International Journal of Mathematics And its Applications
Volume 5, Issue 4–F (2017), 875–878.
ISSN: 2347-1557
Available Online: http://ijmaa.in/

International Journal of Mathematics And its Applications

New Membership Function and New Ranking Function on Heptagon Fuzzy Number

Research Article

K.Dhurai[1] and A.Karpagam[1]*

1 Department of Mathematics, Government College of Engineering, Tharmapuri, Taminadu, India.

2 Department of Mathematics, Valliammai Engineering College, Kattankulathur, Taminadu, India.

Abstract: The Fuzzy set theory has been applied in many fields such as management, Engineering etc. In this paper, a new membership function and new ranking function introduce on Heptagon fuzzy number and a new ranking method based on heptagon fuzzy numbers used to a Travelling Salesman problems.

Keywords: Membership function, Ranking Function, Heptagon Fuzzy numbers, Travelling Salesman problem.

1. Introduction

The ordinary form of travelling salesman problem, a map of cities is given to the salesman problem and has to visit all the cities only one and return to the starting point to compute the tour. There are different methods to solve travelling salesman problem. But this method to solve easily and minimum number of iteration. In fuzzy environment ranking fuzzy numbers is a very important decision making procedure. The idea of fuzzy set was first proposed by Bellman and Zadeh [3] as a mean of handling uncertainty that is due to imprecision rather than randomness. K.Dhurai and A.Karpagam [7] proposed a new membership function on hexagonal fuzzy number. The concept of Fuzzy Linear Programming (FLP) was first introduced by Tanaka et al [10]. Zimmerman [12] introduced fuzzy linear programming in fuzzy environment. Chanas [4] proposed a fuzzy programming in multiobjective linear programming. Amit Kumar et al. [1] proposed a new method for solving fully fuzzy linear programming problems with inequality constraints. H. Arsham and A.B.Kahn [2] introduced a Simplex type algorithm for general transportation problems. This paper is organized as follows: In section 2 Basic definitions, In section 3 new membership function and new ranking function with fuzzy Travelling Salesman problems are presented. Finally concludes the paper.

2. Preliminaries

Definition 2.1. *The characteristic function μ_A of a crisp set $A \subset X$ assigns a value either 0 or 1 to each member in X. This function can be generalized to a function $\mu_{\tilde{A}}$ such that the value assigned to the element of the universal set X fall within a specified range i.e. $\mu_{\tilde{A}} : X \to [0,1]$. The assigned value indicate the membership function and the set $\tilde{A} = \{(x, \mu_{\tilde{A}}(x)) : x \in X\}$ defined by $\mu_{\tilde{A}}(x)$ for $x \in X$ is called fuzzy set.*

* *E-mail: karpagamohan@rediff.com*

Definition 2.2. *A Fuzzy set $\tilde{A}$, defined on the universal set of real numbers R, is said to be a fuzzy number if its membership function has the following characteristics:*

(1). $\mu_{\tilde{A}} : R \to [0,1]$ *is continuous.*

(2). $\mu_{\tilde{A}}(x) = 0$ *for all* $x \in (\infty, a] \cup [d, \infty)$

(3). $\mu_{\tilde{A}}(x)$ *is strictly increasing on [a, b] and strictly decreasing on [c, d]*

(4). $\mu_{\tilde{A}}(x) = 1$ *for all* $x \in [b, c]$ *where* $a < b < c < d$.

Definition 2.3. *An effective approach for ordering the elements of F(R) is also to define a ranking function* $\Re : F(R) \to R$ *which maps each fuzzy number into the real line, where a natural order exists. We define orders on* $F(R)$ *by:*

$$\tilde{a} \geq \tilde{b} \ \text{ if and only if } \ R(\tilde{a}) \geq R(\tilde{b})$$
$$\tilde{a} \leq \tilde{b} \ \text{ if and only if } \ R(\tilde{a}) \leq R(\tilde{b})$$
$$\tilde{a} = \tilde{b} \ \text{ if and only if } \ R(\tilde{a}) = R(\tilde{b})$$

3. New Membership Function and New Ranking Function

3.1. New Membership Function of Heptagon fuzzy number

Let $\overline{A_{hep}} = (a_1, a_2, a_3, a_4, a_5, a_6, a_7)$ and $\overline{B_{hep}} = (b_1, b_2, b_3, b_4, b_5, b_6, b_7)$ be two heptagon fuzzy numbers, then its membership function is defined as,

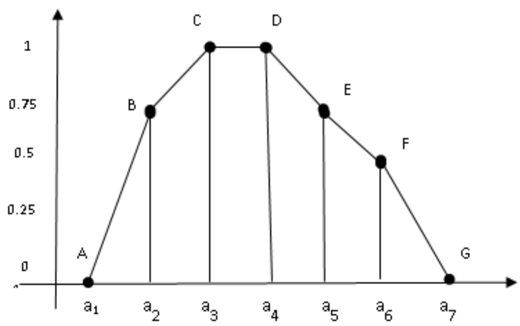

Figure 1. **Graphical representation of a Heptagon fuzzy number**

$$\mu_{\overline{A_{HP}}}(x) = \begin{cases} 0, & \text{for } x \prec a_1 \\ \frac{1}{2}\left(\frac{x-a_1}{a_2-a_1}\right), & \text{for } a_1 \leq x \leq a_2 \\ \frac{1}{2} + \frac{1}{2}\left(\frac{x-a_2}{a_3-a_2}\right), & \text{for } a_2 \leq x \leq a_3 \\ 1, & \text{for } a_3 \leq x \leq a_4 \\ 1 - \frac{1}{4}\left(\frac{x-a_4}{a_5-a_4}\right), & \text{for } a_4 \leq x \leq a_5 \\ \frac{3}{4} - \frac{1}{2}\left(\frac{x-a_5}{a_5-a_6}\right), & \text{for } a_5 \leq x \leq a_6 \\ \frac{1}{4}\left(\frac{x-a_7}{a_6-a_7}\right), & \text{for } a_6 \leq x \leq a_7 \\ 0, & \text{for } x \succ a_7 \end{cases}$$

3.2. New Ranking Function of Heptagon Fuzzy Number

Let $\overline{A_{hep}} = (a_1, a_2, a_3, a_4, a_5, a_6, a_7)$ and $\overline{B_{hep}} = (b_1, b_2, b_3, b_4, b_5, b_6, b_7)$ be two heptagon fuzzy numbers, then

$$\overline{A_{hep}} = \overline{B_{hep}} \Leftrightarrow R(\overline{A_{hep}}) = R(\overline{B_{hep}})$$

$$\overline{A_{hep}} \geq \overline{B_{hep}} \Leftrightarrow R(\overline{A_{hep}}) \geq R(\overline{B_{hep}})$$

$$\overline{A_{hep}} \leq \overline{B_{hep}} \Leftrightarrow R(\overline{A_{hep}}) \leq R(\overline{B_{hep}})$$

In this paper for a heptagon of fuzzy number in a ranking method is from the following formula,

$$R\left(\tilde{A}\right) = \frac{a_1 + 0.75a_2 + a_3 + a_4 + 0.75a_5 + 0.5a_6 + a_7}{6}$$

3.3. Formulation of Fuzzy Travelling Salesman Problems

Suppose a person has to visit n cities. He starts from a particular city once and then returns to the starting point. The fuzzy travelling costs from i^{th} city to j^{th} city is given by $\overline{c_{ij}}$. The chosen of Travelling salesman problem may be formulated by Maximize or Minimize $Z = \sum X_{ij}$; $j = 1, 2, \ldots, n,\ j \neq i$
and $X_{ij} = 1,\ i = 1, 2, \ldots, n,\ i \neq j$ and $j = 1$
$\sum\limits_{j=1}^{n} X_{ij} = 1,\ i = 1, 2, \ldots, n,\ i \neq j.$

3.4. Numerical Example

The expected times required to be taken by a salesman in travelling from one city to another are as follows

	A	B	C	D
A	$-$	$(3,4,5,6,8,10,11)$	$(0,1,2,3,5,7,8)$	$(4,6,7,9,12,15,16)$
B	$(1,2,3,4,6,8,9)$	$-$	$(0,4,6,7,8,10,11)$	$(1,2,3,4,8,9,10)$
C	$(2,6,7,8,12,13,14)$	$(2,4,6,7,8,12,15)$	$-$	$(0,2,3,4,6,8,9)$
D	$(1,2,3,4,6,8,9)$	$(1,2,3,4,8,9,10)$	$(1,2,3,4,8,9,12)$	$-$

How should the salesman plan his trip so that he covers each of these cities no more than once, and completes his trip in minimum possible time required for travelling?

Solution. Here

$$R\left(\tilde{A}\right) = \frac{a_1 + 0.75a_2 + a_3 + a_4 + 0.75a_5 + 0.5a_6 + a_7}{6}.$$

Therefore

$$R\left(\tilde{A}_{12}\right) = \frac{3 + 0.75(4) + 5 + 6 + 0.75(8) + 0.5(10) + 11}{6} = 6.5.$$

Similarly $R\left(\tilde{A}_{13}\right) = 3.5$, $R\left(\tilde{A}_{14}\right) = 9.5$, $R\left(\tilde{A}_{21}\right) = 4.5$, $R\left(\tilde{A}_{23}\right) = 6.3$, $R\left(\tilde{A}_{24}\right) = 5$.

Step 1: Row Reduction

	A	B	C	D
A	$-$	6.5	3.5	9.5
B	4.5	$-$	6.3	5
C	8.5	7.5	$-$	4.3
D	5.5	5	5.3	$-$

Step 2: Column Reduction

$$\begin{array}{c} \\ A \\ B \\ C \\ D \end{array}\begin{array}{c} \begin{array}{cccc} A & B & C & D \end{array} \\ \begin{pmatrix} - & 1.5 & 0 & 5.2 \\ 0 & - & 2.8 & 0.7 \\ 4 & 2.5 & - & 0 \\ 1 & 0 & 1.8 & - \end{pmatrix} \end{array}$$

Therefore the optimal solution is $A \to c \to D \to B \to A = 17.3$.

4. Conclusion

In this paper, New membership function and New Ranking Function of Heptagon fuzzy number has been newly introduced with numerical example. Numerical example shows that by this new Ranking function we can have the optimal solution as well as the crisp and fuzzy optimal cost. This technique occurring real life situations.

References

[1] Amit kumar, Jagdeep Kaur and Pushpinder Sign, *Fuzzy optimal solution of fully fuzzy linear programming problems with inequality constraints*, International Journal of mathematical and computer science, (2010), 37-40.

[2] H.Arsham and A.B.Kahn, *A Simplex type algorithm for general transportation problems, an alternative to stepping-stone*, Journal of operational research society, 40(1989), 581-590.

[3] R.E.Bellman and L.A.Zadeh, *Decision making in a fuzzy environment*, Management Sciences, 17(1970), 141-164.

[4] S.Chanasand and D.Kuchta, *A concept of optimal solution of the transportation with fuzzy cost coefficient*, Fuzzy sets and systems, 82(1996), 229-305.

[5] S.Chandrasekaran, G.Kokila and Junusaju, *Ranking of heptagon number using zero suffix Method*, International Journal of Science and Research, 4(2015), 2256-2257.

[6] D.Dubois and H.Prade, *Fuzzy sets and systems*, Theory and applications, Academic press, Newyork, (1980).

[7] K.Dhurai and A.Karpagam, *A new membership function on hexagonal fuzzy number*, International Journal of Science and Research, 5(2016), 1129-1131.

[8] Edward Samuel and A.Nagoorgani, *Simplex type algorithm for solving fuzzy transportation problem*, Tamsui oxford journal of information and mathematical sciences, 27(2011), 89-98.

[9] T.S.Lious and M.J.Wang, *Ranking fuzzy numbers with integral value*, Fuzzy sets and systems, 50(1992), 247-255.

[10] Tanaka, H.Ichihashi and K.Asai, *A formulation of fuzzy linear programming based on comparison of fuzzy numbers*, Control and Cybernetics, 13(1984), 185-194.

[11] L.A.Zadeh, *Fuzzy Set*, Information and Control, 8(1965), 338-353.

[12] H.J.Zimmermann, *Fuzzy Set theory and its applications*, Third edition, Klue Academic publishers, Bosten Massachusetts, (1996).