} element of max(A,B).

Definition2.8 [1]: Arithmetic mean (AM) for Pentagonal fuzzy number

Let $A = (a_1, a_2, a_3, a_4, a_5)$ be pentagonal fuzzy number

$$AM(A) = \frac{(a_1+a_2+a_3+a_4+a_5)}{5}$$

Definition2.9[2]: Relativity function

Let x and y be a variable defined on a universal set X. The relativity function is denoted as **f**

$$f\left(\frac{x}{y}\right) = \left\{ \frac{\mu_y(x) - \mu_y(x)}{\max\{\mu_y(x), \mu_y(x)\}} \right\}$$

Where $\mu_y(x)$ is the membership function of x with respect to y for pentagonal fuzzy number and $\mu_x(y)$ is the membership function of y with respect to x for pentagonal fuzzy number. Here $\mu_y(x) - \mu_y(x)$ is calculated using subtraction operation and max $\{\mu_y(x), \mu_y(x)\}$ is calculated using maximum operation

Definition2.10[2]: Comparison matrix

Let $A = \{x_1, x_2, x_3, \ldots\ldots\ldots\ldots \ldots. x_{i-1}, x_i, x_{i+n}, \ldots\ldots\ldots\ldots x_n\}$ be a set of n-variables defined on X. Form a matrix of relativity values as $f\left(\frac{x_i}{x_j}\right)$ where x_i's for i=1 to n variable defined on a matrix x.

The matrix $C = (c_{ij})$ is a square matrix of order n is called comparison matrix (or) C-matrix with AM

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

Where AM represents arithmetic mean.

3.APPLICATION PROCEDURE:

Step 1:

Consider the pentagonal fuzzy number matrix from the imprecise estimation needed for the problem using the definition of "Pentagonal fuzzy number matrix".

Step 2:

Convert the given matrix into membership function using the definition of "Pentagonal fuzzy membership matrix".

Step3:

Calculate the relativity values $f\left(\frac{x_i}{x_j}\right)$ by the definition of Relativity Function.

Step 4:

Calculate the comparison matrix from the values of f (x_i /x_j) using the definition "Comparison matrix".

Step 5:

Find the minimum value from each row C_i.

Step 6:

The maximum value of the column C_i is the required solution.

4.PENTAGONAL FUZZY NUMBER DECISION MAKING IN PERSONALITY DEVELOPMENT INDEX :

Let us consider fiveperson from whom we measure the 10 dynamic areas of personality and were carefully selected and evaluated by various experts in the field of personality psychology. The 10 dynamic areas are

1) Emotional Adjustment – **EA** 2) Social Concern – **SC**
3) Value and Culture – **VC** 4) Leadership – **LS**
5) Communication Skill – **CS** 6) Assertiveness – **A**
7) Self Awareness – **SA** 8) Self Confidence – **SC**
9) Interpersonal Relationship – **IR** 10) Stress Coping Ability – **SCA**

Here the first five are the social factors and next five are the personal factors

PERSONS	SOCIAL FACTORS					PERSONAL FACTORS				
	EA	**SC**	**VC**	**LS**	**CS**	**A**	**SA**	**SC**	**IR**	**SCA**
1	69	72	63	70	90	76	60	80	74	93
2	59	71	80	77	87	76	73	80	83	95
3	73	49	65	63	43	68	70	53	68	49
4	76	63	65	73	60	58	73	71	62	63
5	69	69	54	66	76	76	70	76	71	83

STEP 1:

Taking persons 1 and 2,

$$X = \begin{array}{c} \\ 1 \\ 2 \end{array} \begin{bmatrix} A & B \\ (69,72,63,70,90) & (76,60,80,74,93) \\ (59,71,80,77,87) & (76,73,80,83,95) \end{bmatrix}$$

$$X(mem) = \begin{array}{c} \\ 1 \\ 2 \end{array} \begin{bmatrix} A & B \\ (0.63,0.69,0.70,0.72,0.90) & (0.60,0.74,0.76,0.80,0.93) \\ (0.59,0.71,0.77,0.80,0.87) & (0.73,0.76,0.80,0.83,0.95) \end{bmatrix}$$

STEP 2:

$\mu_A(1) = (0.63,0.69,0.70,0.72,0.90)$
$\mu_A(2) = (0.59,0.71,0.77,0.80,0.87)$
$\mu_B(1) = (0.60,0.74,0.76,0.80,0.93)$
$\mu_B(2) = (0.73,0.76,0.80,0.83,0.95)$

STEP 3 :

$$f(1/A) = \frac{\mu_A(1) - \mu_A(1)}{\max\{\mu_A(1), \mu_A(1)\}}$$

$$= \frac{(0.63,0.69,0.70,0.72,0.90) - (0.63,0.69,0.70,0.72,0.90)}{\text{Max}\{(0.63,0.69,0.70,0.72,0.90), (0.63,0.69,0.70,0.72,0.90)\}}$$

$= 0$

$$f(2/A) = \frac{\mu_A(2) - \mu_B(1)}{\max\{\mu_A(2), \mu_B(1)\}}$$

$$= \frac{(0.59,0.71,0.77,0.80,0.87) - (0.60,0.74,0.76,0.80,0.93)}{\mathrm{Max}\{(0.59,0.71,0.77,0.80,0.87), (0.60,0.74,0.76,0.80,0.93)\}}$$

$$= \frac{(-0.01,-0.03,0.01,0,-0.06)}{(0.60,0.74,0.76,0.80,0.93)} = \frac{-0.018}{0.766}$$

$$= -0.0235$$

$$f(1/B) = \frac{\mu_B(1) - \mu_A(2)}{\max\{\mu_A(2), \mu_B(1)\}}$$

$$= \frac{(0.60,0.74,0.76,0.80,0.93) - (0.59,0.71,0.77,0.80,0.87)}{\mathrm{Max}\{(0.60,0.74,0.76,0.80,0.93), (0.59,0.71,0.77,0.80,0.87)\}}$$

$$= \frac{(0.01,0.03,-0.01,0,0.06)}{(0.60,0.74,0.76,0.80,0.93)} = \frac{0.018}{0.766}$$

$$= 0.0235$$

$$f(2/B) = \frac{\mu_B(2) - \mu_B(2)}{\max\{\mu_B(2), \mu_B(2)\}}$$

$$= \frac{(0.73,0.76,0.80,0.83,0.95) - (0.73,0.76,0.80,0.83,0.95)}{\mathrm{Max}\{(0.73,0.76,0.80,0.83,0.95), (0.73,0.76,0.80,0.83,0.95)\}}$$

$$= 0$$

STEP 4:

The comparison matrix

$C = (C_{ij})$

$= A.M\,(f(x_i / x_j))$ is given by

C=

	A	B
P1	0	0.0235
P2	-0.0235	0

STEP 5 :

C_i= minimum of i^{th} row,

For person 1 = 0,For Person 2 = -0.0235.

Person 1 is better than Person 2.

Similarly, following the above steps and comparing the personalities of remaining persons, we get the following results.

Person 1 is better than Person 3.
Person 1 is better than Person 4.
Person 1 is better than Person 5.
Person 2 is better than Person 3.
Person 2 is better than Person 4.
Person 2 is better than Person 5.

Person 4 is better than Person 3.
Person 5 is better than Person 3.
Person 5 is better than Person 4.
As a result of all the above comparison, we get,
Person 1 is better than person 2, person 3, person 4 and person 5.
Person 2 is better than person 3, person 4, and person 5.
Person 4 is better than person 3.
Person 5 is better than person 3, person 4.

5.RESULT:

Thus Person 1 is the best person among all others who could manage his social and personal characters well.

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