A Method For Solving Balanced And Unbalanced Trapezoidal Intuitionistic Fuzzy Assignment Quandary

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Abstract. In this paper, we discuss Trapezoidal intuitionistic fuzzy assignment quandary (TrIFAP). In classical assignment quandary, Cost always remains same. But, here we develop an method to solve Trapezoidal intuitionistic fuzzy assignment quandary where cost is not deterministic numbers but infelicitous ones. Here, the costs(profits) matrix have all the elements they are TrIFN and others have been immensely colossal demonstration against the classical method. Then its trapezoidal membership and non-membership functions are defined. In general compare the findings from different methods attested the same picture. Numerical examples show that an intuitionistic fuzzy ranking method is very efficacious and utilizable method for handling a TrIFAP.

Keywords: Trapezoidal Intuitionistic fuzzy, fuzzy assignment problem.

1. Introduction
The assignment quandary is one of the rudimental combinatorial analytics in the branch of operation research in mathematics. It consists of finding a maximum weight equal in numbers (or minimum weight perfect equal in numbers) The quandary cases has a number of person and a number of works. Any person can be assigned to perform any work, incurring some cost that may vary depending on the person-work assignment.

It is required to perform all works by assigning precisely one work to one person in such a way that the total cost of the assignment is minimized. If the numbers of person and works are identically tantamount and the total cost of the assignment for all works is identically tantamount to the sum of the costs for each person (or the sum of the costs for each work, which is identically tantamount thing in this case), then the quandary is called the linear assignment quandary.

Conventionally, when verbalizing about of the assignment quandary without any adscititious qualification, then the linear assignment quandary is betokened. However, in authentic life situations, the inhibition of assignment quandary are inopportune numbers in lieu of fine-tuned authentic numbers because time/cost for doing a work by a facility (machine/person) modal vary due to different reasons.

[1] In 1965 Zadeh introduced fuzzy set it has been achieved prosperous applications in sundry fields. [6] In 1970, Belmann and Zadeh introduce the concepts of fuzzy set theory into the decision making quandaries involving dubiousness and imprecision. Amir Kumar et al investigated Assignment and Travelling Salesman Quandaries with cost coefficients as LR fuzzy parameters [7] and Fuzzy
linear programming approach for solving fuzzy conveyance quandaries with transhipment [8] R.ZahirHussain, P.Senthil Kumar Method for solving plenarily fuzzy assignment quandaries utilizing trapezoidal fuzzy numbers[9],[10] In Sathi Mukherjee et al presented an Application of fuzzy ranking method for solving assignment quandaries with fuzzy costs. Lin and Wen [11] proposed an efficient algorithm predicated an labeling method for solving the linear fractional programming case.

Y.L.P.Thorani and N.RaviSankar did Fuzzy assignment quandary with generalized fuzzy numbers [4]. Different kinds of fuzzy assignment quandaries are worked out in the many papers. The concept of Intuitionistic Fuzzy Sets (IFSs) proposed by Atanassow[2] in 1986 is found to be highly utilizable to deal with vagueness. Jahir Hussain et al presented An Optimal More-for-Less Solution of Commixed Constraints Intuitionistic Fuzzy Conveyance Quandaries. [12], This paper is framed as follows: Section 2 contain with some rudimentary definitions and ranking of trapezoidal intuitionistic fuzzy numbers, In section 3, yield not only the definition of intuitionistic fuzzy assignment quandary but withal Fundamental Theorems of an Intuitionistic Fuzzy Assignment Quandary. Section 4 describes the solution procedure of an intuitionistic fuzzy assignment quandary, In section 5, to illustrate the proposed method a numerical example with results is discussed and followed by the conclusions which are given in Section 6.

2 Preliminaries. Definition 2.1 [1, 2] FUZZY SET: Let $X$ be a universal set. The fuzzy set $\tilde{A}$ contain in $X$ is defined by the set of tuples as $\tilde{A} = \{(x, \mu_A(x)); \mu_A(x) : X \to [0,1]\}$. The membership function $\mu_A(x)$ of a fuzzy set $\tilde{A}$ is a function with mapping $\mu_A(x):X \to [0,1]$. So every element x in X has membership function $\mu_A(x)$ in [0, 1] which is real number.

Definition 2.2[1, 2] INTUITIONISTIC FUZZY SET: Let $X$ be a universe of discourse, then an intuitionistic fuzzy set $A$ in $X$ is given by a set of ordered triples.

$A_{IFS} = \{< x, \mu_A(x), \vartheta_A(x) >; x \in X\}$

Where $\mu_A, \vartheta_A: X \to [0,1]$, are functions such that $\leq \mu_A(x) + \vartheta_A(x) \leq 1, \forall x \in X$. For each x the membership $\mu_A(x)$ and $\vartheta_A(x)$ represent the degree of membership and the degree of non-membership of the element $x \in X$ to $A \subset X$ respectively.

Definition 2.3 [1, 2] An intuitionistic fuzzy number $\tilde{A}^{TrIFN} = (a_2,a_3,a_1,\beta_1)(a_2,a_3,a_1,\beta_1)$ is said to be trapezoidal intuitionistic fuzzy number (TrIFN) if its membership and non-membership functions are respectively given by,

$$
\mu_A(x) = \begin{cases}
\frac{x-a_1}{a_2-a} & a_1 \leq x \leq a_2 \\
1 & a_2 \leq x \leq a_3 \\
\frac{\beta_1-x}{a_4-a_3} & a_3 \leq x \leq \beta_1 \\
0 & \text{otherwise}
\end{cases}
$$

$$
\vartheta_A(x) = \begin{cases}
\frac{a_2-x}{a_2-a_1} & a_1 \leq x \leq a_2 \\
0 & a_2 \leq x \leq a_3 \\
\frac{a_3-x}{a_3-a_1} & a_3 \leq x \leq \beta_1 \\
1 & \text{otherwise}
\end{cases}
$$

Definition 2.4 Let $\tilde{A}^{TrIFN}$ and $\tilde{B}^{TrIFN}$ be two TrIFNs. The ranking of $\tilde{A}^{TrIFN}$ and $\tilde{B}^{TrIFN}$ by the $R(\cdot)$ on U, the set of TrIFNs is defined as follows:

i. $R(\tilde{A}^{TrIFN}) > R(\tilde{B}^{TrIFN})$ iff $\tilde{A}^{TrIFN} > \tilde{B}^{TrIFN}$

ii. $R(\tilde{A}^{TrIFN}) < R(\tilde{B}^{TrIFN})$ iff $\tilde{A}^{TrIFN} < \tilde{B}^{TrIFN}$
iii. \( R(\tilde{A}^{TrIFN}) = R(\tilde{B}^{TrIFN}) \) iff \( \tilde{A}^{TrIFN} = \tilde{B}^{TrIFN} \)

iv. \( R(\tilde{A}^{TrIFN} + \tilde{B}^{TrIFN}) = R(\tilde{A}^{TrIFN}) + R(\tilde{B}^{TrIFN}) \)

v. \( R(\tilde{A}^{TrIFN} - \tilde{B}^{TrIFN}) = R(\tilde{A}^{TrIFN}) - R(\tilde{B}^{TrIFN}) \)

**Arithmetic Operations**

Let \( \tilde{A}^{TrIFN} = (a_2, a_3, a_1, \beta_1)(a_2, a_3, a_1, \beta_1) \) and \( \tilde{B}^{TrIFN} = (b_2, b_3, \gamma_1, \delta_1)(b_2, b_3, \gamma_1, \delta_1) \) be any two TrIFNs then the following arithmetic operations as follows:

**Addition**

\( \tilde{A}^{TrIFN} + \tilde{B}^{TrIFN} = (a_1 + \gamma_1, a_2 + b_2, a_3 + b_3, \beta_1 + \delta_1)(a_1 + \gamma_1, a_2, a_3 + b_3, \beta_1 + b_1 + b_1) \)

**Subtraction**

\( \tilde{A}^{TrIFN} - \tilde{B}^{TrIFN} = (a_1 - \delta_1, a_2 - b_2, a_3 - b_3, \beta_1 - \gamma_1)(a_1 - \delta_1, a_2 - b_2, a_3 - b_3, \beta_1 - \gamma_1) \)

**Ranking of Trapezoidal Intuitionistic Fuzzy Numbers**

The Ranking of a Trapezoidal intuitionistic fuzzy number \( \tilde{A}^{TrIFN} \)

\[ R(\tilde{A}^{NTrIFN}) = \frac{1}{4} \left[ (\beta_1 - a_1)(a_2 + a_3 - 3a_1 - 3\beta_1) + (\beta_2 - a_1)(a_1 + a_2 + a_3 + 3\beta_1) + 4(\beta_1^2 - a_1^2) \right] \]

The ranking technique is, If \( R(\tilde{A}^{NTrIFN}) \leq R(\tilde{B}^{TrIFN}) \) iff \( \tilde{A}^{TrIFN} \leq \tilde{B}^{TrIFN} \)

**Example:** Let \( \tilde{A}^{TrIFN} = (9, 10, 10, 11)(9, 10, 7, 12) \) and \( \tilde{B}^{TrIFN} = (18, 19, 17, 20)(18, 19, 16, 21) \) be any two TrIFN, then its rank is defined by \( R(\tilde{A}^{TrIFN}) = 9.485 \) and \( R(\tilde{B}^{TrIFN}) = 8.489 \) this implies \( \tilde{A}^{TrIFN} < \tilde{B}^{TrIFN} \).

3 Trapezoidal Intuitionistic Fuzzy Assignment Quandary. Consider the solution of assigning \( n \) person to \( n \) works and each person is capable of doing any works at different costs. Let \( c_{ij}^{TrIFN} \) TrIFN be an intuitionistic fuzzy cost of assigning intuitionistic fuzzy cost of assigning the \( j^{th} \) work to the \( i^{th} \) person. Let \( x_{rc} \) be the decision variable denoting the assignment of the person \( i \) to the work \( j \). The objective is to minimize the total cost. This situation is Kenned as balanced intuitionistic fuzzy assignment quandary.

Minimize \( \hat{Z}^{TrIFN} = \sum_{i=1}^{n} \sum_{j=1}^{n} c_{rc}^{TrIFN} x_{rc} \)

Subject to

\[ \sum_{c=1}^{r=1} x_{rc} = 1, \quad i = 1, 2, ..., n \]
\[ \sum_{r=1}^{n} x_{rc} = 1, \quad i = 1, 2, ..., n \]

\[ c_{rc}^{TrIFN} = \begin{pmatrix} c_{rc}^{a_2}, c_{rc}^{a_3}, c_{rc}^{a_1}, c_{rc}^{\beta_1} \\ c_{rc}^{a_2}, c_{rc}^{a_3}, c_{rc}^{a_1}, c_{rc}^{\beta_1} \\ c_{rc}^{a_2}, c_{rc}^{a_3}, c_{rc}^{a_1}, c_{rc}^{\beta_1} \\ c_{rc}^{a_2}, c_{rc}^{a_3}, c_{rc}^{a_1}, c_{rc}^{\beta_1} \end{pmatrix} x_{ij} \in [0,1] \]

Where,

\[ x_{rc} = \begin{cases} 1, & \text{if } r^{th} \text{ person is assigned to } c^{th} \text{ work} \\ 0, & \text{if } r^{th} \text{ person is not assigned to } c^{th} \text{ work} \end{cases} \]

3.1 Fundamental Theorems Of An Intuitionistic Fuzzy Assignment Quandary. The Solution of an intuitionistic fuzzy assignment quandary is primary source predicated on the following theorems.

**Theorem**

In an intuitionistic fuzzy assignment quandary, if we sum or difference an intuitionistic fuzzy number to every element of any row (or column) of the intuitionistic fuzzy cost matrix \( [c_{rc}^{TrIFN}] \), then an assignment that minimizes the total intuitionistic fuzzy cost on one matrix willah minimizes the total intuitionistic fuzzy cost on the other matrix. In other words if \( x_{rc} = x_{rc}^* \).
minimizes, 

$$
\bar{Z}_{TrIFN} = \sum_{r=1}^{n} \sum_{c=1}^{n} \tilde{c}_{rc} x_{rc} \quad \text{with} \quad \sum_{c=1}^{n} x_{rc} = 1, \quad \sum_{r=1}^{n} x_{rc} = 1, \quad x_{rc} = 0 \text{ or } 1 \quad \text{then} \quad x_{rc}^* \text{ also minimizes } \bar{Z}_{TrIFN}^* = \sum_{r=1}^{n} \sum_{c=1}^{n} \tilde{c}_{rc}^* x_{rc} \quad \text{where} \quad \tilde{c}_{rc}^* = \tilde{c}_{rc} - \tilde{u}_{r TrIFN} - \tilde{v}_{c TrIFN}
$$

for all \( r, c = 1, 2, ..., n \) and \( \tilde{u}_{r TrIFN}, \tilde{v}_{c TrIFN} \) are some real trapezoidal intuitionistic fuzzy numbers.

\textbf{Proof:} 

$$
\bar{Z}_{TrIFN}^* = \sum_{r=1}^{n} \sum_{c=1}^{n} \tilde{c}_{rc}^* x_{rc} = \sum_{r=1}^{n} \sum_{c=1}^{n} (\tilde{c}_{rc} - \tilde{u}_{r TrIFN} - \tilde{v}_{c TrIFN}) x_{rc}
$$

$$
= \sum_{r=1}^{n} \sum_{c=1}^{n} \tilde{c}_{rc} x_{rc} - \sum_{r=1}^{n} \tilde{u}_{r TrIFN} x_{rc} - \sum_{c=1}^{n} \tilde{v}_{c TrIFN} x_{rc} = \sum_{r=1}^{n} \sum_{c=1}^{n} \tilde{c}_{rc} x_{rc}
$$

This display that the minimization of the new objective function \( \bar{Z}_{TrIFN}^* \) submit the same solution as the minimization of a primary form objective function \( \bar{Z}_{TrIFN} \) because \( \sum_{r=1}^{n} \tilde{u}_{r TrIFN} \) and \( \sum_{c=1}^{n} \tilde{v}_{c TrIFN} \) are independent of \( x_{rc} \).

\textbf{Theorem 2} 

In an intuitionistic fuzzy assignment problem with cost \( [\tilde{c}_{rc} TrIFN] \), if all \( [\tilde{c}_{rc}] \geq \tilde{0}_{TrIFN} \) then a suitable solution \( x_{rc} \) which satisfies \( \sum_{r=1}^{n} \sum_{c=1}^{n} \tilde{c}_{rc} x_{rc} = \tilde{0}_{TrIFN} \), \( x_{rc} \) is best for the problem.

\textbf{Proof:} 

Since all \( [\tilde{c}_{rc}] \geq \tilde{0}_{TrIFN} \) and \( [x_{rc}] \geq 0 \),

The objective function \( \bar{Z}_{TrIFN} = \sum_{r=1}^{n} \sum_{c=1}^{n} \tilde{c}_{rc} x_{rc} \) cannot be negative.

The minimum possible value that TrIFN can attain \( \tilde{0}_{TrIFN} \).

Thus, any suitable solution \( [x_{rc}] \) that satisfies \( \sum_{r=1}^{n} \sum_{c=1}^{n} \tilde{c}_{rc} x_{rc} = \tilde{0}_{TrIFN} \), \( x_{rc} \) will be an best.

4 The Computational Procedure For trapezoidal Intuitionistic Fuzzy Assignment Problem. 

To find optimal solution to TrIFN Assignment problem there two stages

\textbf{STAGE 1:}

\textbf{Step 1:} Obtain new matrix by doing the following

\textbf{ROW REDUCTION:} 

From each row, find the row minimum TrIFN, subtract it from all entries on that row

\textbf{Step 2:} 

\textbf{COLUMN REDUCTION:} 

Next from each column, find the column minimum TrIFN; subtract it from all entries on that Column.

\textbf{STAGE 2:}

\textbf{Step 3:} 

Draw minimum number of lines covered all zeros of the TrIFN matrix. The procedure to do it is follows

(a) \textbf{ROWSCANNING} 

Starting from first Row, check for precisely on Zero in the row, if so square it and draw a vertical line passing through that zero otherwise skip the row. After consummating all row, check all zero’s are strike, if so go to step-4, otherwise do column scanning

(b) \textbf{COLUMN SCANNING} 

Starting from first column check for precisely one zero’s in the column(only not strike zero)
If so square it and draw a horizontal line passing through it otherwise skip the column. After scanning all column, check whether all zero’s are strike, If yes go to step-4, otherwise again do row scanning.

**Step 4:**
Check whether the number of square marked is equipollent to the number of rows of the matrix. If yes optimality is reached treat the marked zero’s as assignment, Otherwise go to Step 5.

**Step 5:**
Identify the minimum value of the undeleted cell values. Obtain the next matrix by doing the following:
1. Copy the ingressions on the line except the intersection points of the present matrix, as such to the incipient matrix.
2. Add the minimum undeleted cell value to the intersection point and facsimile to incipient matrix.
3. Subtract the minimum undeleted cell value from all undeleted cell and copy then to the incipient matrix.

**Step 6:**
Go to Step 3.

### 5 Numerical Examples

**Example 5.1** Let us consider an intuitionistic fuzzy assignment quandary with rows representing 3 persons namely A, B, C and columns representing 3 jobs namely 1,2,3. The cost matrix \( [e^{trifn}] \) is given whose elements are TrplFN. The problem is to find the Correct assignment so that the total cost of
job assignment becomes minimum.

|   | 1                  | 2                  | 3                  |
|---|--------------------|--------------------|--------------------|
| A | (10, 11, 9, 12)    | (8, 9, 7, 10)      | (12, 13, 11, 14)   |
| B | (18, 19, 17, 20)   | (6, 7, 5, 8)       | (14, 15, 13, 16)   |
| C | (6, 7, 5, 8)       | (4, 5, 3, 6)       | (2, 3, 1, 4)       |

Solution:
The above intuitionistic fuzzy assignment quandary can be formulated in the following mathematical programming form

Min \( [(10, 11, 9, 12)(10, 11, 8, 13)x_{A1} + (8, 9, 7, 10)(8, 9, 6, 11)x_{A2} + (12, 13, 11, 14)(12, 13, 10, 15)x_{A3} + (18, 19, 17, 20)(18, 19, 16, 21)x_{B1} + (6, 7, 5, 8)(6, 7, 4, 9)x_{B2} + (14, 15, 13, 16)(13, 14, 12, 17)x_{B3} + (6, 7, 5, 8)(6, 7, 4, 9)x_{C1} + (4, 5, 3, 6)(4, 5, 2, 7)x_{C2} + (2, 3, 1, 4)(2, 3, 0, 5)x_{C3}] \)

Subject to \( x_{A1} + x_{A2} + x_{A3} = 1, x_{B1} + x_{B2} + x_{B3} = 1, x_{C1} + x_{C2} + x_{C3} = 1 \)
\( x_{A1} + x_{B1} + C_{31} = 1, x_{A2} + x_{B2} + x_{C2} = 1, x_{A3} + x_{B3} + x_{C3} = 1 \)
\( x_{A1}, x_{B1}, x_{C1}, x_{A2}, x_{B2}, x_{C2}, x_{A3}, x_{B3}, x_{C3} \in [0, 1] \)

Now, using the Step 1 of the intuitionistic fuzzy Hungarian assignment method, we have the following reduced intuitionistic fuzzy assignment table.

|   | 1                  | 2                  | 3                  |
|---|--------------------|--------------------|--------------------|
| A | (2, 2, -1, 5, 2, 2, -3, 7) | (0, 0, -3, 3, 0, -5, 0, 5) | (4, 4, 1, 7, 4, 4, -1, 7) |
| B | (10, 12, 9, 15, 12, 12, 7, 17) | (0, 0, -3, 3, 0, -5, 0, 5) | (8, 8, 5, 11, 8, 8, 3, 13) |
| C | (4, 4, 1, 7, -1, 4, 4, 7) | (2, 2, -1, 5, -3, 2, 2, 7) | (0, 0, -3, 3, 0, -5, 0, 5) |

Now, using the Step 2 of the intuitionistic fuzzy Hungarian assignment method, we have the following reduced intuitionistic fuzzy assignment table.

|   | 1                  | 2                  | 3                  |
|---|--------------------|--------------------|--------------------|
| A | (0, 0, -6, 6, 0, 0, -10, 10) | (0, 0, -3, 3, 0, 0, -5, 5) | (4, 4, 1, 7, 4, 4, -1, 7) |
| B | (10, 10, 4, 16, 0, 10, 10, 20) | (0, 0, -3, 3, 0, 0, -5, 5) | (8, 8, 5, 11, 8, 8, 3, 13) |
| C | (2, 2, -4, 8, 2, 2, -8, 12) | (2, 2, -1, 5, 2, 2, -3, 7) | (0, 0, -3, 3, 0, 0, -5, 5) |

The optimal solution is,
\( x_{A1}^* = x_{B2}^* = x_{C3}^* = 1, \quad x_{A2}^* = x_{A3}^* = x_{B1}^* = x_{B3}^* = x_{C1}^* = x_{C2}^* = 0 \)

With the optimal objective value \( R(\tilde{Z}_{TrIFN}^*) = 18.125 \approx 18 \) which represents the optimal total cost. In other words the optimal assignment is \( A \to 1, B \to 2, C \to 3 \)

The intuitionistic fuzzy minimum total cost is calculated as,
\( e_{A1}^{TrIFN} + e_{B2}^{TrIFN} + e_{C3}^{TrIFN} = (9, 10, 11, 12)(8, 10, 11, 13) + (5, 6, 7, 8)(4, 6, 7, 9) + (1, 2, 3, 4)(0, 2, 3, 5) \)
\( = (15, 18, 21, 24)(12, 18, 21, 27) \)

Also we find that \( R(\tilde{Z}_{TrIFN}^*) = R[(15, 18, 21, 24)(12, 18, 21, 27)] = 19.512 \)

**Example 5.2** Let us consider an intuitionistic fuzzy assignment problem with rows representing 4 persons namely 1, 2, 3, 4 and columns representing 4 Works namely A, B, C, D. The cost matrix \([e_{rc}^{TrIFN}]\)
is given whose elements are TrplFN. The problem is to find the optimal assignment so that the total cost of job assignment becomes minimum

\[
\begin{align*}
A & : (18,19,17,20),(18,19,16,21) \\
B & : (8,9,7,10),(8,9,6,11) \\
C & : (10,11,9,12),(10,11,8,13) \\
D & : (0,0,-1,1),(0,0,-3,3)
\end{align*}
\]

Solution:

The above intuitionistic fuzzy assignment quandary can be formulated in the following linear programming problem form

\[
\begin{align*}
\text{Min} & \quad x_{A1} + (23,24,25,26) + (27,28,29,30) + (26,28,29,31) \\
& + (31,32,33,34) + (30,32,33,35) + (7,8,9,10) + (6,8,9,11) \\
& + (12,13,14,15) + (11,13,14,16) \\
& + (16,17,18,19) + (15,17,18,20) + (17,19,20,22) + (9,10,11,12) + (8,10,11,13) \\
& + (14,15,16,17) + (13,15,16,18) + (18,19,20,21) + (17,19,20,22) + (17,19,20,22) + (17,19,20,22)
\end{align*}
\]

Subject to \( x_{A1} + x_{A2} + x_{A3} + x_{A4} = 1, x_{A1} + x_{B1} + x_{C1} + x_{D1} = 1 \)

\[
\begin{align*}
x_{B1} + x_{B2} + x_{B3} + x_{B4} & = 1, x_{A2} + x_{B2} + x_{C2} + x_{D2} = 1 \\
x_{C1} + x_{C2} + x_{C3} + x_{C4} & = 1, x_{A3} + x_{B3} + x_{C3} + x_{D3} = 1 \\
x_{D1} + x_{D2} + x_{D3} + x_{D4} & = 1, x_{A4} + x_{B4} + x_{C4} + x_{D4} = 1, x_{rc} \in [0,1]
\end{align*}
\]

Now, using the Step 1 of the intuitionistic fuzzy Hungarian assignment method, we have the following bring down intuitionistic fuzzy assignment table.

\[
\begin{array}{cccc}
1 & 2 & 3 & 4 \\
A & (0,0,-3,3) & (0,0,-5,5) & (6,6,3,9) & (6,6,1,11) & (10,10,7,13) & (10,10,5,15) & (14,14,11,17) & (14,14,9,19) \\
B & (0,0,-3,3) & (0,0,-5,5) & (5,5,2,8) & (5,5,0,10) & (9,9,6,12) & (9,9,4,14) & (11,11,8,14) & (11,11,6,16) \\
C & (0,0,-3,3) & (0,0,-5,5) & (5,5,2,8) & (5,5,0,10) & (9,9,6,12) & (9,9,4,14) & (12,12,9,15) & (12,12,7,17) \\
D & (0,0,-1,1) & (0,0,-3,3) & (0,0,-1,1) & (0,0,-3,3) & (0,0,-1,1) & (0,0,-3,3) & (0,0,-1,1) & (0,0,-3,3)
\end{array}
\]

Now, using the Step 3 to the Step 6 of the intuitionistic fuzzy Hungarian assignment method, we have the following bring down intuitionistic fuzzy assignment table.

\[
\begin{array}{cccc}
1 & 2 & 3 & 4 \\
A & (0,0,-3,3) & (0,0,-5,5) & (1,1,-5,7) & (1,1,-9,11) & (5,5,-1,11) & (5,5,-5,15) & (9,9,7,15) & (9,9,-9,19) \\
B & (0,0,-3,3) & (0,0,-5,5) & (0,0,-6,6) & (0,0,-10,10) & (4,4,-2,10) & (4,4,-6,14) & (6,6,0,12) & (6,6,-4,16) \\
C & (0,0,-3,3) & (0,0,-5,5) & (0,0,-6,6) & (0,0,-10,10) & (4,4,-2,10) & (4,4,-6,14) & (7,7,1,13) & (7,7,-3,17) \\
D & (5,5,2,8) & (5,5,0,10) & (0,0,-1,1) & (0,0,-3,3) & (0,0,-1,1) & (0,0,-3,3) & (0,0,-1,1) & (0,0,-3,3)
\end{array}
\]

The solutions is not optimal. Now, again using the Step 3 to the Step 6 of the intuitionistic fuzzy Hungarian assignment method, we have the following bring down intuitionistic fuzzy assignment table.

\[
\begin{array}{cccc}
1 & 2 & 3 & 4 \\
A & (0,0,-3,3) & (0,0,-5,5) & (1,1,-5,7) & (1,1,-9,11) & (5,5,-1,11) & (5,5,-5,15) & (9,9,7,15) & (9,9,-9,19) \\
B & (0,0,-3,3) & (0,0,-5,5) & (0,0,-6,6) & (0,0,-10,10) & (4,4,-2,10) & (4,4,-6,14) & (6,6,0,12) & (6,6,-4,16) \\
C & (0,0,-3,3) & (0,0,-5,5) & (0,0,-6,6) & (0,0,-10,10) & (4,4,-2,10) & (4,4,-6,14) & (7,7,1,13) & (7,7,-3,17) \\
D & (5,5,2,8) & (5,5,0,10) & (0,0,-1,1) & (0,0,-3,3) & (0,0,-1,1) & (0,0,-3,3) & (0,0,-1,1) & (0,0,-3,3)
\end{array}
\]
A \begin{array}{ccc}
(0,0,-3,3)(0,0,-5,5) & (1,1,-11,13)(0,0,-9,11) & (1,1,19,21)(5,5,17,15,25) \\
(-1,1,-5,7)(1,1,-9,11) & (1,1,19,21)(5,5,17,15,25) & (5,5,17,15,25) \\
\end{array}

B \begin{array}{ccc}
(0,0,-3,3)(0,0,-5,5) & (0,0,-12,12)(0,0,-20,20) & (2,2,10,14)(2,2,18,22) \\
(0,0,-6,6)(0,0,-10,10) & (0,0,-12,12)(0,0,-20,20) & (2,2,10,14)(2,2,18,22) \\
\end{array}

C \begin{array}{ccc}
(0,0,-3,3)(0,0,-5,5) & (0,0,-12,12)(0,0,-20,20) & (3,3,11,15)(3,3,17,23) \\
(0,0,-6,6)(0,0,-10,10) & (0,0,-12,12)(0,0,-20,20) & (3,3,11,15)(3,3,17,23) \\
\end{array}

D \begin{array}{ccc}
(9,9,0,18)(9,9,-6,24) & (4,4,-3,11)(4,4,-9,17) & (0,0,-1,1)(0,0,-3,3) \\
(0,0,-1,1)(0,0,-3,3) & (0,0,-1,1)(0,0,-3,3) & \end{array}

The optimal solution is,

\[x_{A1}^* = x_{B2}^* = x_{C3}^* = x_{D4}^* = 1,
\]
\[x_{A2}^* = x_{A3}^* = x_{A4}^* = x_{B1}^* = x_{B3}^* = x_{B4}^* = x_{C1}^* = x_{C2}^* = x_{C4}^* = x_{D1}^* = x_{D2}^* = x_{D3}^* = 0.
\]

With the optimal objective value \(R(Z^{TIFN}) = 50.123 \pm 50\) which represents the optimal total cost. In other words the optimal assignment is \(A \rightarrow 1, B \rightarrow 2, C \rightarrow 3, D \rightarrow 4\).

The intuitionistic fuzzy minimum total cost is calculated as,

\[\bar{c}_{A1}^{TIFN} + \bar{c}_{B2}^{TIFN} + \bar{c}_{C3}^{TIFN} + \bar{c}_{D4}^{TIFN} = (17,18,19,20)(16,18,19,21) + (12,13,14,15)(11,13,14,16) + (18,19,20,21)(17,19,20,22) + (-1,0,0,1)(-3,0,0,3)\]
\[= (42,46,49,53)(37,46,49,58)\]

Also we find that \(R(Z^{TIFN}) = R[(42,46,49,53)(37,46,49,58)] = 50.113 \pm 50\).

6. Conclusion

In this paper, we discussed to bring out a solution of an assignment quandary in which cost coefficients are trapezoidal intuitionistic fuzzy numbers. The total cost is optimal by our method stay with same as that obtained by transform the total intuitionistic fuzzy cost by assigning the ranking technique. This technique can additionally be applied in solving variants of quandaries like, engenderment orchestrating , conveyance quandary and network flow, Dihydrogen monoxide line quandaries.

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