An Approach to Fuzzy Shortest Path by using Hexagonal Fuzzy Numbers

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ABSTRACT:

In this paper a new approach in made to find Fuzzy shortest path using Hexagonal Fuzzy numbers. Hexagonal Fuzzy Numbers is given to access the shortest path the from initial node to end node by Ranking method.

Keywords: Fuzzy Set, Hexagonal Fuzzy Numbers, Ranking Functions.

Introduction: Fuzzy logic has become the most explosive new concept in science. The concept of Fuzzy set theory was introduced by Zadeh[1] the fuzzy has created into all walks of the scientific understanding. The shortest path [Kleinkm (2)] is one of the most well known optimization problems that appear many applications as a sub-problem. [4] Fuzzy shortest path was developed by Dubois and prade[3] In fuzzy environment Ranking fuzzy numbers plays very important role in decision making. Several methods have been proposed so far. Chen and hwang classified ranking methods some classes.Ranking [6] Fuzzy Nos were first proposed by Jain [7]for decision making in the fuzzy environment. some of the Ranking methods have been compared and reviewed by P.Rajeswari [8, 10].
Thus ,ranking fuzzy numbers is crucial procedure for decesion making fuzzy environment.

2. Preliminaries

2.1 **Definitions: [FuzzySet]**

A Fuzzy set is characterized by a membership function mapping element of a domains, space, or the universe of discourse X to the unit interval [0,1].

2.2 Definition [Fuzzy numbers]

A fuzzy number is a genenalisation of a regular real number and which does not refer to a single value but rather to a connected a set of possible value, where each possible value has its weight between 0 and 1.

A Fuzzy number is a convex normalized fuzzy set on the real line R such that ,There exist at least one i)x ϵ X with μA (x) = 1,

ii)μ_A (x) is piece wise continuous.

2.3 Definition (Hexagonal Fuzzy number)

A Fuzzy number A_H is a HFN [9]. denoted by $A_H = (a_1, a_2, a_3, a_4, a_5, a_6)$. Where $a_1, a_2, a_3, a_4, a_5, a_6$ and real numbers. And it membership function is given below.

$$\mu_A(x) = \begin{cases} \frac{1}{2}\left[\frac{x-a_1}{a_2-a_1}\right] & \text{for } a_1 \le x \le a_2 \\ \frac{1}{2}+\frac{1}{2}\left[\frac{x-a_2}{a_3-a_2}\right] & \text{for } a_2 \le x \le a_3 \\ 1 & \text{for } a_3 \le x \le a_4 \\ 1-\frac{1}{2}\left[\frac{x-a_4}{a_5-a_4}\right] & \text{for } a_4 \le x \le a_5 \\ \frac{1}{2}\left[\frac{a_6-x}{a_6-a_5}\right] & \text{for } a_5 \le x \le a_6 \end{cases}$$

3. Ranking of Hexagonal Fuzzy Numbers [10]

3.1 Proposed centroied Ranking Method.

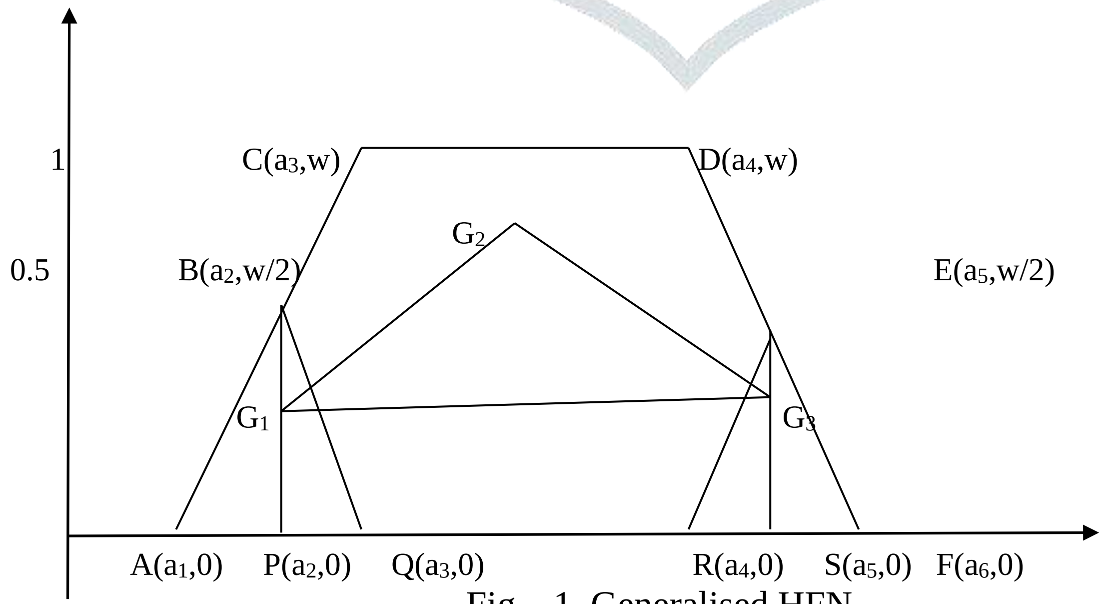


Fig – 1 Generalised HFN.

The centroied of a hexagonal fuzzy umber is considered to be the balancing point of the hexagonal. Divide the hexagonal into the plane figures, such as ABQ, CDERQB and REF respectively. The Circum- center of the centroids of these three plane figures is taken as the point of reference to define ranking of Hexagonal fuzzy numbers. let the centroid the three plane. Figures is

$$G_1 = \left(\frac{a_1 + a_2 + a_3}{3}, \frac{w}{6}\right) \qquad G_2 \left(= \frac{a_2 + 2a_3 + 2a_4 + a_5}{6}, \frac{w}{2}\right) \quad G_3 = \left(\frac{a_4 + a_5 + a_6}{3}, \frac{w}{6}\right) \qquad (1)$$

The ranking functions of the generlised Hexagonal fuzzy numbers

A_H = (a_1 a_2 a_3 a_4 a_5 a_6) which maps the set of all fuzzy numbers to a set of real numbers is

$$R[A_H] = \left[\frac{2a_1+3a_2+4a_3+4a_4+3a_5+2a_6}{18} \text{ X } \frac{5W}{18}\right] \qquad (2)$$

Remark: Where w. represents the maximum membership value , if w = 1 then the HFN is called a Normal HFN.

4. Description of the Model

Hexagonal fuzzy numbers are converted into expected time (Normal time) for each activity by using Ranking method $R[A_H]$

These values treated as a normal time between the nodes and the shortest travelling path ,(ie.minimum distance) is determined by using the given algorithm.

4.1 Algorithm

Step: 1 Construct the network diagram according to the given activity.

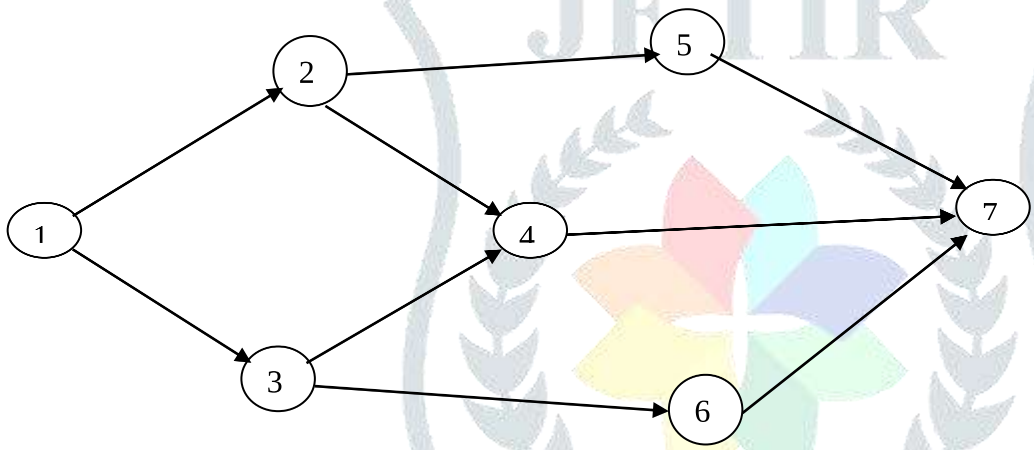
Step: 2 From given HFN find the (normal) Expected time using Ranking method.

Step: 3 Determine the Number of possible ways of i.e path from initial node to end node.

Step: 4 From the all possible ways calculate the summation of expected time , from that we can find the minimum Travelling time (i.e) shortest traveling path.

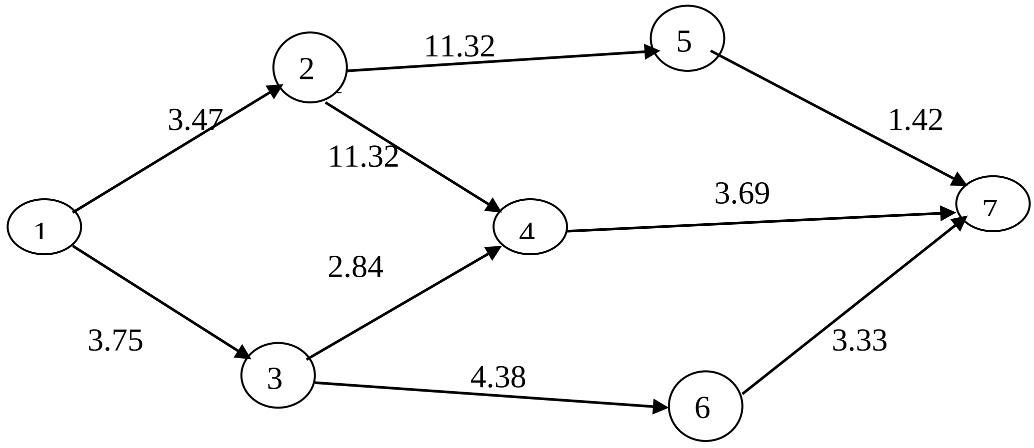
5. Numerical examples.

Consider a project with the nodes and a activities. The distance between there is represented by HFN.



Activity	**HFN**
1-2	(7, 9, 11, 13, 16, 20)
1-3	(6, 8, 11, 14, 19, 25)
2-4	(9, 11, 13, 15, 18, 20)
2-5	(6, 9, 12, 15, 20, 25)
3-4	(6, 7, 9, 11, 13, 16)
3-6	(10, 12, 14, 16, 20, 24)
4-7	(7, 9 , 11, 14, 18, 22)
5-7	(2, 3, 4, 5, 7, 9)
6-7	(5, 7, 10, 12, 17, 21)

Step1 : After evaluating the expected time (Normal) for each activity by the method of Ranking method we get network with expected time as



Step 2: The number of possible (Paths) ways with minimum distance are

1-2-5-7	=	16.21
1-2-4-7	=	18.48
1-3-4-7	=	10.28
1-3-6-7	=	11.46

Fuzzy shortest travelling path is 1-3-4-7

CONCLUSION

In this paper Hexagonal fuzzy numbers are converted as Expected time (ie.normal time) by Ranking method for each activity. Hence fuzzy shortest travelling path is obtained based on the given algorithm.

IT helps decision makes to, decide on the best possible shortest path is fuzzy environment using Ramking method.

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