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A NEW METHOD FOR OBTAINING AN OPTIMAL SOLUTION FOR FUZZY TRANSPORTATION PROBLEMS

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ABSTRACT

In this paper a new method is proposed for finding an optimal solution for a wide range of Fuzzy transportation. This method is easy to understand and use compared to other methods. The main feature of this method is that it requires very simple arithmetical and logical calculations and avoids large number of iterations. This method is very efficient for those decision makers who are dealing with logistics and supply chain related issues. This method can easily adopt among the existing method.

Key words: *Fuzzy Transportation problem, Exponential approach, cost matrix, optimal solution.*

I. INTRODUCTION

Fuzzy Transportation problem is a special variety of classical linear-programming problem. The objective of the Fuzzy transportation problem is to provide the following information to the decision makers: what quality should be transported from a manufacturing unit to all possible destinations? And what would be the cost for this allocation? Fuzzy Transportation problem is a particular class of linear programming, which is associated with day-to-day activities in our real life and mainly deals with logistics. It helps in solving problems on distribution and Fuzzy transportation of resources from place to another. Fuzzy Transportation problems deal with Fuzzy transportation of a single product manufactured at different plants (supply origins) to a number of different warehouses (demand destination). The objective is to satisfy the demand at destination from the supply constraint at the minimum Fuzzy transportation cost possible. The objective of the Fuzzy transportation model is to determine the amount to be shipped from each source to each destination so as to maintain the supply and demand requirements at the lowest Fuzzy transportation cost.

PRELIMINARIES

Zadeh [16] in 1965 first introduced Fuzzy set as a mathematical way of representing impreciseness or vagueness in everyday life.

2.1 Definition: A fuzzy set is characterized by a membership function mapping elements of a domain, space, or universe of discourse X to the unit interval [0, 1]. (i, e) $A = \{(x, \mu_A(x) ; x \in X\}$, Here $\mu_A: X \rightarrow [0,1]$ is a mapping called the degree of membership function of the fuzzy set A and $\mu_A(x)$ is called the membership value of $x \varepsilon X$ in the fuzzy set A. These membership grades are often represented by real numbers ranging from [0, 1].

2.2 Definition: A fuzzy set A of the universe of discourse X is called a *normal* fuzzy set implying that there exist at least one $x \varepsilon X$ such that $\mu_A(x) = 1$.

2.3 Definition: The fuzzy set A is *convex* if and only if, for any $x_1, x_2 \in X$, the membership function of A satisfies the inequality $\mu_A\{\lambda x_1+(1-\lambda)x_2\} \geq \min\{\mu_A(x_1), \mu_A(x_2)\}$. $0\leq \lambda\leq 1$.

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2.4 Definition (***Triangular fuzzy number***): For a triangular fuzzy number A(x), it can be represented by A (a, b, c; 1) with membership function μ(x) given by

$$A(x)\begin{cases}(x-a)/\ (b-a), & a\ \le x\ \le \\ 1, & x=b \\ (c-x)/(c-b), & c\le x\le\ d \\ 0, & \text{otherwise}\end{cases}$$

2.5 Definition: (***Trapezoidal fuzzy number***): For a trapezoidal number A(x), it can be represented by A (a, b, c, d; 1) with membership function μ(x) given by

$$A(x)\begin{cases}(x-a)/\ (b-a), & a\ \le x\ \le \\ 1, & b\ \le\ x\le\ c \\ (d-x)/(d-c), & c\le x\le\ d \\ 0, & \text{otherwise}\end{cases}$$

2.4. Arithmetic operations on triangular fuzzy numbers Ming Ma *et al.* [10] have proposed a new fuzzy arithmetic based upon both location index and fuzziness index functions. The location index number is taken in the ordinary arithmetic, whereas the fuzziness index functions are considered to follow the lattice rule which is least upper bound in the lattice L. That is for a, b€L we define For arbitrary triangular fuzzy numbers and the arithmetic operations on the triangular fuzzy numbers are defined by a v b = max{a, b} and a $\wedge$ b = min{a, b}.

For arbitrary triangular fuzzy numbers $\tilde{A} = (a_1, a_2, a_3) = (m_1, \alpha_1, \beta_1)$, $\tilde{B} = (b_1, b_2, b_3) = (m_2, \alpha_2, \beta_2)$ and *= {+, -, x, ÷} the arithmetic operations on the triangular fuzzy numbers are defined by

$$\begin{aligned}\tilde{A} * \tilde{B} &= (m_1, \alpha_1, \beta_1) * (m_2, \alpha_2, \beta_2)\\ &= (m_1 * m_2, \max\{\alpha_1, \alpha_2\}, \max\{\beta_1, \beta_2\})\\ &= (m_1 * m_2, \alpha_1 \vee \alpha_2, \beta_1 \vee \beta_2)\end{aligned}$$

In particular for any two triangular fuzzy numbers

$\tilde{A} = (a_1, a_2, a_3) = (m_1, \alpha_1, \beta_1)$, $\tilde{B} = (b_1, b_2, b_3) = (m_2, \alpha_2, \beta_2)$ we define

Addition:

$$\begin{aligned}\tilde{A} + \tilde{B} &= (a_1, a_2, a_3) + (b_1, b_2, b_3)\\ &= (m_1, \alpha_1, \beta_1) + (m_2, \alpha_2, \beta_2)\\ &= (m_1+m_2, \max\{\alpha_1, \alpha_2\}, \max\{\beta_1, \beta_2\})\end{aligned}$$

Subtraction:

$$\begin{aligned}\tilde{A} - \tilde{B} &= (a_1, a_2, a_3) - (b_1, b_2, b_3)\\ &= (m_1, \alpha_1, \beta_1) - (m_2, \alpha_2, \beta_2)\\ &= (m_1-m_2, \max\{\alpha_1, \alpha_2\}, \max\{\beta_1, \beta_2\})\end{aligned}$$

Multiplications:

$$\begin{aligned}\tilde{A}\,\tilde{B} &= (a_1, a_2, a_3)\,(b_1, b_2, b_3)\\ &= (m_1, \alpha_1, \beta_1)\,(m_2, \alpha_2, \beta_2)\\ &= (m_1 m_2, \max\{\alpha_1, \alpha_2\}, \max\{\beta_1, \beta_2\})\end{aligned}$$

ARITHMETIC OPERATORS FOR SOLVING TRAPEZOIDAL FUZZY NUMBER

If $\tilde{A} = [m_1, n_1, a_1, b_1]$ and $\tilde{B} = [m_2, n_2, a_2, b_2]$ two trapezoidal fuzzy numbers then the arithmetic operations on A and B as follows:

Addition: $\tilde{A}+\tilde{B} = (m_1+m_2, n_1+n_2, a_1+a_2, b_1+b_2)$

Subtraction: $\tilde{A}-\tilde{B} = (m_1-b_2, n_1-a_2, a_1-n_2, b_1-m_2)$

Multiplication: $\tilde{A}\bullet\tilde{B} = (t_1, t_2, t_3, t_4)$

where t_1 = minimum$\{m_1m_2, m_1b_2, b_1m_2, b_1b_2\}$;
t_2= minimum$\{n_1n_2, n_1a_2, a_1n_2, a_1a_2\}$;
t_3 = maximum$\{n_1n_2, n_1a_2, a_1n_2, a_1a_2\}$ and
t_4 = maximum$\{m_1m_2, m_1b_2, b_1m_2, b_1b_2\}$.

Definition: 2.6 If a = (a_1, a_2, a_3) is a triangular fuzzy number then the defuzzified value or ordinary (crisp) numbers a, ã is given below Grane median integration formula a = $(a_1+2a_2+a_3)/4$

Definition: 2.7 If a = (a_1, a_2, a_3, a_4) is a trapezoidal fuzzy number then the defuzzified value or ordinary (crisp) numbers a, ã is given below a = $(a_1+2a_2+2a_3+a_4)/6$

The Fuzzy transportations Problem can be stated in the form of n×n cost matrix [aij] of real numbers as given in the following

	Job1	Job2	Job3	….Jobj	jobN
Person 1	a_{11}	a_{12}	a_{13}	…a_{1j}…	a_{1n}
Person 2	a_{21}	a_{22}	a_{23}	…a_{2j}…	a_{2n}
Person i	--- --- a_{i1} ---	--- --- a_{i2} ---	--- --- a_{i3} ---	--- --- …a_{ij}… ---	--- --- a_{in} ---
Person N	a_{n1}	a_{n2}	a_{n3}	…a_{nj}…	a_{nm}

Mathematically assignment problem can be stated as

$$\text{Minimize } z = \sum_{i=1}^{n} \sum_{j=1}^{n} a_{ij} x_{ij}$$

Subject to

$$\sum_{i=1}^{n} x_{ij} = 1$$

$$\sum_{j=1}^{n} x_{ij} = 1, \quad x_{ij} \in [0,1] \qquad (1)$$

where $x_{ij} = \begin{cases} 1, \text{ if the } i^{th} \text{ person is assigned the } j^{th} \text{ job} \\ 0, \text{ otherwise} \end{cases}$

PROPOSED METHOD OF IMPROVED FUZZY EXPONENTIAL APPROACH

Step 1: Formulation Construct the Fuzzy transportation model (Table) from the given Fuzzy transportation problem.

Step 2: Row & Column reduction Subtract each row entries of the Fuzzy transportation table from the respective row minimum and then subtract each column entries of the Fuzzy transportation table from the respective column minimum, so that each row and column will have least one zero.

Step 3: Assigning Exponential penalties Now there will be at least one zero in each row and column in the reduced cost matrix. Select the first zero (row wise) occurring in the cost matrix. Count the total number of zeros excluding the selected one in the corresponding row and column. And then assign exponential penalties (sum of zeros in respective row and column). Repeat the procedure for all zeros in the matrix.

Step 4: Optimality Test Now chooses a zero for which the minimum exponential penalty is assigned from step 3 and allocate the respective cell value with maximum possible amount. If tie occurs for any cell in the penalty values then first check for the corresponding value in Fuzzy demand and Fuzzy supply, find its average value and assign the allocation for least average value. And if again tie occurs then check the corresponding value in the rows and column and select the minimum.

Step 5: After performing step 4 delete the row or column (where supply or demand becomes zero) for further calculation.

Step 6: Check whether the resultant matrix possesses at least one zero in each column and in each row. If not repeat step2, otherwise go to step 7.

Step 7: Repeat step 3 to step 6 until and unless all the demands are satisfied and all the supplies are exhausted.

Step 8: Given an initial fuzzy basic feasible solution of a fuzzy transportation problem in the form of allocated and unallocated cells of fuzzy transportation table. Assign the auxiliary variables $\tilde{u}_i$=1,2,3,…,m and $\tilde{v}_j$=1,2,3,…,n for rows and columns respectively. Compute the values of and using the relationship $\tilde{c}_{ij} = \tilde{u}i+\tilde{v}j$ for all i,j for all occupied cells. Assume either $\tilde{u}_i$ or $\tilde{v}_j$ as zero arbitrarily for the allocations in row/column**.**

Step 9: For each unoccupied cell (i, j), compute the fuzzy opportunity cost $\tilde{\delta}_{ij} \approx \tilde{c}_{ij}-(\tilde{u}_i+ \tilde{v}_j)$ using

Step 10: For the allocated values calculate the optimal cost.

I. NUMERICAL EXAMPLE

Consider the following cost minimizing Fuzzy transportation problem with the three origins and four destinations.

Sources	Demand1	Demand2	Demand3	Demand4	supply
Sources 1	(4,15,18)	(12,18,32)	(10,25,40)	(4,6,16)	(4,6,16)
Sources 2	(25,50,75)	(12,18,32)	(20,25,30)	(20,50,60)	(4,10,16)
Sources 3	(10,25,40)	(4,5,10)	(25,50,95)	(4,10,16)	(6,10,18)
Demand	(2,3,8)	(6,5,12)	(4,5,10)	(8,10,20)	

Step1: Mathematical Formulation: Construct the Fuzzy transportation table from the given Fuzzy transportation problem

Sources	Demand1	Demand2	Demand3	Demand4	supply
Sources 1	(4,15,18)	(12,18,32)	(10,25,40)	(4,6,16)	(4,6,16)
Sources 2	(25,50,75)	(12,18,32)	(20,25,30)	(20,50,60)	(4,10,16)
Sources 3	(10,25,40)	(4,5,10)	(25,50,95)	(4,10,16)	(6,10,18)
Demand	(2,3,8)	(6,5,12)	(4,5,10)	(8,10,20)	

Step 2: Row reduction & Column reduction: Subtract each row entries of the fuzzy transportation table from the respective row minimum and then subtract each column entries of the fuzzy transportation table from the respective column minimum.

SUBTRACTING ROW, COLUMN MINIMUM:

Sources	Demand1	Demand2	Demand3	Demand4	supply
Sources 1	$(0,0,0)^1$	(-4,12,28)	(-24,12,48)	$(0,0,0)^1$	(4,6,16)
Sources 2	(-21,23,75)	$(0,0,0)^2$	$(0,0,0)^1$	(-12,32,48)	(4,10,16)
Sources 3	(-14,11,48)	$(0,0,0)^1$	(-3,38,103)	(-6,5,12)	(6,10,18)
Demand	(2,3,8)	(6,5,12)	(4,5,10)	(8,10,20)	

Step 3: Now there will be at least one zero in each row and column in the reduced cost matrix. Select the first zero (row wise) occurring in the cost matrix. Count the total number of zeros excluding the selected one in the corresponding row and column. And then assign exponential penalties (sum of zeros in respective row and column). Repeat the procedure for all zeros in the matrix.

(position)	No. of zeros
(1,1)	1
(1,4)	1
(2,2)	2
(2,3)	1
(3,2)	1

Step4: Now choose a zero for which the minimum exponential penalty is assigned from step 3 and allocate the respective cell value with maximum possible amount. If tie occurs for any cell in the penalty values then first check for the corresponding value in demand and supply, find its average value and assign the allocation for least average value. And if again tie occurs then check the corresponding value in the rows and column and select the minimum. The tie

occurs at position (1,1),(1,4),(2,3) &(3,2) then check the values in demand and supply and find the respective average value

1. (4, 6, 16) + (2, 3, 8) = (6+9+24)/2=19.5
2. (4, 6, 16) + (8, 10, 20) = (12+16+36)/2=32
3. (4, 10, 16) + (4, 5, 10) = (8+15+26)/2=24.5
4. (6, 10, 18) + (6, 5, 12) = (12+15+30)/2=28.5

Hence select the minimum average value of cell (1, 1) and allocate the respective cell as shown below

Sources	Demand1	Demand2	Demand3	Demand4	supply
Sources 1	$(0,0,0)^1$**(2,3,8)**	(-4,12,28)	(-24,12,48)	$(0,0,0)^1$	(4,6,16)
Sources 2	(-21,23,75)	$(0,0,0)^2$	$(0,0,0)^1$	(-12,32,48)	(4,10,16)
Sources 3	(-14,11,48)	$(0,0,0)^1$	(-3,38,103)	(-6,5,12)	(6,10,18)
Demand	(2,3,8)	(6,5,12)	(4,5,10)	(8,10,20)	

(4,6,16) (2,3,8) √ (4,6,16) (8,10,20), (4,10,16)(6,5,2), (4,10,16) (4,5,10), (6,10,18) (6,5,12).

Step 5: After performing step 4, demand of D1 is zero. Hence delete the column D1

Sources	Demand2	Demand3	Demand4	supply
Sources 1	(-4,12,28)	(-24,12,48)	$(0,0,0)^1$	(4,6,16)
Sources 2	$(0,0,0)^1$	$(0,0,0)^2$	(-12,32,48)	(4,10,16)
Sources 3	$(0,0,0)^1$	(-3,38,103)	(-6,5,12)	(6,10,18)
Demand	(6,5,12)	(4,5,10)	(8,10,20)	

Step 6: Check whether the resultant matrix possesses at least one zero in each column and each row, if not repeat step-2. Otherwise go to step7.Next position is (1, 4), again tie exist for cell values (1, 4), (2, 3) & (3, 2) then check the values in demand and supply and find the respective average value

Hence delete the column D3

Sources	Demand2	Demand4	supply
Sources 1	(-4,12,28)	$(0,0,0)^1$ **(-4,3,14)**	(4,6,16)
Sources 2	$(0,0,0)^1$	(-12,32,48)	(4,10,16)
Sources 3	$(0,0,0)^2$	(-6,5,12)	(6,10,18)
Demand	(6,5,12)	(8,10,20)	

Step7: Step8: Step9: Repeat step 3 to step 6 until and unless all the demands are satisfied and all the supplies are exhausted.

Sources	Demand1	Demand2	Demand3	Demand4	supply
Sources 1	(4,15,18) **(2,3,8)**	(12,18,32)	(10,25,40)	(4,6,16) **(-4,3,14)**	(4,6,16)
Sources 2	(25,50,75)	(12,18,32) **(-6,5,12)**	(20,25,30) **(4,5,10)**	(20,50,60)	(4,10,16)
Sources 3	(10,25,40)	(4,5,10) **(-6,0,18)**	(25,50,95)	(4,10,16) **(-12,10,24)**	(6,10,18)
Demand	(2,3,8)	(6,5,12)	(4,5,10)	(8,10,20)	

Step10: The total cost associated with these allocations is

X_{11}= (4, 15, 18) (2, 3, 8),
x_{14}=(4,6,16)(-4,3,14)
x_{22}=(12,18,32)(6,5,12)
x_{23}=(20,25,30)(4,5,10)
x_{32}=(4,5,10)(-6,0,18)
x_{34} = (4,10,16)(-12,10,24)
x_{11}=(8,45,144)
x_{14}=(-64,18,244)
x_{22} = (-192,90,384)
x_{23}=(80,125,300)
x_{23}=(-60,0,180)

x_{34} = (-192,100,384)

Min (z) = (-420, 378, 1616) and the crisp value of the optimum fuzzy transportation cost for the problem z = Rs 488

II. NUMERICAL EXAMPLE

Consider the following cost minimizing Fuzzy transportation problem with the three origins and four destinations.

Sources	Demand1	Demand2	Demand3	Demand4	supply
Sources 1	(4,12,14,22)	(10,18,22,30)	(10,20,30,40)	(4,610,12)	(4,6,10,12)
Sources 2	(20,40,60,80)	(10,18,22,30)	(10,20,30,40)	(20,40,50,70)	(5,9,10,20)
Sources 3	(10,20,30,40)	(2,5,6,15)	(30,45,65,80)	(5,9,10,20)	(5,10,12,17)
Demand	(1,3,5,7)	(4,5,6,16)	(4,5,6,10)	(8,10,12,20)	

Step 1: Mathematical Formulation: Construct the Fuzzy transportation table from the given Fuzzy transportation problem

Sources	Demand1	Demand2	Demand3	Demand4	supply
Sources 1	(4,12,14,22)	(10,18,22,30)	(10,20,30,40)	(4,610,12)	(4,6,10,12)
Sources 2	(20,40,60,80)	(10,18,22,30)	(10,20,30,40)	(20,40,50,70)	(5,9,10,20)
Sources 3	(10,20,30,40)	(2,5,6,15)	(30,45,65,80)	(5,9,10,20)	(5,10,12,17)
Demand	(1,3,5,7)	(4,5,6,16)	(4,5,6,10)	(8,10,12,20)	

Step 2: Row reduction & Column reduction: Subtract each row entries of the fuzzy transportation table from the respective row minimum and then subtract each column entries of the fuzzy transportation table from the respective column minimum.

Subtracting row column minimum:

Sources	Demand1	Demand2	Demand3	Demand4	supply
Sources 1	(0,0,0,0)	(-2,8,16,26)	(-32,2,20,36)	(0,0,0,0)	(4,6,10,12)
Sources 2	(-28,10,40,78)	(0,0,0,0)	(0,0,0,0)	(-10,18,32,60)	(5,9,10,20)
Sources 3	(-38,-10,10,38)	(0,0,0,0)	(-30,11,45,90)	(-25,-13,2,10)	(5,10,12,17)
Demand	(1,3,5,7)	(4,5,6,16)	(4,5,6,10)	(8,10,12,20)	

Step 3: Now there will be at least one zero in each row and column in the reduced cost matrix. Select the first zero (row wise) occurring in the cost matrix. Count the total number of zeros excluding the selected one in the corresponding row and column. And then assign exponential penalties (sum of zeros in respective row and column). Repeat the procedure for all zeros in the matrix.

(position)	No. of zeros
(1,1)	1
(1,4)	1
(2,2)	2
(2,3)	1
(3,2)	1

Step 4: Now choose a zero for which the minimum exponential penalty is assigned from step 3 and allocate the respective cell value with maximum possible amount. If tie occurs for any cell in the penalty values then first check for the corresponding value in demand and supply, find its average value and assign the allocation for least average value. And if again tie occurs then check the corresponding value in the rows and column and select the minimum. The tie occurs at position (1,1),(1,4),(2,3) &(3,2) then check the values in demand and supply and find the respective average value

1. (4, 6, 10, 12) + (1, 3, 5, 7) = (5+9+15+19)/2=24
2. (4, 6, 10, 12) + (8, 10, 12, 20) =(12+16+22+32)/2=41
3. (5, 9, 10, 17) + (4, 5, 6, 10) = (9+14+16+27)/2=33
4. (5, 10, 12, 17) + (4, 5, 6, 16) = (9+15+18+33)/2=37.5

Hence select the minimum average value of cell (1, 1) and allocate the respective cell as shown below

Sources	Demand1	Demand2	Demand3	Demand4	supply
Sources 1	$(0,0,0,0)^2$ (1,3,5,7)	(-2,8,16,26)	(-32,2,20,36)	(-3,1,7,11) $(0,0,0,0)^1$	(-3,1,7,11)
Sources 2	(-28,10,40,78)	$(0,0,0,0)^2$	$(0,0,0,0)^1$	(-10,18,32,60)	(5,9,10,17)
Sources 3	(-38,-10,10,38)	$(0,0,0,0)^1$	(-30,11,45,90)	(-25,-13,2,10)	(5,10,12,17)
Demand	(1,3,5,7)	(4,5,6,16)	(4,5,6,10)	(8,10,12,20) (-3,3,11,23)	

(4,6,10,12) (1,3,5,7) √ (4,6,10,12) (8,10,12,20), (5,9,10,17) (4,5,6,16), (5,9,10,17) (4,5,6,10), (5,10,12,17) (4,5,6,16).

Step 5: After performing step 4, demand of D1 is zero. Hence delete the column D1

Sources	Demand2	Demand3	Demand4	supply
Sources 1	(-2,8,16,26)	(-32,2,20,36)	(-3,1,7,11) $(0,0,0,0)^1$	(-3,1,7,11)
Sources 2	$(0,0,0,0)^2$	$(0,0,0,0)^1$	(-10,18,32,60)	(5,9,10,17)
Sources 3	$(0,0,0,0)^1$	(-30,11,45,90)	(-25,-13,2,10)	(5,10,12,17)
Demand	(4,5,6,16)	(4,5,6,10)	(8,10,12,20) (-3,3,11,23)	

Step 6: Check whether the resultant matrix possesses at least one zero in each column and each row, if not repeat step2. Otherwise go to step7.Next position is (1,4), again tie exist for cell values (1,4),(2,3) & (3,2) then check the values in demand and supply and find the respective average value

Supply of S1 is zero. Hence delete row S1 Delete the row minimum from the cell and the column minimum from that cell.

Sources	Demand2	Demand3	Demand4	supply
Sources 2	$(0,0,0,0)^1$	$(0,0,0,0)^1$ (4,5,6,10)	(-10,18,32,60)	(5,9,10,17)
Sources 3	$(0,0,0,0)^2$	(-30,11,45,90)	(-25,-13,2,10)	(5,10,12,17)
Demand	(4,5,6,16)	(4,5,6,10)	(8,10,12,20) (-3,3,11,23)	

Supply of D3 is zero. Hence delete row D3 Delete the row minimum from the cell and the column minimum from that cell.

Sources	Demand2	Demand4	supply
Sources 3	$(0,0,0,0)^2$	$(0,0,0,0)^1$	(5,10,12,17)
Demand	(4,5,6,16) (-9,0,3,21)	(8,10,12,20) (-3,3,11,23)	

Step 7: Step 8: Step 9: Repeat step 3 to step 6 until and unless all the demands are satisfied and all the supplies are exhausted.

Sources	Demand1	Demand2	Demand3	Demand4	supply
Sources 1	(4,12,14,22) **(1,3,5,7)**	(10,18,22,30)	(10,20,30,40)	(4,610,12) **(-3,1,7,11)**	(4,6,10,12)
Sources 2	(20,40,60,80)	(10,18,22,30) **(-5,3,5,13)**	(10,20,30,40) **(4,5,6,10)**	(20,40,50,70)	(5,9,10,20)
Sources 3	(10,20,30,40)	(2,5,6,15) **(-9,0,3,21)**	(30,45,65,80)	(5,9,10,20) **(-39,-4,9,29)**	(5,10,12,17)
Demand	(1,3,5,7)	(4,5,6,16)	(4,5,6,10)	(8,10,12,20)	

Step10: The total cost associated with these allocations is
$\tilde{x}_{11}$= (4, 12, 14, 22) (1, 3, 5, 7)
$\tilde{x}_{14}$= (4, 610, 12) (-3, 1, 7, 11)
$\tilde{x}_{22}$= (10, 18, 22, 30) (-5, 3, 5, 13)
$\tilde{\mathbf{x}}_{23}$= (10, 20, 30, 40) (4, 5, 6, 10)
$\tilde{x}_{32}$= (2, 5, 6, 15) (-9, 0, 3, 21)

$\tilde{x}_{34}$= (5, 9, 10, 20) (-39,-4, 9, 29)
$\tilde{X}_{11}$= (4, 36, 70,154)
$\tilde{x}_{14}$= (-36, 6, 70,132)
$\tilde{x}_{22}$= (-150, 54,110,390)
$\tilde{x}_{23}$= (40,100,180,400)
$\tilde{X}_{32}$= (-135, 0, 18,315)
$\tilde{x}_{34}$= (-780,-40, 90,580)

Min ($\tilde{z}$) = (-1057, 156, 538, 1971) and the crisp value of the optimum fuzzy transportation cost for the problem z =Rs 383.67

IV. CONCLUSIONS

[9] Proposed method provides an optimal solution in less number of iterations, directly for the given transportation problem. As this method required less number of time and is very easy to understand and apply. So it will be very helpful for decision makers who are dealing with logistic and supply chain problem.

FUTURE WORK

Once can be obtain similar Result by using squared triangular trapezoidal fuzzy numbers by suitable approach

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