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Solving Fuzzy Assignment Problem for Hexagonal Fuzzy Number Using Ones Assignment Method and Robust's Ranking Technique

Research Article*

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Abstract: In this paper, ones assignment method is used to solve fuzzy assignment problem and Robust's ranking technique to find maximum and minimum objective function. C_{ij} is considered to be hexagonal fuzzy number. From this, we find the optimal assignment and it gives as the required optimal total cost for the problem. Finally, examples are given to explain this method.

Keywords: Fuzzy assignment problem, ones assignment algorithm, hexagonal fuzzy number and Robust's ranking technique method.

1. Introduction

In this Mathematics fuzzy sets are sets whose elements have degree of membership fuzzy sets were introduced by Lofi A.Zadeh in 1965 as an extension of the classical notation of set. Then such as fuzzy number, Hexagonal fuzzy number has been introduced in this method. The fuzzy assignment problem is one of the special kind of fuzzy linear programming problems. Ones assignment method is used to solve fuzzy assignment problem and Robust's Ranking Technique to find Minimum and Maximum objective function. C_{ij} is considered to be Hexagonal fuzzy number. 6 salesmen are to be performed by 6 products sales are depending on their salesmen. In this problem, C_{ij} denotes the cost of assigning the 6 salesmen to the 6 products. We find the optimal assignment and it gives us the required optimal total cost for the Minimum and Maximum.

1.1. Preliminaries

Definition 1.1 (Fuzzy set). *A Let X be a non empty set. A fuzzy set $\tilde{A}$ of X is defined as $\tilde{A} = \{x, \mu_A(x)/x \in X\}$ where $\mu_{\tilde{A}}(x)$ is called the membership function where $\mu_{\tilde{A}}(x) : R \to [0, 1]$.*

Definition 1.2 (Fuzzy numbers). *A fuzzy number f in the real line R is a fuzzy set $f : R \to [0, 1]$ that satisfies the following properties,*

- *f is piecewise continuous*

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- *there exist an* $x \in R$ *such that* $f(x) = 1$
- f *is convex. ie, if* $x_1,\ x_2 \in R$ *and* $a \in [0,1]$.

Definition 1.3 (Hexagonal fuzzy number)**.** *A fuzzy number* $\tilde{A}_H$ *is a hexagonal fuzzy number denoted by* $\tilde{A}_H = (a_1, a_2, a_3, a_4, a_5, a_6)$ *where* $a_1 \le a_2 \le a_3 \le a_4 \le a_5 \le a_6$ *are real number and its membership function is given below*

$$\mu_{\tilde{A}}(x) = \begin{cases} \frac{1}{2}\left(\frac{x-a^1}{a^2-a^1}\right), & for\ a^1 \le x \le a^2 \\ \frac{1}{2} + \frac{1}{2}\left(\frac{x-a^2}{a^3-a^2}\right), & for\ a^2 \le x \le a^3 \\ 1, & for\ a^3 \le x \le a^4 \\ 1 - \frac{1}{2}\left(\frac{x-a^4}{a^5-a^4}\right), & for\ a^4 \le x \le a^5 \\ \frac{1}{2}\left(\frac{a^6-x}{a^6-a^5}\right), & for\ a^5 \le x \le a^6 \\ 0, & otherwise \end{cases}$$

Definition 1.4 (α-cut)**.** *The* α*-cut of a fuzzy number* $A(\alpha)$ *is defined as* $A(\alpha) = \{x/\mu(x) \ge \alpha,\ \alpha \in [0,1]\}$.

Definition 1.5 (Robust's Ranking Technique)**.** *Robust Ranking Technique satisfies the following properties,*

1. *Compensation*
2. *Linearity*
3. *Additivity*

If $\tilde{A}$ *is a fuzzy number the Robust ranking is defined by* $R(\tilde{A}_H) = \int_0^1 0.5(a^L_{h\alpha},\ a^U_{h\alpha})d\alpha$*, where* $(a^L_{h\alpha},\ a^U_{h\alpha})$ *is the* α*-level cut of the fuzzy number* $\tilde{A}$.

2. Ones Assignment Method Using Hexagonal Fuzzy Number

2.1. Mathematical Formulation of Assignment Problem's

The mathematical formulation of the assignment problem is, associated to each assignment problem there is a matrix called cost or effectiveness matrix $[c_{ij}]$ where c_{ij} is the cost of assigning i^{th} products to j^{th} salesmen. In this paper we call it assignment matrix and represent it as follows:

$$\begin{array}{c} \\ 1 \\ \vdots \\ n \end{array} \begin{array}{c} \begin{matrix} 1 & \dots & n \end{matrix} \\ \begin{pmatrix} c_{11} & \dots & c_{1n} \\ \vdots & \ddots & \vdots \\ c_{n1} & \dots & c_{nn} \end{pmatrix} \end{array}$$

The mathematical formulation of the assignment problem is,

$$\begin{aligned} \text{Minimize} \quad & Z = \sum_{i=1}^{n}\sum_{j=1}^{n} c_{ij}X_{ij} \\ \text{subject to} \quad & \sum_{i=1}^{n} X_{ij} = 1,\ i = 1, \dots, n \\ & \sum_{j=1}^{n} X_{ij} = 1,\ j = 1, \dots, n \\ & X_{ij} = 0\ \ or\ \ 1 \end{aligned}$$

2.2. Algorithm

Ones Assignment Algorithm Using Hexagonal Fuzzy Number

Step 1: In a minimization or maximization case, find the minimum or maximum element of each row in the assignment matrix and write it on the right hand side of the

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array} \begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{pmatrix} \end{array} \begin{array}{c} \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \end{array}$$

Then divide each element 6 rows of the matrix by a_1 to a_6. These operations create at least one ones in each rows. In term of ones for each row and column do assignment, otherwise go to Step 2.

Step 2: Find the minimum or maximum element of each column in assignment matrix b_6, and write it below 6 columns. Then divide each element of 6 columns of the matrix by b_1 to b_6. These operations create at least one ones in each columns. Make assignment in terms of ones. If no feasible assignment can be achieved from Step 1 and 2 then go to Step 3.

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ \\ \end{array} \begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{pmatrix} a_{11}/a_1 & a_{12}/a_1 & a_{13}/a_1 & a_{14}/a_1 & a_{15}/a_1 & a_{16}/a_1 \\ a_{21}/a_2 & a_{22}/a_2 & a_{23}/a_2 & a_{24}/a_2 & a_{25}/a_2 & a_{26}/a_2 \\ a_{31}/a_3 & a_{32}/a_3 & a_{33}/a_3 & a_{34}/a_3 & a_{35}/a_3 & a_{36}/a_3 \\ a_{41}/a_4 & a_{42}/a_4 & a_{43}/a_4 & a_{44}/a_4 & a_{45}/a_4 & a_{46}/a_4 \\ a_{51}/a_5 & a_{52}/a_5 & a_{53}/a_5 & a_{54}/a_5 & a_{55}/a_5 & a_{56}/a_5 \\ a_{61}/a_6 & a_{62}/a_6 & a_{63}/a_6 & a_{64}/a_6 & a_{65}/a_6 & a_{66}/a_6 \end{pmatrix} \\ \begin{array}{cccccc} b_1 & b_2 & b_3 & b_4 & b_5 & b_6 \end{array} \end{array} \begin{array}{c} \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ \\ \end{array}$$

Step 3: Draw the minimum or maximum number of lines to cover all the ones of the matrix. If the number of draw lines less than 6, then complete assignment is not possible, while if the number of lines is exactly equal to 6, then the complete assignment is obtained.

Step 4: If a complete assignment program is not possible in Step 3, then select the smallest or largest element out of those which do not lie on any of the lines in the above matrix. Then divide by d_{ij} each element of the uncovered rows or columns, which d_{ij} lies on it. This operation creates some new ones to this row or column.

If still a complete optimal assignment is not achieved in this new matrix, then use Step 4 and 3 iteratively. By repeating the same procedure the optimal assignment will be obtained. Priority plays an important role in this method, when we want to assign the ones. Priority rule, for minimization or maximization assignment problem, assign the ones on the row which have smallest or greatest element on the right hand side, respectively.

Example 2.1. *Let us consider a fuzzy assignment problem with rows representing 6 salesmen A, B, C, D, E, F and columns representing 6 products. The problem is to find the optimal assignment of salesmen to products that will minimize total cost and maximum total cost.*

salesmen → products ↓	A	B	C	D	E	F
1	(1,2,3,4,5,6)	(7,8,9,10,11,12)	(6,1,2,3,5,4)	(7,4,2,3,8,9)	(5,4,2,1,6,7)	(11,12,13,14,3,2)
2	(2,4,6,8,10,12)	(9,10,11,15,5,6)	(5,8,10,11,3,7,)	(3,5,6,7,11,13)	(5,8,3,7,1,2)	(5,8,10,11,1,7)
3	(7,8,10,12,4,5)	(3,5,6,7,8,9)	(6,4,2,8,10,12)	(5,7,10,11,14,12)	(8,11,13,15,10,12)	(6,8,10,12,4,1)
4	(6,8,1,4,10,2)	(2,5,6,7,1,13)	(4,6,7,9,1,3)	(11,12,14,1,2,4)	(6,7,1,6,2,5)	(9,7,1,3,4,6)
5	(12,8,7,15,4,7)	(9,1,14,10,6,3)	(12,6,7,1,2,4)	(9,6,12,10,3,1)	(4,5,11,10,12,14)	(15,11,13,10,1,2)
6	(6,14,4,11,7,9)	(2,1,4,3,10,11)	(1,3,5,7,9,11)	(6,10,2,14,8,7)	(4,1,3,11,10,12)	(10,1,7,6,3,4)

Solution: The fuzzy assignment problem can be formulated in following min or max $\{ R(1,2,3,4,5,6)x_{11} + R(7,8,9,10,11,12)x_{12} + R(6,1,2[,3,5,4)x_{13} + R(7,4,2,3,8,9)x_{14} + R(5,4,2,1,6,7)x_{15} + R(11,12,13,14,3,2)x_{16} + R(2,4,6,8,10,12)x_{21} + R(9,10,11,15,5,6)x_{22} + R(5,8,10,11,3,7) + R(3,5,6,7,11,13)x_{24} + R(5,8,3,7,1,2)x_{25} + R(5,8,10,11,1,7)x_{26} + R(7,8,10,12,4,5)x_{31} + R(3,5,6,7,89)x_{32} + R(6,4,2,8,10,12)x_{33} + R(5,7,10,11,14,12)x_{34} + R(8,11,13,15,10,12)x_{35} + R(6,8,10,12,4,1)x_{36} + R(6,8,1,4,10,2)x_{41} + R(2,5,6,7,1,13)x_{42} + R(4,6,7,9,1,3)x_{43} + R(11,12,14,1,2,4)x_{44} + R(6,7,1,6,2,5)x_{45} + R(9,7,1,3,4,6)x_{46} + R(12,8,7,15,4,7)x_{51} + R(9,1,14,10,6,3)x_{52} + R(12,6,7,1,2,4)x_{53} + R(9,6,12,10,3,1)x_{54} + R(4,5,11,10,12,14)x_{55} + R(15,11,13,10,1,2)x_{56} + R(6,14,4,11,7,9)x_{61} + R(2,1,4,3,10,11)x_{62} + R(1,3,5,7,9,11)x_{63} + R(6,10,2,14,8,7)x_{64} + R(4,1,3,11,10,12)x_{65} + R(10,1,7,6,3,4)x_{66} \}$

Subject to

$$x_{11}+x_{12}+x_{13}+x_{14}+x_{15}+x_{16}=1; \quad x_{21}+x_{22}+x_{23}+x_{24}+x_{25}+x_{26}=1; \quad x_{31}+x_{32}+x_{33}+x_{34}+x_{35}+x_{36}=1;$$

$$x_{41}+x_{42}+x_{43}+x_{44}+x_{45}+x_{46}=1; \quad x_{51}+x_{52}+x_{53}+x_{54}+x_{55}+x_{56}=1; \quad x_{61}+x_{62}+x_{63}+x_{64}+x_{65}+x_{66}=1$$

$x_{ij} \in [0,1]$. Now we calculate R(1,2,3,4,5,6) by applying Robust's ranking method using the membership function of hexagonal fuzzy number

$$\mu_{\tilde{A}}(x) = \begin{cases} \frac{1}{2}\left(\frac{x-1}{2-1}\right), & for\ 1 \le x \le 2 \\ \frac{1}{2}+\frac{1}{2}\left(\frac{x-2}{3-2}\right), \ for\ 2 \le x \le 3 & \\ 1, & for\ 3 \le x \le 4 \\ 1-\frac{1}{2}\left(\frac{x-4}{5-4}\right), & for\ 4 \le x \le 5 \\ \frac{1}{2}\left(\frac{6-x}{6-5}\right), & for\ 5 \le x \le 6 \\ 0, & otherwise \end{cases}$$

The α-cut of the fuzzy number (1, 2, 3, 4, 5, 6) is $(a^L_{h\alpha}, a^U_{h\alpha}) = (2\alpha+1, 2\alpha+1, 6-2\alpha, 6-2\alpha)$.

$$R(\tilde{A}_{1,1}) = R(1,2,3,4,5,6) = \int_0^1 0.5(a^L_{h\alpha},\ a^U_{h\alpha})d\alpha = \int_0^1 0.5(14)d\alpha = 7$$

Proceeding similarly, calculate the values using the Robust's ranking method $R(\tilde{A}_{1,2}) = 19$, $R(\tilde{A}_{1,3}) = 5.5$, $R(\tilde{A}_{1,4}) = 5.5$, $R(\tilde{A}_{1,5}) = 5.5$, $R(\tilde{A}_{1,6}) = 22$.

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array} \begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{pmatrix} 7 & 19 & 5.5 & 5.5 & 5.5 & 22 \\ 12 & 5.5 & 17 & 14.5 & 10.5 & 10 \\ 16.5 & 13.5 & 14 & 19 & 14.5 & 28.5 \\ 11.5 & 10 & 2.5 & 14 & 7 & 5.5 \\ 15 & 13 & 4 & 18.5 & 18.5 & 20 \\ 20.5 & 17 & 11.5 & 19.5 & 10 & 3.5 \end{pmatrix} \end{array}$$

We solve it by ones assignment method to get the following optimal solution

Step 1: In a minimization case, find the minimum element of each row in the assignment matrix and write it on the right hand side of the matrix. Then divide each element 6rows of the matrix by a_1 to a_6. These operations create at least one ones in each rows. In term of ones for each row and column do assignment, otherwise go

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{pmatrix} 7 & 19 & 5.5 & 5.5 & 5.5 & 22 \\ 12 & 5.5 & 17 & 14.5 & 10.5 & 10 \\ 16.5 & 13.5 & 14 & 19 & 14.5 & 28.5 \\ 11.5 & 10 & 2.5 & 14 & 7 & 5.5 \\ 15 & 13 & 4 & 18.5 & 18.5 & 20 \\ 20.5 & 17 & 11.5 & 19.5 & 10 & 3.5 \end{pmatrix} \end{array}\begin{array}{c} min \\ 5.5 \\ 5.5 \\ 13.5 \\ 2.5 \\ 4 \\ 3.5 \end{array}$$

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{pmatrix} 7/5.5 & 19/5.5 & 1 & 1 & 1 & 22/5.5 \\ 12/5.5 & 1 & 17/5.5 & 14.5/5.5 & 10.5/5.5 & 10/5.5 \\ 16.5/13.5 & 1 & 14/13.5 & 19/13.5 & 14.5/13.5 & 28.5/13.5 \\ 11.5/2.5 & 10/2.5 & 1 & 14/2.5 & 7/2.5 & 5.5/2.5 \\ 15/4 & 13/4 & 1 & 18.5/4 & 18.5/4 & 20/4 \\ 20.5/3.5 & 17/3.5 & 11.5/3.5 & 19.5/3.5 & 10/3.5 & 1 \end{pmatrix} \end{array}$$

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{pmatrix} 1.8 & 3.5 & 1 & 1 & 1 & 4 \\ 2.2 & 1 & 3.1 & 2.6 & 1.9 & 1.8 \\ 1.2 & 1 & 1 & 1.4 & 1.1 & 2.1 \\ 4.6 & 4 & 1 & 5.6 & 2.8 & 2.2 \\ 3.6 & 3.3 & 1 & 4.6 & 4.6 & 5 \\ 5.8 & 4.9 & 3.2 & 5.5 & 2.8 & 1 \end{pmatrix} \end{array}$$

Step 2: Find the minimum element of each column in assignment matrix b_6, and write it below 6 columns. Then divide each element of 6 columns of the matrix by b_1 to b_6. These operations create at least one ones in each columns.

$$\begin{array}{cc} & \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array} & \begin{pmatrix} 1.8 & 3.5 & 1 & 1 & 1 & 4 \\ 2.2 & 1 & 3.1 & 2.6 & 1.9 & 1.8 \\ 1.2 & 1 & 1 & 1.4 & 1.1 & 2.1 \\ 4.6 & 4 & 1 & 5.6 & 2.8 & 2.2 \\ 3.6 & 3.3 & 1 & 4.6 & 4.6 & 5 \\ 5.8 & 4.9 & 3.2 & 5.5 & 2.8 & 1 \end{pmatrix} \\ min & \begin{array}{cccccc} 1.2 & 1 & 1 & 1 & 1 & 1 \end{array} \end{array}$$

	1	2	3	4	5	6
1	1.5	3.5	1	1	1	4
2	1.8	1	3.1	2.6	1.9	1.8
3	1	1	1	1.4	1.1	2.1
4	3.8	4	1	5.6	2.8	2.2
5	3	3.3	1	4.6	4.6	5
6	4.8	4.9	3.2	5.5	2.8	1

Step 3: Draw the minimum number of lines to cover all the ones of the matrix. if the number of lines is exactly equal to 6, then the complete assignment is obtained while If the number of draw lines less than 6 go to step

	1	2	3	4	5	6
1	1.5	3.5	1	(1)	1	4
2	1.8	(1)	3.1	2.6	1.9	1.8
3	(1)	1	1	1.4	1.1	2.1
4	3.8	4	(1)	5.6	2.8	2.2
5	3	3.3	1	4.6	4.6	5
6	4.8	4.9	3.2	5.5	2.8	(1)

Step 4: If a complete assignment program is not possible in Step 3, then select the smallest element out of those which do not lie on any of the lines in the above matrix. Then divide by d_{ij} each element of the uncovered rows, which d_{ij} lies on it. This operation creates some new ones to this row. Make assignment in terms of ones.

	1	2	3	4	5	6
1	1.5	3.5	1	1	(1)	4
2	1.8	(1)	3.1	1.4	1.1	1
3	(1)	1	1	1.3	1	1.9
4	3.8	4	(1)	2.5	1.2	1
5	3	3.3	1	(1)	1	1.1
6	4.8	4.9	3.2	5.5	2.8	(1)

The solution is (1,5), (2,2), (3,1), (4,3), (5,4), (6,6)

$$\begin{aligned}\text{The fuzzy optimal minimum total cost} &= \tilde{A}_{15} + \tilde{A}_{22} + \tilde{A}_{31} + \tilde{A}_{43} + \tilde{A}_{54} + \tilde{A}_{66} \\ &= R(5,4,2,1,6,7)x_{15} + R(9,10,11,15,5,6)x_{22} + R(7,8,10,12,4,5)x_{31} \\ &\quad + R(4,6,7,9,1,3)x_{43} + R(9,6,12,10,3,1)x_{54} + R(10,1,7,6,3,4)x_{66} \\ &= R(44,35,49,53,22,26)\end{aligned}$$

Similarly we find the method for maximum total cost

Step 1: In a maximization case, find the maximum element of each row in the assignment matrix and write it on the right hand side of the matrix. Then divide each element 6rows of the matrix by a_1 to a_6. These operations create at least one ones in each rows. In term of ones for each row and column do assignment, otherwise go

$$\begin{array}{c|cccccc|c}
 & 1 & 2 & 3 & 4 & 5 & 6 & max \\
\hline
1 & 7 & 19 & 5.5 & 5.5 & 5.5 & 22 & 22 \\
2 & 12 & 5.5 & 17 & 14.5 & 10.5 & 10 & 17 \\
3 & 16.5 & 13.5 & 14 & 19 & 14.5 & 28.5 & 28.5 \\
4 & 11.5 & 10 & 2.5 & 14 & 7 & 5.5 & 14 \\
5 & 15 & 13 & 4 & 18.5 & 18.5 & 20 & 20 \\
6 & 20.5 & 17 & 11.5 & 19.5 & 10 & 3.5 & 20.5
\end{array}$$

$$\begin{array}{c|cccccc}
 & 1 & 2 & 3 & 4 & 5 & 6 \\
\hline
1 & 7/22 & 19/22 & 5.5/22 & 5.5/22 & 5.5/22 & 1 \\
2 & 12/17 & 5.5/17 & 1 & 14.5/17 & 10.5/17 & 10/17 \\
3 & 16.5/28.5 & 13.5/28.5 & 14/28.5 & 19/28.5 & 14.5/28.5 & 1 \\
4 & 11.5/14 & 10/14 & 2.5/14 & 1 & 7/28.5 & 5.5/28.5 \\
5 & 15/20 & 13/20 & 4/20 & 18.5/20 & 18.5/20 & 1 \\
6 & 1 & 17/20.5 & 11.5/20.5 & 19.5/20.5 & 10/20.5 & 3.5/20.5
\end{array}$$

$$\begin{array}{c|cccccc}
 & 1 & 2 & 3 & 4 & 5 & 6 \\
\hline
1 & 0.31 & 0.86 & 0.25 & 0.25 & 0.25 & 1 \\
2 & 0.7 & 0.32 & 1 & 0.85 & 0.61 & 0.58 \\
3 & 0.56 & 0.47 & 0.49 & 0.66 & 0.50 & 1 \\
4 & 0.82 & 0.71 & 0.17 & 1 & 0.5 & 0.39 \\
5 & 0.75 & 0.65 & 0.2 & 0.92 & 0.92 & 1 \\
6 & 1 & 0.82 & 0.56 & 0.95 & 0.48 & 0.17
\end{array}$$

Step 2: Find the maximum element of each column in assignment matrix b_6, and write it below 6 columns. Then divide each element of 6 columns of the matrix by b_1 to b_6. These operations create at least one ones in each columns.

$$\begin{array}{c|cccccc}
 & 1 & 2 & 3 & 4 & 5 & 6 \\
\hline
1 & 0.31 & 0.86 & 0.25 & 0.25 & 0.25 & 1 \\
2 & 0.7 & 0.32 & 1 & 0.85 & 0.61 & 0.58 \\
3 & 0.56 & 0.47 & 0.49 & 0.66 & 0.50 & 1 \\
4 & 0.82 & 0.71 & 0.17 & 1 & 0.5 & 0.39 \\
5 & 0.75 & 0.65 & 0.2 & 0.92 & 0.92 & 1 \\
6 & 1 & 0.82 & 0.56 & 0.95 & 0.48 & 0.17 \\
\hline
max & 1 & 0.86 & 1 & 1 & 0.92 & 1
\end{array}$$

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{pmatrix} 0.31 & 1 & 0.25 & 0.25 & 0.27 & 1 \\ 0.7 & 0.37 & 1 & 0.85 & 0.66 & 0.58 \\ 0.56 & 0.54 & 0.49 & 0.66 & 0.54 & 1 \\ 0.82 & 0.82 & 0.17 & 1 & 0.54 & 0.39 \\ 0.75 & 0.75 & 0.2 & 0.92 & 1 & 1 \\ 1 & 0.95 & 0.56 & 0.95 & 0.52 & 0.17 \end{pmatrix} \end{array}$$

Step 3: Make assignment in terms of ones

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{pmatrix} 0.31 & (1) & 0.25 & 0.25 & 0.27 & 1 \\ 0.7 & 0.37 & (1) & 0.85 & 0.66 & 0.58 \\ 0.56 & 0.54 & 0.49 & 0.66 & 0.54 & (1) \\ 0.82 & 0.82 & 0.17 & (1) & 0.54 & 0.39 \\ 0.75 & 0.75 & 0.2 & 0.92 & (1) & 1 \\ (1) & 0.95 & 0.56 & 0.95 & 0.52 & 0.17 \end{pmatrix} \end{array}$$

The solution is (1,2), (2,3), (3,6), (4,4), (5,5), (6,1)

$$\begin{aligned} \text{The fuzzy optimal maximum total cost} &= \tilde{A}_{12} + \tilde{A}_{23} + \tilde{A}_{36} + \tilde{A}_{44} + \tilde{A}_{55} + \tilde{A}_{61} \\ &= R(7,8,9,10,11,12)x_{12} + R(5,8,10,11,3,7)x_{23} + R(6,8,10,12,4,1)x_{36} \\ &\quad + R(11,12,14,1,2,4)x_{44} + R(4,5,11,10,12,14)x_{55} + R(6,14,4,11,7,9)x_{61} \\ &= R(39,55,58,55,39,47) \end{aligned}$$

3. Conclusion

In this paper, ones assignment method is used to solved fuzzy assignment problem to calculate maximum and minimum objective function using hexagonal fuzzy number. Moreover, we have used Robust's ranking technique method. Then finally we calculate the fuzzy optimal maximum cost and minimum total cost. In future we find, this type of assignment problem using another fuzzy number to solve it in Hungarian method. Hungarian method is similar method of ones assignment problem.

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