International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

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 Є R , a ≤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 ЄX 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

$$d(a,b) = \int_{-0.5}^{0.5} [(a_1+a_2)/2 + x(a_2-a_1)] – [(b_1+b_2)/2 + x(b_2-b_1)]\, dx$$

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. α_A must be a closed interval for every α Є [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,

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

$\tilde{A}_p \geq \tilde{U}_p \Leftrightarrow R(\tilde{A}_p) \geq R(\tilde{U}_p)$
$\tilde{A}_p \leq \tilde{U}_p \Leftrightarrow R(\tilde{A}_p) \leq R(\tilde{U}_p)$

Graphical Representation

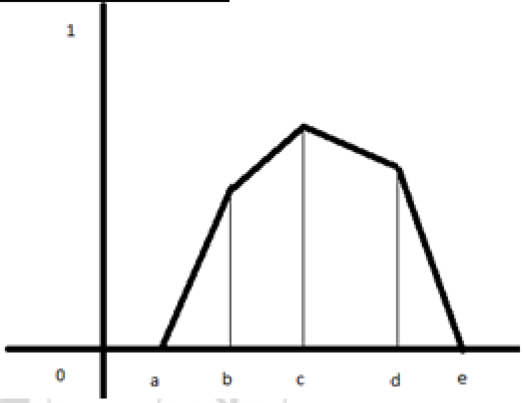

Figure (a): Graphical Representation of Pentagon Fuzzy Number

Definition

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

I. μ_A is a continuous mapping from R to the closed interval [0,1].
II. $\mu_A(x) = 0$, $-\infty < x \leq a$.
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, ∞].

Where 0≤ w≤ 1 a, b are real numbers, c, d are positive real numbers. we denote this type of generalized exponential fuzzy number as $B=(a, b, c, d, e ;w)_E$ .Especially ,when w=1, we denoted it as $B=(a, b, c ,d ,e ;w)_E$ 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:

$$f_E(x) = \begin{cases} w\, e^{-[(b-x)/(b-a)]} & \text{for } a \le x \le b \\ w\, e^{-[(c-x)/(c-b)]} & \text{for } b \le x \le c \\ w & x = c \\ w\, e^{-[(x-c)/(d-c)]} & \text{for } c \le x \le d \\ w\, e^{-[(x-d)/(e-d)]} & \text{for } x > e \end{cases}$$

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:

$$\text{Card B} = \int_a^b B(x)\,dx$$

$$= \int_a^b w\, e^{-\left(\frac{(b-x)}{(b-a)}\right)} dx + \int_b^c w\, e^{-\left(\frac{(c-x)}{(c-b)}\right)} dx + \int_c^d w\, e^{-\left(\frac{(x-c)}{(d-c)}\right)} dx + \int_e^{\infty} w\, e^{-\left(\frac{(x-d)}{(e-d)}\right)} dx + w \longrightarrow (1)$$

= 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 [∫ $we^{-[(x-d)/(e-d)]}{}_{dx}$ -∫$we^{-[(b-x)/(b-a)]}{}_{dx}$] ^{e} 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.

$$\begin{pmatrix} (0.2,0.5,0.3,0.4,0.1;0.35) & (0.1,0.3,0.4,0.5,0.6;0.2) \\ (0.2,0.3,0.5,0.4,0.1;0.1) & (0.1,0.2,0.3,0.5,0.6;0.4) \\ (0.1,0.2,0.3,0.5,0.6;0.21) & (0.2,0.4,0.6,0.8,0.9;0.5) \\ (0.3,0.4,0.5,0.6,0.7;0.28) & (0.1,0.15,0.2,0.25,0.6,0.48) \\ (0.1,0.2,0.3,0.5,0.6;0.4) & (0.2,0.3,0.5,0.4,0.1;0.1) \\ (0.2,0.4,0.7,0.75,0.8;0.39) & (0.1,0.15,0.2,0.25,0.6;0.48) \end{pmatrix}$$

$$\begin{pmatrix} (0.1,0.2,0.3,0.41,0.6;0.51) & (0.1,0.2,0.4,0.1,0.7;0.5) \\ (0.1,0.2,0.4,0.6,0.7;0.3) & (0.1,0.2,0.3,0.4,0.6;0.25) \end{pmatrix}$$

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

$$\text{Card } B_{ij} = \begin{pmatrix} 0.06 & 0.07 & 0.04 & 0.1 \\ 0.07 & 0.27 & 0.12 & .05 \\ 0.12 & 0.04 & 0.26 & 0.05 \\ 0.03 & 0.2 & 0.16 & 0.15 \end{pmatrix}$$

$$\text{Row Reduction: } = \begin{pmatrix} 0.02 & 0.03 & 0 & 0.06 \\ 0.02 & 0.22 & 0.07 & 0 \\ 0.08 & 0 & 0.22 & 0.01 \\ 0 & 0.17 & 0.13 & 0.12 \end{pmatrix}$$

$$\text{Column Reduction: } = \begin{pmatrix} 0.02 & 0.03 & \boxed{0} & 0.06 \\ 0.02 & 0.22 & 0.07 & \boxed{0} \\ 0.08 & \boxed{0} & 0.22 & 0.01 \\ \boxed{0} & 0.17 & 0.13 & 0.12 \end{pmatrix}$$

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 and Amirpreet Kumar(2010)	R(A) = 0.2
Rajeshwari and Sahaya Sudha.A	R(A) = 0.23
Salim Rezvani(2014)	R(A) = 1
S.Rezvani , M.Molani and M.Ebrahimi (2013)	R(A) = 0.2
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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