# A New Method for Ranking Exponential Pentagon Fuzzy Numbers with Using Assignment Problem

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**Abstract**: In this paper, we present a method for ranking of two exponential pentagon numbers. In this study a new cardinality between exponential fuzzy numbers is proposed cardinality in this relatively simple and easier in computation and ranks various types of exponential fuzzy numbers. For this results of the proposed approach to calculate Hungarian Assignment problems.

Keywords: Exponential fuzzy numbers ranking method

#### 1. Introduction

Ranking fuzzy numbers are an important tool in decision making. In fuzzy decision analysis, fuzzy quantities are used to describe the performances of alternatives in modeling real world problems. Various ranking procedures have been developed since 1976, when the theory of fuzzy sets were first introduced by Zadeh[24]. Ranking fuzzy numbers were first proposed by Jain [25] for decision making in fuzzy subsets. In this paper presenting a new method for ranking exponential fuzzy numbers with using Assignment Problem.

#### **Preliminaries**

#### **DEFINITION:**

Let R be the set of real numbers. Then closed interval [a,b] is said to be an interval number, Where a,b  $\in R$ , a  $\leq b$ .

#### **DEFINITION:**

The fuzzy set A the universe of discourse X is called a normal fuzzy set implying that there exist at least one x  $\in$ X such that  $\mu_A(x) = 1$ .

#### **DEFINITION:**

Let  $a = [a_1, a_2]$ ;  $b=[b_1, b_2]$  be two interval numbers. Then the distance between (a, b) denoted by d (a, b) is defined by <sup>0.5</sup>  $d(a,b) = -0.5 \int [(a_1+a_2)/2 + x(a_2-a_1)] - [(b_1+b_2)/2 + x(b_2-b_1)] dx$ 

#### **DEFINITION:**

To qualify as a fuzzy number a fuzzy set A on R must posses atleast the following three properties :

- 1. A must be normal fuzzy set.
- 2.  $\alpha_A$  must be a closed interval for every  $\alpha \in [0,1]$
- 3. The support of  $A_{1,}O^{+}A$  must be bounded.

#### **Ranking of Pentagon Fuzzy Number**

Let  $\tilde{A}_p = (a_1, a_2, a_3, a_4, a_5)$  a ranking method is devised based on the following formula.

#### Card B =wc + w/3e' [(d-e)(1-e')] - [(b-a)(e'-1)]

Let  $\tilde{A}_p=(a_1, a_2, a_3, a_4, a_5)$ ;  $\tilde{U}_p=(b_1, b_2, b_3, b_4, b_5)$  be two pentagon fuzzy number then,

 $\tilde{A}_{p=}\tilde{U}_{p} \Leftrightarrow R(\tilde{A}_{p}) = R(\tilde{U}_{p})$ 

$$\begin{split} \tilde{A}_{p} &\geq \tilde{U}_{p} \Leftrightarrow R(\tilde{A}_{p}) \geq R(\tilde{U}_{p}) \\ \tilde{A}_{p} &\leq \tilde{U}_{p} \Leftrightarrow R(\tilde{A}_{p}) \leq R(\tilde{U}_{p}) \end{split}$$

**Graphical Representation** 



Number

#### **Definition**

Generally, a generalized fuzzy number A is described as any fuzzy subsets of the real line R , Whose membership function  $\mu_n$  satisfies the following conditions,

- I.  $\mu_A$  is a continuous mapping from R to the closed interval [0,1].
- II.  $\mu_A(x) = 0, -\infty < x \le a.$
- III.  $\mu_A(x) = L_1(x)$  is strictly increasing on [a, b].
- IV.  $\mu_A(x) = L_2(x)$  is strictly increasing on [b, c].

V. 
$$\mu_A(x) = W, x = c.$$

- VI.  $\mu_A(x) = R_1(x)$  is strictly decreasing on [c, d].
- VII.  $\mu_A(x) = R_2(x)$  is strictly decreasing on  $[e, \infty]$ .

Where  $0 \le w \le 1$  a, b are real numbers, c, d are positive real numbers. we denote this type of generalized exponential fuzzy number as B=(a, b, c, d, e; w)<sub>E</sub>. Especially, when w=1, we denoted it as B=(a, b, c, d, e; w)<sub>E</sub> exponential fuzzy number, Based on the integral value of graded mean h-level as follows.

However, these fuzzy numbers always have a fix range as[c, d]. Here, we define their general forms as follows:

$\mathbf{f}_{\mathbf{E}}(\mathbf{X}) = \left\{ \begin{array}{c} \\ \end{array} \right\}$	w $e^{-[(b-x)/(b-a)]}$	for $a \le x \le b$
	w e <sup>-[(c-x)/(c-b)]</sup>	for $\mathbf{b} \leq \mathbf{x} \leq \mathbf{c}$
	W	$\mathbf{x} = \mathbf{c}$
	w e <sup>-[(x-c)/(d-c)]</sup>	for $c \le x \le d$
	w e <sup>-[(x-d)/(e-d)]</sup>	for $x \ge e$

Where  $0 < w \le 1$ , a, b are real numbers and c ,d, e are positive real numbers.

Now let monotonic functions be  $L_1(x) = We^{-[(b-x)/(b-a)]}$   $L_2(x) = We^{-[(c-x)/(c-b)]}$   $R_1(x) = We^{-[(x-c)/(d-c)]}$  $R_2(x) = We^{-[(x-d)/(e-d)]}$ 

#### **Proposition**

Cardinality of a exponential pentagon fuzzy number B characterized by (2.1) is the value of the integral. Card B =w/e' {[(b-a)(e'-1)] +[(c-b)(e'-1)] +(c-d)(e'-1) + [e-d] }+w

Proof:  
Card B = 
$$\int_{a}^{b} B(x) dx$$
  
=  $\int_{a}^{b} w e^{-\left(\frac{(b \cdot x)}{(b \cdot a)}\right)} dx + \int_{b}^{c} w e^{-\left(\frac{(c \cdot x)}{(c \cdot b)}\right)} dx + \int_{c}^{d} w e^{-\left(\frac{(x \cdot c)}{(d \cdot c)}\right)} dx + \int_{c}^{\infty} w e^{-\left(\frac{(x \cdot d)}{(e \cdot d)}\right)} dx + w$ 

= w[(b-a)(1-1/e')] + w[(c-b)(1-1/e')] + w[(c-d)(1/e'-1) + w[(e-d)(1/e)]

Card B =w/e' [(b-a)(e'-1)]+ [(c-b)(e'-1)]+ [(c-d)(e'-1)]+ [(e-d)]] +w

#### **Preposition 2**

If A is a exponential pentagon fuzzy number with light tails then

Card B =wc + w/3e' [(d-e)(1-e')] - [(b-a)(e'-1)] d b Card B = wc + 1/3 [ $\int we^{-[(x-d)/(e-d)]} dx - \int we^{-[(b-x)/(b-a)]} dx$ ] <sup>e</sup> a = wc + 1/3 [w(d-e) (1-1/e') - (b-a) (1/e'-1)] = wc + 1/3e' [w(d-e) (e'-1) - w(b-a) (1-e')]

Card B = wc + w/3e' [(d-e) (e'-1)-(b-a)(1-e')]

#### Proposed Approach

In this section some important results that are useful for the proposed approach are proved.

#### Numerical Example

To solve the following Assignment Problem of minimal cost by using the Proposed Approach method.



Card B = wc + w/3e' [(d-e)(1-e')] - [(b-a)(e'-1)]

Let  $b_{11} = (0.2, 0.5, 0.3, 0.4, 0.1; 0.35)$  then Here a=0.2 b=0.5 c=0.3 d=0.4 e=0.1 w=0.35 e^1=2.72 Card  $b_{11} = (0.35*0.3) + (0.35/(3*2.72)) [(0.4-0.1)(-1.72)-(0.3)(1.72)]$ Card  $b_{11} = 0.06$ 

Similarily Card  $b_{12} = 0.07Card \ b_{13} = 0.04Card \ b_{14} = 0.1Card \ b_{21} = 0.07$ 

Card  $b_{22}$ = 0.27 Card  $b_{23}$  = 0.12 Card  $b_{24}$  = 0.05 Card  $b_{31}$  = 0.12Card  $b_{32}$  = 0.04 Card  $b_{33}$  = 0.26 Card  $b_{34}$  = 0.05 Card  $b_{41}$  = 0.03Card  $b_{42}$  = 0.2 Card  $b_{43}$  = 0.16 Card  $b_{44}$  = 0.15

Card B<sub>ij</sub> = 
$$\begin{pmatrix} 0.06\ 0.07\ 0.04\ 0.1 \\ 0.07\ 0.27\ 0.12\ .05 \\ 0.12\ 0.040\ .26\ 0\ .05 \\ 0.03\ 0.2\ 0\ .16\ 0\ .15 \end{pmatrix}$$
  
Row Reduction: =  $\begin{pmatrix} 0.02\ 0.03\ 0\ 0.06 \\ 0.02\ 0.22\ 0.07\ 0 \\ 0.08\ 0\ 0.22\ 0.01 \\ 0\ 0.17\ 0.13\ 0.12 \end{pmatrix}$   
Column Reduction: =  $\begin{pmatrix} 0.02\ 0.03\ 0\ 0.06 \\ 0.02\ 0.22\ 0.07\ 0 \\ 0.08\ 0\ 0.22\ 0.01 \\ 0\ 0.17\ 0.13\ 0.12 \end{pmatrix}$ 

Therefore

Card  $B_{ij} = 0.16$ 

Table 1: A Comparison of Assignment through Ranking			
with different approaches			

Approaches	Results for Ranking Using
	Assignment Problem
Salim Rezvani	R(A) = 0.27
Amitkumar, Pushpinder Singh	R(A) = 0.2
and Amirpreet Kumar(2010)	
Rajeshwari and Sahaya Sudha.A	R(A) = 0.23
Salim Rezvani(2014)	R(A) = 1
S.Rezvani, M.Molani and	R(A) = 0.2
M.Ebrahimi (2013)	
Proposed Approach	R(A) = 0.16

### 2. Conclusion

A method for comparison generalized exponential ranking fuzzy numbers provide correct ordering pentagon fuzzy numbers. This proposed ranking method used to solve the real life problem simply and easily.

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