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ON SOLVING INTUITIONISTIC ASSIGNMENT PROBLEM USING MODIFIED ONES DIRECT METHOD

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Abstract

In this paper, we develop a new arrival for an intuitionistic fuzzy optimal cost for the assignment problem whose parameters are intuitionistic nonagonal fuzzy numbers. We introduced a new ranking technique and proposed a modified ones direct method for the solution of intuitionistic fuzzy assignment problem. Numerical examples are explained in a clear way.

I. Introduction

Prof. Zadeh introduced Fuzzy. Many authors discussed the minimum optimal solution for fuzzy assignment problem using so many techniques. In 2018, [4] A. Trupti et al. introduced a new method for fuzzy assignment problem which is similar to Hungarian method. Atanasov [1] introduced the concept of Intuitionistic fuzzy. In 2020, Suresh Mohan et al. [3] proposed an intuitionistic fuzzy numbers and find a new ranking approach. G. Menaka [2] 2017, described an octagonal intuitionistic fuzzy number and also find its ranking method.

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II. Preliminaries

Definition 2.1. An intuitionistic nonagonal fuzzy number $\widetilde{A}_{IN}$ denoted as $(a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9); (b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9)$ and the membership and non-membership function is defined as

$$\mu_{\widetilde{A}_N}(x) = \begin{cases} 0;\ x \le a_1 \\ \frac{1}{4}\frac{(x-a_1)}{(a_2-a_1)};\ a_1 \le x \le a_2 \\ \frac{1}{4}+\frac{1}{4}\frac{(x-a_2)}{(a_3-a_2)};\ a_2 \le x \le a_3 \\ \frac{1}{2}+\frac{1}{4}\frac{(x-a_3)}{(a_4-a_3)};\ a_3 \le x \le a_4 \\ \frac{3}{4}+\frac{1}{4}\frac{(x-a_4)}{(a_5-a_4)};\ a_4 \le x \le a_5 \\ 1;\ x = a_5 \\ 1-\frac{1}{4}\frac{(x-a_5)}{(a_6-a_5)};\ a_5 \le x \le a_6 \\ \frac{3}{4}-\frac{1}{4}\frac{(x-a_6)}{(a_7-a_6)},\ a_6 \le x \le a_7 \\ \frac{1}{2}-\frac{1}{4}\frac{(x-a_7)}{(a_8-a_7)};\ a_7 \le x \le a_8 \\ \frac{1}{4}\frac{(a_9-x)}{(a_9-a_8)};\ a_8 \le x \le a_9 \\ 0;\ x \ge a_9 \end{cases}$$

$$\vartheta_{\tilde{A}_{IN}}(x) = \begin{cases} 1;\ x < b_1 \\ \frac{1}{4} - \frac{(x - b_1)}{(b_2 - b_1)};\ b_1 \le x \le b_2 \\ \frac{3}{4} + \frac{1}{4}\frac{(x - b_2)}{(b_3 - b_2)};\ b_2 \le x \le b_3 \\ \frac{1}{2} - \frac{1}{4}\frac{(x - b_3)}{(b_4 - b_3)};\ b_3 \le x \le b_4 \\ \frac{1}{4}\frac{(x - b_4)}{(b_5 - b_4)};\ b_4 \le x \le b_5 \\ 0;\ x = b_5 \\ \frac{1}{4}\frac{(x - b_5)}{(b_6 - b_5)};\ b_5 \le x \le b_6 \\ \frac{1}{4} + \frac{1}{4}\frac{(x - b_6)}{(b_7 - b_6)},\ b_6 \le x \le b_7 \\ \frac{1}{2} - \frac{1}{4}\frac{(x - b_7)}{(b_8 - b_7)};\ b_7 \le x \le b_8 \\ \frac{3}{4} + \frac{1}{4}\frac{(b_9 - x)}{(b_9 - b_8)};\ b_8 \le x \le b_9 \\ 1;\ x \ge b_9 \end{cases}$$

III. New Ranking Technique for Intuitionistic Nonagonal Fuzzy Number

For Membership Function: $R^{IN}(a) = \frac{1}{2}[0.125a_1 + 0.5a_2 + 0a_3 + 0.25a_4 + 0.25a_5 + 0.25a_6 + 0.25a_7 + 0.25a_8 + 0.125a_9]$. For Non-Membership Function: $R^{IN}(a') = \frac{1}{2}[-0.625b_1 + 0.75b_2 + 0.75b_3 + 0.75b_4 + 0.25b_6 + 1b_7 + 0.75b_8 - 0.25b_9]$. The ranking function of intuitionistic nonagonal fuzzy number $\tilde{A}_{IN}(a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9)$; $(b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9)$ maps the set of all fuzzy numbers to a set of real numbers defined as $R(\tilde{A}_{IN}) = Max[R^{IN}(a), R^{IN}(a')]$.

IV. Algorithm for Modified ones Direct Method

Step 1. Construct a balanced assignment problem if not convert it into a balanced problem.

Step 2. Now create a new matrix by dividing each row from minimum

element of that row.

Step 3. Locate the ones position of $(i, j)^{th}$ entry for the column of the matrix. Make allocation where ones has unique position and delete the corresponding row and column. Continue the process till all the persons are assigned.

Step 4. If some rows have same column, then find the value of next successor of ones and make the allocation to the row where there is maximum value of successor. If tie is found for the maximum, then find the value of next to the next successor of ones and make the allocation to maximum value.

Step 5. In reduced matrix after allocation, each row must have at least one ones, if not then divide the minimum element of each row from every element of that row.

Step 6. Repeat all the steps from step 3 to step 5 until get the optimal solution.

V. Numerical Example

Consider an intuitionistic fuzzy assignment problem with rows represents 4 jobs, and columns represent 4 machines, respectively. Find the optimal cost. The parameters of the intuitionistic cost matrix are as follows:

a_{11} = (1, 3, 5, 7, 9, 11, 13, 15, 17); (0, 2, 4, 5, 9, 10, 12, 14, 17)

a_{12} = (2, 4, 6, 8, 10, 12, 14, 16, 18); (1, 3, 5, 7, 10, 11, 13, 15, 18)

a_{13} = (12, 14, 16, 18, 20, 22, 24, 26, 28); (10, 12, 14, 16, 20, 21, 23, 25, 28)

a_{14} = (8, 10, 12, 14, 16, 18, 20, 22, 24); (6, 9, 10, 13, 16, 17, 19, 21, 24);

a_{21} = (11, 13, 15, 17, 19, 21, 23, 25, 27); (10, 12, 14, 16, 19, 20, 22, 24, 27);

a_{22} = (10, 12, 14, 16, 18, 20, 22, 24, 26); (9, 11, 13, 15, 18, 19, 21, 23, 26);

a_{23} = (21, 23, 25, 27, 29, 31, 33, 34, 35); (19, 22, 24, 26, 29, 30, 31, 32, 35);

a_{24} = (1, 4, 7, 9, 11, 13, 15, 17, 19); (0, 2, 3, 5, 11, 12, 14, 16, 19);

a_{31} = (7, 9, 11, 13, 15, 17, 20, 23, 25); (5, 7, 9, 11, 15, 16, 18, 20, 25);

a_{32} = (18, 20, 22, 24, 26, 29, 31, 33, 35); (16, 18, 20, 22, 26, 28, 30, 32, 35)

a_{33} = (17, 19, 21, 23, 25, 27, 31, 33, 35); (15, 17, 19, 21, 25, 26, 28, 30, 35);

a_{34} = (3, 5, 7, 9, 11, 13, 15, 17, 19); (1, 3, 5, 7, 11, 12, 13, 15, 19);

a_{41} = (2, 5, 8, 11, 14, 16, 18, 20, 22); (1, 2, 5, 9, 14, 15, 17, 18, 22);

a_{42} = (1, 5, 7, 11, 13, 15, 17, 19, 21); (0, 3, 5, 7, 13, 14, 16, 18, 21);

a_{43} = (4, 6, 8, 10, 12, 14, 16, 18, 20); (2, 4, 6, 8, 12, 13, 14, 16, 20);

a_{44} = (7, 9, 11, 13, 15, 17, 19, 21, 23); (4, 7, 9, 11, 15, 16, 18, 20, 23).

Solution. Here, the given problem is balanced assignment problem. First calculate the ranking for intuitionistic nonagonal fuzzy number as given in section 3.

Jobs	Machines			
	I	II	III	IV
I	9.9375	10.5625	20.5	16.5
II	19.5625	18.5625	28.5	14.875
III	14.875	27.3125	25.375	10.75
IV	12.8125	13.6875	11.75	15.8125

Step 1. Row Reduction and assign the position of ones.

Jobs	Machines			
	I	II	III	IV
I	1	1.0629	2.0629	1.6604
II	1.3151	1.2479	1.916	1
III	1.3837	2.5407	2.3605	1
IV	1.0904	1.1649	1	1.3457

Rows	Columns	Successor of ones
I	I	1.0629
II	IV	1.2479
III	IV	1.3837
IV	III	1.0904

Step 2. Reduced and again assign the position of ones.

Rows	Columns	Successor of ones
I	I	1.0629
II	II	1.0539
IV	III	1.0904

Step 3. Now assign the position of ones.

Rows	Columns	Successor of ones
I	I	1.0629
II	II	1.0539

Step 4. The Assignment Schedule is as follows: $I \rightarrow II \rightarrow II$, $III \rightarrow IV$, $IV \rightarrow III$. The Optimal cost $= 9.9375 + 18.5625 + 10.75 + 11.75 = 51$.

VI. Conclusion

In this paper, a new algorithm has been developed for solving intuitionistic assignment problem with costs as intuitionistic nonagonal fuzzy number by using a new ranking technique.

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