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OBTAINING INITIAL BASIC FEASIBLE SOLUTION FOR TRANSPORTATION PROBLEM USING DIFFERENT METHODS IN OCTAGONAL INTUITIONISTIC FUZZY

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ABSTRACT

In this paper we introduce Octagonal Intuitionistic fuzzy numbers with its membership and non-membership functions. Octagonal Intuitionistic Fuzzy Numbers using Transportation problem by Proposed Ranking Method. A Comparative study of Vogel's Approximation Method, Row Minima Method, Column Minima Method, Russell's Approximation Method, North West Method, Least Cost Method, Heuristic Method- Iand Heuristic Method- II is analysed in this paper to find the best method that can minimized the Transportation method. The procedure is illustrated with a numerical example.

***Keywords**: Intuitionistic fuzzy transportation problems, Octagonal Intuitionistic fuzzy numbers, Ranking method, VAM method, Row Minima Method, Column Minima Method, Russell's Approximation Method, North West Method, LCM Method, Heuristic Method- I and Heuristic Method- II, Initial Basic Feasible Solution.*

1. INTRODUCTION

The central concept in the problem is to find the least total transportation cost of commodity. In general, transportation problems are solved with assumptions that the cost, supply and demand are specified in precise manner. However, in many cases the decision maker has no precise information about the coefficient belonging to the transportation problem. Intuitionistic fuzzy set is a powerful tool to deal with such vagueness.

The concept of Intuitionistic Fuzzy Sets (IFSs), proposed by Atanassov in [1] and [2], has been found to be highly useful to deal with vagueness. Many authors discussed the solutions of Fuzzy Transportation Problem (FTP) using various techniques. In 1982, O'heigeartaigh [9] proposed an algorithm to solve Fuzzy Transportation Problem with triangular membership function. In 2013, Nagoor Gani. A and Abbas. S [8], introduced a new method for solving in Fuzzy Transportation Problem. In 2016, Mrs. Kasthuri. B [7] introduced Pentagonal intuitionistic fuzzy. In 2015, A. Thamaraiselvi and R. Santhi [3] introduced Hexagonal Intuitionistic Fuzzy Numbers. In 2015, Thangaraj Beaula – M. Priyadharshini [4] proposed. A New Algorithm for Finding a Fuzzy Optimal Solution.K. Prasanna Devi, M. Devi Durga [5] and G. Gokila, Juno Saju [6] introduced Octagonal Fuzzy Number.

The paper is organized as follows, in section 2, introduction with some basic concepts of Intuitionistic fuzzy numbers, in section 3, introduce Octagonal Intuitionistic Fuzzy Definition and proposed algorithm followed by a Numerical example using different method and in section 4, finally the paper is concluded.

2. PRELIMINARIES

2.1. FUZZY SET [FS][3]:

Let X be a nonempty set. A fuzzy set $\overline{\mathrm{A}}$ of X is defined as $\overline{\mathrm{A}}=\{< x,\ \mu_{\overline{\mathrm{A}}}(\mathrm{x}) >/x \in X\}$. Where $\mu_{\overline{\mathrm{A}}}(\mathrm{x})$ is called membership function, which maps each element of X to a value between 0 and 1.

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2.2. FUZZY NUMBER [FN][3]:
A fuzzy number is a generalization of a regular real number and which does not refer to a single value but rather to a connected a set of possible values, where each possible value has its weight between 0 and 1. The weight is called the membership function.
A fuzzy number $\overline{A}$ is a convex normalized fuzzy set on the real line R such that

- There exist at least one x ∈R with $\mu_{\overline{A}}(x) = 1$.
- $\mu_{\overline{A}}(x)$ is piecewise continuous.

2.3. OCTAGONAL FUZZY NUMBER [OFN][4]:
A Fuzzy Number $\overline{A}_{0C}$ is a normal Octagonal Fuzzy Number denoted by
$\overline{A} = (a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8)$. where $a_1, a_2, a_3, a_4, a_5, a_6, a_7$ and a_8 are real numbers and its membership function $\mu_{\overline{A}}(x)$ is given below:

$$\mu_{\overline{A}}(x) = \begin{cases} 0 & \text{for} \quad x < a_1 \\ k\left(\dfrac{x - a_1}{a_2 - a_1}\right) & \text{for } a_1 \le x \le a_2 \\ k & \text{for } a_2 \le x \le a_3 \\ k + (1-k)\left(\dfrac{x - a_3}{a_4 - a_3}\right) & \text{for } a_3 \le x \le a_4 \\ 1 & \text{for } a_4 \le x \le a_5 \\ k + (1-k)\left(\dfrac{a_6 - x}{a_6 - a_5}\right) & \text{for } a_5 \le x \le a_6 \\ k & \text{for } a_6 \le x \le a_7 \\ k\left(\dfrac{a_8 - x}{a_8 - a_7}\right) & \text{for } a_7 \le x \le a_8 \\ 0 & \text{for} \quad x > a_8 \end{cases}$$

Where 0 < k < 1.

2.4. INTUITIONISTIC FUZZY SET [IFS][3]:
Let X be a non-empty set. An Intuitionistic fuzzy set $\overline{A}^I$ of X is defined as,
$\overline{A}^I = \{<x, \mu_{\overline{A}^I}(x), \vartheta_{\overline{A}^I}(x)> / x \in X\}$. Where $\mu_{\overline{A}^I}(x)$ and $\vartheta_{\overline{A}^I}(x)$ are membership and non-membership function. Such that $\mu_{\overline{A}^I}(x), \vartheta_{\overline{A}^I}(x)$: X→ [0, 1] and $0 \le \mu_{\overline{A}^I}(x) + \vartheta_{\overline{A}^I}(x) \le 1$ for all x∈ X.

2.5. INTUITIONISTIC FUZZY NUMBER [IFN][3]:
An Intuitionistic Fuzzy Subset $\overline{A}^I = \{< x, \mu_{\overline{A}^I}(x), \vartheta_{\overline{A}^I}(x) > / x \in X\}$ of the real line R is called an Intuitionistic Fuzzy Number, if the following conditions hold,

- There exists m ∈ R suct that $\mu_{\overline{A}^I}(m) = 1$ and $\vartheta_{\overline{A}^I}(m) = 0$.
- $\mu_{\overline{A}^I}$ is a continuous function from R → [0,1] such that
- $0 \le \mu_{\overline{A}^I}(x) + \vartheta_{\overline{A}^I}(x) \le 1$ for all x∈ X.

The membership and non- membership functions of $\overline{A}^I$ are in the following form

$$\mu_{\overline{A}^I}(x) = \begin{cases} 0 & \text{for} -\infty < x \le a_1 \\ f(x) & \text{for } a_1 \le x \le a_2 \\ 1 & \text{for } x = a_2 \\ g(x) & \text{for } a_2 \le x \le a_3 \\ 0 & \text{for } a_3 \le x < \infty \end{cases}$$

$$\vartheta_{\overline{A}^I}(x) = \begin{cases} 1 & \text{for } -\infty < x \le a_1' \\ f'(x) & \text{for } a_1' \le x \le a_2 \\ 0 & \text{for } x = a_2 \\ g'(x) & \text{for } a_2 \le x \le a_3' \\ 1 & \text{for } a_3' \le x < \infty \end{cases}$$

Where f, f', g, g' are functions from R → [0,1]. f and g' are strictly increasing functions and g and f' are strictly decreasing functions with the conditions $0 \le f(x) + f'(x) \le 1$ and $0 \le g(x) + g'(x) \le 1$.

3. OCTAGONAL INTUITIONISTIC FUZZY NUMBER

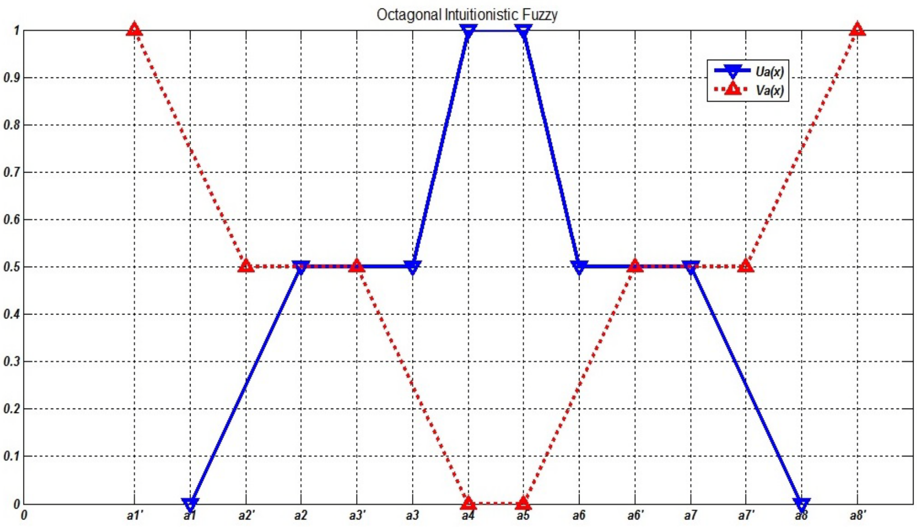
3.1. OCTAGONAL INTUITIONISTIC FUZZY NUMBER [OIFN]

An Octagonal Intuitionistic Fuzzy Number is specified by $\bar{A}_{oc}{}^{I} = (a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8)$, $(a_1', a_2', a_3', a_4, a_5, a_6', a_7', a_8')$. Where $a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_1', a_2', a_3', a_6', a_7'$ *and* a_8' and its membership and non-membership functions are given below

$$\mu_{\bar{A}}(x) = \begin{cases} 0 & for\, x < a_1 \\ k\left(\dfrac{x - a_1}{a_2 - a_1}\right) & for\, a_1 \le x \le a_2 \\ k & for\, a_2 \le x \le a_3 \\ k + (1-k)\left(\dfrac{x - a_3}{a_4 - a_3}\right) & for\, a_3 \le x \le a_4 \\ 1 & for\, a_4 \le x \le a_5 \\ k + (1-k)\left(\dfrac{a_6 - x}{a_6 - a_5}\right) & for\, a_5 \le x \le a_6 \\ k & for\, a_6 \le x \le a_7 \\ k\left(\dfrac{a_8 - x}{a_8 - a_7}\right) & for\, a_7 \le x \le a_8 \\ 0 & for\, x > a_8 \end{cases}$$

$$\vartheta_{\bar{A}^I}(x) = \begin{cases} 1 & for\, a_1' < x \\ k + (1-k)\left(\dfrac{a_2' - x}{a_2' - a_1'}\right) & for\, a_1' \le x \le a_2' \\ k & for\, a_2' \le x \le a_3' \\ k\left(\dfrac{a_4 - x}{a_4 - a_3'}\right) & for\, a_3' \le x \le a_4 \\ 0 & for\, a_4 \le x \le a_5 \\ k\left(\dfrac{x - a_5}{a_6' - a_5}\right) & for\, a_5 \le x \le a_6' \\ k & for\, a_6' \le x \le a_7' \\ k + (1-k)\left(\dfrac{x - a_7'}{a_8' - a_7'}\right) & for\, a_7' \le x \le a_8' \\ 1 & for\, x > a_8' \end{cases}$$

Graphical representation of Octagonal Intuitionistic Fuzzy Number for k = 0.5



___ Membership Function $\mu_{\bar{A}}(x)$.
----- NonMembership Function $\vartheta_{\bar{A}^I}(x)$.

3.2. ARITHMETIC OPERATIONS ON OCTAGONAL INTUITIONISTIC FUZZY NUMBERS

Let $\bar{A}_{oc}{}^{I} = (a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8)$ $(a_1', a_2', a_3', a_4, a_5, a_6', a_7', a_8')$ and $\bar{B}_{oc}{}^{I} = (b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8)$ $(b_1', b_2', b_3', b_4, b_5, b_6', b_7', b_8')$ be two Octagonal Intuitionistic Fuzzy Numbers, then the arithmetic operations are as follows.

3.2.1. ADDITION

$$\bar{A}_{oc}{}^{I} + \bar{B}_{oc}{}^{I} = (a_1 + b_1, a_2 + b_2, a_3 + b_3, a_4 + b_4, a_5 + b_5, a_6 + b_6, a_7 + b_7, a_8 + b_8)$$
$$(a_1' + b_1', a_2' + b_2', a_3' + b_3', a_4 + b_4, a_5 + b_5, a_6' + b_6', a_7' + b_7', a_8' + b_8')$$

3.2.2. SUBTRACTION

$$\bar{A}_{oc}{}^{I} - \bar{B}_{oc}{}^{I} = (a_1 - b_8, a_2 - b_7, a_3 - b_6, a_4 - b_5, a_5 - b_4, a_6 - b_3, a_7 - b_2, a_8 - b_1)$$
$$(a_1' - b_8', a_2' - b_7', a_3' - b_6', a_4 - b_5, a_5 - b_4, a_6' - b_3', a_7' - b_2', a_8' - b_1').$$

3.2.3. MULTIPLICATION

$$\bar{A}_{oc}{}^{I} * \bar{B}_{oc}{}^{I} = (a_1 * b_1, a_2 * b_2, a_3 * b_3, a_4 * b_4, a_5 * b_5, a_6 * b_6, a_7 * b_7, a_8 * b_8)$$
$$(a_1' * b_1', a_2' * b_2', a_3' * b_3', a_4 * b_4, a_5 * b_5, a_6' * b_6', a_7' * b_7', a_8' * b_8')$$

3.3. RANKING OF OCTAGONAL INTUITIONISTIC FUZZY NUMBERS:

The ranking function of Octagonal Intuitionistic Fuzzy Number (OIFN) $\bar{A}_{oc}{}^{I}=(a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8)$ $(a_1', a_2', a_3', a'_4, a'_5, a_6', a_7', a_8')$ maps the set of all Fuzzy numbers to a set of real numbers defined as

$$R[\bar{A}_{oc}{}^{I}] = \text{Max}\,[\,\text{Mag}_{\mu}(\bar{A}_{oc}{}^{I}), \text{Mag}_{\vartheta}(\bar{A}_{oc}{}^{I})] \text{ and similarly}$$
$$R[\bar{B}_{oc}{}^{I}] = \text{Max}\,[\,\text{Mag}_{\mu}(\bar{B}_{oc}{}^{I}), \text{Mag}_{\vartheta}(\bar{B}_{oc}{}^{I})], \text{Where}$$
$$\text{Mag}_{\mu}\left(\bar{A}_{oc}{}^{I}\right) = \frac{2a_1 + 3a_2 + 4a_3 + 5a_4 + 5a_5 + 4a_6 + 3a_7 + 2a_8}{28}$$
$$\text{Mag}_{\vartheta}\left(\bar{A}_{oc}{}^{I}\right) = \frac{2a_1' + 3a_2' + 4a_3' + 5a_4' + 5a_5' + 4a_6' + 3a_7' + 2a_8'}{28}$$

3.4. REMARK:

If $\bar{A}_{oc}{}^{I}$ and $\bar{B}_{oc}{}^{I}$ are any two OIFNs. Then

1. $\bar{A}_{oc}{}^{I} < \bar{B}_{oc}{}^{I}$ if $Mag_{\mu}\left(\bar{A}_{oc}{}^{I}\right) < Mag_{\mu}\left(\bar{B}_{oc}{}^{I}\right)$ and $Mag_{\vartheta}\left(\bar{A}_{oc}{}^{I}\right) < Mag_{\vartheta}\left(\bar{B}_{oc}{}^{I}\right)$
2. $\bar{A}_{oc}{}^{I} > \bar{B}_{oc}{}^{I}$ if $Mag_{\mu}\left(\bar{A}_{oc}{}^{I}\right) > Mag_{\mu}\left(\bar{B}_{oc}{}^{I}\right)$ and $Mag_{\vartheta}\left(\bar{A}_{oc}{}^{I}\right) > Mag_{\vartheta}\left(\bar{B}_{oc}{}^{I}\right)$
3. $\bar{A}_{oc}{}^{I} = \bar{B}_{oc}{}^{I}$ if $\text{Mag}_{\mu}\left(\bar{A}_{oc}{}^{I}\right) = \text{Mag}_{\mu}\left(\bar{B}_{oc}{}^{I}\right)$
4. $\text{Mag}_{\vartheta}\left(\bar{A}_{oc}{}^{I}\right) = \text{Mag}_{\vartheta}\left(\bar{B}_{oc}{}^{I}\right)$

3.5. ROW MINIMA METHOD ALGORITHM [12]

Step-1: In this method, we allocate as much as possible in the lowest cost cell of the first row, i.e. allocate min(si, dj).
Step-2: a. Subtract this min value from supply si and demand dj.
b. If the supply si is 0, then cross (strike) that row and if the demand dj is 0 then cross (strike) that column.
c. If min unit cost cell is not unique, then select the cell where maximum allocation can be possible
Step-3: Repeat this process for all uncrossed (unstriped) rows and columns until all supply and demand values are 0.

3.6. COLUMN MINIMA METHOD ALGORITHM [12]

Step-1: In this method, we allocate as much as possible in the lowest cost cell of the first Column, i.e. allocate min(si, dj).
Step-2: a. Subtract this min value from supply si and demand dj.
b. If the supply si is 0, then cross (strike) that row and If the demand dj is 0 then cross (strike) that column.
c. If min unit cost cell is not unique, then select the cell where maximum allocation can be possible
Step-3: Repeat this process for all uncrossed (unstriped) rows and columns until all supply and demand values are 0.

3.7. RUSSELL'S APPROXIMATION METHOD ALGORITHM [12]

Step-1: For each source row still under consideration, determine its ¯Ui (largest cost in row i).
Step-2: For each destination column still under consideration, determine its ¯Vj (largest cost in **column j).**
Step-3: For each variable, calculate Δij=cij-(¯Ui+¯Vj).
Step-4: Select the variable having the most negative Δ value, break ties arbitrarily.
Step-5: Allocate as much as possible. Eliminate necessary cells from consideration. Return to Step-1.

3.8. HEURISTIC METHOD-1 ALGORITHM [12]

Step-1: Calculate the difference between the two lowest cost cells (called Penalty) for each row and column. These are called as row and column penalties, P, respectively.
Step-2: Add the cost of cells for each row and column. These summations are called row and column cost, T, respectively.
Step-3: Compute the product of penalty 'P' and the total cost 'T', that is PT for each row and column.

Step-4: Identify the row/column having largest 'PT'.
Step-5: Choose the cell having minimum cost in row/column identified in Step-4.
Step-6: Make maximum feasible allocation to the cell chosen in Step-5, if the cost of this cell is also minimum in its column/row. Otherwise allocation is avoided and goto Step-7.
Step-7: Identify the row/column having next to largest 'PT'.
Step-8: Choose the cell having minimum cost in row/column identified in step 7.
Step-9: Make maximum feasible allocation to the cell chosen in Step-8.
Step-10: Cross out the satisfied row/column.
Step-11: Repeat the procedure until all the requirements are satisfied.

3.9. HEURISTIC METHOD-2 ALGORITHM [12]

Step-1: Determine the penalty cost i.e. the difference between the lowest and highest cost element of that row/column.
Step-2: Identify the row/column having highest penalty and choose the variable having lowest cost in this selected row/column. Allocate as much as possible to this variable.
Step-3: Cross out the row or column whichever is satisfied and adjust the variable and required quantities.
Step-4: Compute the penalties and repeat procedure till all rows and columns are satisfied.

3.10. NUMERICAL EXAMPLE

Consider a 3×3 Octagonal Intuitionistic Fuzzy Number.

Table-1: To Find Octagonal Intuitionistic Fuzzy

	$\mathbf{B_1}$	$\mathbf{B_2}$	$\mathbf{B_3}$	Supply
$\mathbf{A_1}$	(1,2,3,4,5,6,7,8) (0,1,2,3,4,5,6,7)	(3,4,5,6,7,8,9,10) (1,2,3,4,5,6,7,8)	(6,7,8,9,10,11,12,13) (3,4,5,6,7,8,9,10)	(3,4,5,6,7,8,9,10) (8,9,10,11,12,13,14,15)
$\mathbf{A_2}$	(4,5,6,7,8,9,10,11) (1,2,3,4,5,6,7,10)	(8,9,10,11,12,13,14,15) (3,4,5,6,7,8,9,10)	(3,6,7,8,9,10,12,13) (2,3,4,5,6,7,8,9)	(3,4,5,6,7,8,9,10) (6,7,8,9,10,11,12,13)
$\mathbf{A_3}$	(5,6,7,8,9,10,11,12) (0,1,2,3,4,5,6,7)	(7,8,9,10,11,12,13,14) (3,6,7,8,9,10,12,13)	(4,5,6,7,8,9,10,11) (1,2,3,5,6,7,8,10)	(1,2,3,5,6,7,8,13) (0,1,2,3,4,7,9,10)
Demand	(7,8,9,10,11,12,13,14) (3,6,7,8,9,10,12,13)	(2,4,6,7,8,9,10,11) (1,2,3,4,5,6,7,10)	(1,2,3,5,6,7,8,10) (5,6,7,8,9,10,11,12)	

ΣDemand = Σ Supply

The problem is a balanced transportation problem. Using the proposed algorithm, the solution of the problem is as follows. Applying accuracy function on Octagonal Intuitionistic Fuzzy Number [(1,2,3,4,5,6,7,8)(0,1,2,3,4,5,6,7)], we have

$R(\overline{A}_{oc}{}^{I}) = \text{Max}\,[\text{Mag}_{\mu}(\overline{A}_{oc}{}^{I}), \text{Mag}_{\vartheta}(\overline{A}_{oc}{}^{I})]$

$= \text{Max}\,[\frac{2+6+12+20+25+24+21+16}{28}, \frac{0+3+8+15+20+20+18+14}{28}]$

$= \text{Max}\,[4.5, 3.5]$

$R(\overline{A}_{oc}{}^{I}) = 4.5$

Similarly applying for all the values, we have the following table after ranking

Table-2: Reduced Table

	$\mathbf{B_1}$	$\mathbf{B_2}$	$\mathbf{B_3}$	Supply
$\mathbf{A_1}$	4.5	6.5	9.5	11.5
$\mathbf{A_2}$	7.5	11.5	8.5	9.5
$\mathbf{A_3}$	8.5	10.5	7.5	5.25
Demand	10.5	7.25	8.5	26.25

Applying VAM method, Table corresponding to initial basic feasible solution is

Table-3: Reduced Table of VAM Method

	$\mathbf{B_1}$	$\mathbf{B_2}$	$\mathbf{B_3}$	Supply
$\mathbf{A_1}$	[4.25] 4.5	[7.25] 6.5	9.5	11.5
$\mathbf{A_2}$	[6.25] 7.5	11.5	[3.25] 8.5	9.5
$\mathbf{A_3}$	8.5	10.5	[5.25] 7.5	5.25
Demand	10.5	7.25	8.5	26.25

Since the number of occupied cell m+n-1=5 and are also independent. There exist non-negative basic feasible solutions. The initial transportation cost is

$$[(4.25 \times 4.5) + (7.25 \times 6.5) + (6.25 \times 7.5) + (3.25 \times 8.5) + (5.25 \times 7.5)] = 180.125$$

Applying North West Corner method, Table corresponding to initial basic feasible solution is

Table-4: Reduced Table of NWC Method

	$\mathbf{B_1}$	$\mathbf{B_2}$	$\mathbf{B_3}$	Supply
$\mathbf{A_1}$	[10.5] 4.5	[1] 6.5	9.5	11.5
$\mathbf{A_2}$	7.5	[6.25] 11.5	[3.25] 8.5	9.5
$\mathbf{A_3}$	8.5	10.5	[5.25] 7.5	5.25
Demand	10.5	7.25	8.5	26.25

Since the number of occupied cell m+n-1=5 and are also independent. There exist non-negative basic feasible solutions.

The initial transportation cost is

$$[(10.5 \times 4.5) + (1 \times 6.5) + (6.25 \times 11.5) + (3.25 \times 8.5) + (5.25 \times 7.5)] = 192.125$$

Applying Least Cost Method, Table corresponding to initial basic feasible solution is

Table-5: Reduced Table of LCM Method

	$\mathbf{B_1}$	$\mathbf{B_2}$	$\mathbf{B_3}$	Supply
$\mathbf{A_1}$	[10.5] 4.5	[1] 6.5	9.5	11.5
$\mathbf{A_2}$	7.5	[6.25] 11.5	[3.25] 8.5	9.5
$\mathbf{A_3}$	8.5	10.5	[5.25] 7.5	5.25
Demand	10.5	7.25	8.5	26.25

Since the number of occupied cell m+n-1=5 and are also independent. There exist non-negative basic feasible solutions.

The initial transportation cost is

$$[(10.5 \times 4.5) + (1 \times 6.5) + (6.25 \times 11.5) + (3.25 \times 8.5) + (5.25 \times 7.5)] = 192.125$$

Applying Row Minima Method, Table corresponding to initial basic feasible solution is

Table-6: Reduced Table of RM Method

	$\mathbf{B_1}$	$\mathbf{B_2}$	$\mathbf{B_3}$	Supply
$\mathbf{A_1}$	[10.5] 4.5	[1] 6.5	9.5	11.5
$\mathbf{A_2}$	7.5	[1] 11.5	[8.5] 8.5	9.5
$\mathbf{A_3}$	8.5	[5.25] 10.5	7.5	5.25
Demand	10.5	7.25	8.5	26.25

Since the number of occupied cell m+n-1=5 and are also independent. There exist non-negative basic feasible solutions.

The initial transportation cost is

$$[(10.5 \times 4.5) + (1 \times 6.5) + (1 \times 11.5) + (8.5 \times 8.5) + (5.25 \times 10.5)] = 192.625$$

Applying Column Minima Method, Table corresponding to initial basic feasible solution is

Table-7: Reduced Table of CM Method

	B_1	B_2	B_3	Supply
A_1	[10.5] 4.5	[1] 6.5	9.5	11.5
A_2	7.5	[1] 11.5	[8.5] 8.5	9.5
A_3	8.5	[5.25] 10.5	7.5	5.25
Demand	10.5	7.25	8.5	26.25

Since the number of occupied cell m+n-1=5 and are also independent. There exist non-negative basic feasible solutions. The initial transportation cost is

$$[(10.5 \times 4.5) + (1\times6.5) + (1\times11.5) + (8.5\times8.5) + (5.25\times10.5)] = 192.62$$

Applying Russell's Approximation Method, Table corresponding to initial basic feasible solution is

Table-8: Reduced Table of RAM Method

	B_1	B_2	B_3	Supply
A_1	[10.5] 4.5	[1] 6.5	9.5	11.5
A_2	7.5	[6.25] 11.5	[3.25] 8.5	9.5
A_3	8.5	10.5	[5.25] 7.5	5.25
Demand	10.5	7.25	8.5	26.25

Since the number of occupied cell m+n-1=5 and are also independent. There exist non-negative basic feasible solutions. The initial transportation cost is

$$[(10.5\times4.5) + (1\times6.5) + (6.25\times11.5) + (3.25\times8.5) + (5.25\times7.5)] = 192.625$$

Applying Heuristic Method - I, Table corresponding to initial basic feasible solution is

Table-9: Reduced Table of Heuristic Method - I

	B_1	B_2	B_3	Supply
A_1	[4.25] 4.5	[7.25] 6.5	9.5	11.5
A_2	[6.25] 7.5	11.5	[3.25] 8.5	9.5
A_3	8.5	10.5	[5.25] 7.5	5.25
Demand	10.5	7.25	8.5	26.25

Since the number of occupied cell m+n-1=5 and are also independent. There exist non-negative basic feasible solutions. The initial transportation cost is

$$[(4.25 \times 4.5) + (7.25\times6.5) + (6.25\times7.5) + (3.25\times8.5) + (5.25\times7.5)] = 180.125$$

Applying Heuristic Method - II, Table corresponding to initial basic feasible solution is

Table-10: Reduced Table of Heuristic Method - II

	B_1	B_2	B_3	Supply
A_1	[10.5] 4.5	[1] 6.5	9.5	11.5
A_2	7.5	[1] 11.5	[8.5] 8.5	9.5
A_3	8.5	[5.25] 10.5	7.5	5.25
Demand	10.5	7.25	8.5	26.25

Since the number of occupied cell m+n-1=5 and are also independent. There exist non-negative basic feasible solutions. The initial transportation cost is

$$[(10.5 \times 4.5) + (1\times6.5) + (1\times11.5) + (8.5\times8.5) + (5.25\times10.5)] = 192.625$$

COMPARISON OF DIFFERENT METHODS

S. No	Name of the Method	Initial Basic Feasible Solution
1	Vogel's Approximation Method	180.125
2	North West Corner Method	192.125
3	Least Cost Method	192.125
4	Row Minima Method	192.625
5	Column Minima Method	192.625
6	Russell's Approximation Method	192.625
7	Heuristic Method - I	180.125
8	Heuristic Method - II	192.625

4. CONCLUSIONS

In this paper, we discussed finding Initial Basic Feasible solution for Octagonal Intuitionistic Fuzzy Transportation problem. We took the example of Fuzzy Transportation Problem Using Proposed Ranking Method, where the result arrived at using Octagonal Fuzzy Numbers are more cost-effective Method. we discussed finding Initial Basic Feasible solution for Vogel's Approximation Method, Row Minima Method, Column Minima Method, Russell's Approximation Method, North West Method, Least Cost Method, Heuristic Method- I and Heuristic Method- II. The transportation cost can be minimized by using of Proposed Ranking Method under Vogel's Approximation Method and Heuristic Method - I. It is concluded that Octagonal Fuzzy Transportation method proves to be minimum cost of Transportation.

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