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Solutions to fuzzy transportation problem using triangular membership function

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ABSTRACT

In this Paper, the Fuzzy Transportation Problem is investigated with the aid of Triangular Fuzzy Numbers. A new relevant numerical example is included.

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1. Introduction

The transportation problem refers to a special class of linear programming problems. In a typical problem, a product is to be transported from several sources to numerous locations at minimum cost. Suppose there are 'm' warehouses where a commodity is stocked and 'n' markets where it is needed. Let the supply available in the warehouses be $a_1, a_{2,}.......a_m$ and the demands at the markets be $b_1, b_2,....b_n$ respectively. In addition there is a penalty c_{ij} associated with transporting unit of product from source i to destination j. This penalty may be cost, delivery time, safety of delivery etc. A variable x_{ij} represents the unknown quantity to be shipped from source i to destination j.

The basic transportation problem was originally stated in [5], and later discussed in [8].The Concept of decision making in fuzzy environment in [3]. A linear programming problem using L-R fuzzy number was given in [10], an operator theory of parametric programming for GTP was presented by [1], an algorithm introduced for solving this problem which provides an effective solution based on interval and fuzzy coefficients in [6]. Further development on Triangular Membership Functions in solving Transportation Problem under fuzzy environment had been elaborated by [5, 11].

In this work, the fuzzy transportation problems using Triangular Fuzzy Numbers are discussed. Here we propose the method of fuzzy modified distribution to find the optimal solution for the fuzzy transportation problem in the nature of triangular membership function. This paper is organized as follows. In section 2, basic definitions on fuzzy set theory are listed which are needed the squeal. In section 3, the method of fuzzy modified distribution is discussed. In Section 4, a numerical example is worked out for illustrated.

2. Fuzzy Bascis

L.A.Zadeh advanced the fuzzy theory in 1965. This theory proposes mathematical techniques for dealing with the concepts and problems that have much possible solution. In the year 1974, the concept of mathematical programming on a general level was first proposed by Tanaka et al [3], in the frame work of fuzzy decision. We summarize the definitions and results which are needed in equal.

Definition 2.1 [1] If X denote the collection of objects, then the fuzzy sub set μ of x is a membership function which maps each element of x to a membership grade between 0 and 1

Definition 2.2 [9] The α cut (or) α - level set of fuzzy sub set μ is a set consisting of those elements of the universe x whose membership values exceed the threshold level α, $0 \le \alpha \le 1$, i.e. $\mu = \{x / \mu\ (x) \ge \alpha\}$

Definition 2.3 [6] A fuzzy sub set μ of a set x is said to be normal $h(\mu) = \sup_{x \in X} \mu(x) = 1$, the height of a fuzzy set is the supremum of the membership grades, In other words, there is an $x \in X$ for which $\mu(x) = 1$. In summarized which is not normal is called subnormal.

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Definition 2.4 [9] A fuzzy number "a" represent with the three points as follows $a = [\underline{a}, a, \overline{a}]$. This representation is interpreted as membership function and holds the following conditions,

(i) $\underline{a}$ to a is increasing function

(ii) a to $\overline{a}$ is decreasing function

(iii) $\underline{a} \le a \le \overline{a}$

$$\mu_a(x) = \begin{cases} 0 & for \quad x < \underline{a} \\ \dfrac{x-\underline{a}}{a-\underline{a}} & for\ \underline{a} \le x < a \\ \dfrac{\overline{a}-x}{\overline{a}-a} & for\ a \le x \le \overline{a} \\ 0 & for \quad x > \overline{a} \end{cases}$$

Definition 2.5 [9] Let $a = [\underline{a}, a, \overline{a}]$ and $b = [\underline{b}, b, \overline{b}]$ be two triangular fuzzy numbers then the arithmetic operation is

Addition : $a+b = \{ [\underline{a}+\underline{b}], [a+b], [\overline{a}+\overline{b}] \}$

Subtraction : $a-b = \{ [\underline{a}-\overline{b}], [a-b], [\overline{a}-\underline{b}] \}$

Multiplication:

(i) If a and b are positive

$$a \bullet b = \left([a\underline{b}+b\underline{a}], [ab], [a\overline{b}+b\overline{a}] \right)$$

(ii) If "b" is positive and "a" is negative

$$a \bullet b = [\overline{a}, -a, \underline{a}][\underline{b}, b, \overline{b}]$$

$$a \bullet b = \left([b\overline{a}-a\underline{b}], [-ab], [b\underline{a}-a\overline{b}] \right)$$

(iii) If a and b are negative in any sense

$$a \bullet b = [\overline{a}, -a, \underline{a}][\overline{b}, -b, \underline{b}]$$

$$a \bullet b = \left([-a\overline{b}-b\overline{a}], [ab], [-a\underline{b}-b\underline{a}] \right)$$

Definition 2.6 [2] defined measure as a function $M : F(X) \to R^+$, where F(X) denotes the set of all fuzzy numbers on X. For each fuzzy number A, this function assigns a non-negative real number M (A) that expresses the measure of "A" The measure of a fuzzy number is obtained by the average of two side areas; left side and right side are from membership function to an axis the following requirements are essential;

if $A = [\underline{a}, a, \overline{a}]$ is a Triangular Fuzzy Number, then $M(A) = (2a + \underline{a} + \overline{a})/4$ satisfies

(i) M (A) = A iff A is a crisp number

(ii) $A \le B$ *iff* $M(A) \le M(B)$ When a normal fuzzy number is meant, the fuzzy number is shown as follows: $A_\alpha = [\underline{a^\alpha}, \overline{a}^\alpha]$ Where $0 \le \alpha \le 1$

3 Fuzzy transportation problems

Consider the Fuzzy Transportation problem with m fuzzy origins (row) and n fuzzy destinations (columns).Let $c_{ij} = [\underline{c_{ij}}, c_{ij}, \overline{c_{ij}}]$ is the cost of the fuzzy transportation. Let $a = [\underline{a}, a, \overline{a}]$ be the quantity of commodity available at fuzzy origin i, $b = [\underline{b}, b, \overline{b}]$ be the quantity of commodity available at fuzzy destinations j, x_{ij} is quantity transported from ith fuzzy origin to jth fuzzy destinations. Then above fuzzy transportation problem can be stated in the below tabular form;

3.1 The Transportation Problem Table:

	1	2	.	.	.	n	Fuzzy capacity
1	c_{11} x_{11}	c_{12} x_{12}	.	.	.	c_{1n} x_{1n}	a_1
2	c_{21} x_{21}	c_{22} x_{22}				c_{2n} x_{2n}	a_2
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
M	c_{m1} x_{m1}	c_{m2} x_{m2}				c_{mn} x_{mn}	a_m
Fuzzy Demand	b_1	b_2				b_n	$\sum_1^m a_i = \sum_1^n b_j$

where $c_{ij} = [\underline{c_{ij}}, c_{ij}, \overline{c_{ij}}]$, $x_{ij} = [\underline{x_{ij}}, x_{ij}, \overline{x_{ij}}]$ $a = [\underline{a}, a, \overline{a}]$ and $b = [\underline{b}, b, \overline{b}]$.

The linear programming model representing the Fuzzy Transportation problem is given by

$$\min z = \sum_1^m \sum_1^n [\underline{c_{ij}}, c_{ij}, \overline{c_{ij}}]\,[\underline{x_{ij}}, x_{ij}, \overline{x_{ij}}]$$

Subject to the constraints

$$\sum_{j=1}^{n} [\underline{x_{ij}}, x_{ij}, \overline{x_{ij}}] = [\underline{a_i}, a_i, \overline{a_i}]$$ For i= 1, 2, 3...m rows

$$\sum_{i=1}^{m} [\underline{x_{ij}}, x_{ij}, \overline{x_{ij}}] = [\underline{b_i}, b_i, \overline{b_i}]$$ For j = 1, 2, 3...n columns, for all $x_{ij} > 0$

The given fuzzy transportation problem is said to be balanced when $\sum_1^m a_i = \sum_1^n b_j$.

i.e., the total fuzzy capacity is equal to the Fuzzy demands.

3.2 The basic fuzzy transportation solution

(i) Fuzzy basic feasible solution: A feasible solution is a fuzzy basic feasible solution if the number of non-negative allocation is almost (m+n-1) where "m"
is the number of rows and "n" is the number of columns.

(ii) Fuzzy non-degenerate basic feasible solution: A Fuzzy feasible solution to a transportation problem containing m origins and n destinations is said to be fuzzy non-degenerate, if it contains exactly (m+n-1) occupied cells.

(iii) Fuzzy degenerate basic feasible solution: If a Fuzzy basic feasible solution contains less than (m+n -1) non-negative allocation, it is said to be degenerate.

3.3 Solution of Fuzzy Transportation Problem:

The Solution of FTP can be solved in two stages. (i) Initial Solution (ii) Optimal Solution. For finding the initial solution of FTP, fuzzy Vogel's approximation method is preferred over the other methods. Since, the initial and fuzzy basic feasible solution obtained by this method is either optimal (or) nearer to the optimal solution. The Fuzzy Vogel's approximation is discussed in this paper and obtained in the nature of fuzzy triangular membership function.

3.3.1 Fuzzy Vogel's Approximation Method Algorithm:

Step (i). Find the fuzzy penalty cost, namely the fuzzy difference between the smallest and next smallest fuzzy costs in each variable in each row and each column.

Step (ii). Among the fuzzy penalties found in step (i), choose the fuzzy maximum penalty by ranking method. If this maximum penalty attained in more than one cell choose any one arbitrary.

Step (iii). In the selected row (or) column as by step (ii), find out the cell having the least fuzzy cost by using the measure fuzzy number. Allocate to this cell as much as possible depending on the fuzzy capacity and fuzzy demands.

Step (iv). Delete the row (or) column which is truly exhausted, then go to step (i). Repeat
the procedures until all the demands are satisfied. Once the initial fuzzy feasible solution is computed the next step is to determine whether the solution obtained is optimal (or) not.

Fuzzy optimality test can be conducted to any fuzzy initial basic feasible solution of a fuzzy transportation problem provided such allocation has exactly an (m + n-1) non-negative allocation, where "m" is the number of fuzzy origins and "n" is the number of fuzzy destinations. Also these allocations must the independent positions.

3.4 Fuzzy Modified Distribution Method

This proposed method is used for finding the optimal basic feasible solution in the fuzzy environment and the following procedure is utilized to find out the same.

Step.1 Find out the set of fuzzy triangular numbers $[\underline{u_i}, u_i, \overline{u_i}]$ and $[\underline{v_i}, v_i, \overline{v_i}]$ for each row and column satisfying $[\underline{u_i}, u_i, \overline{u_i}]^+ \ [\underline{v_i}, v_i, \overline{v_i}]^= [\underline{c_{ij}}, c_{ij}, \overline{c_{ij}}]$ for each occupied cell. To start with assign a fuzzy zero to any row (or) column having maximum number of allocations. If this maximum number of allocations is more than one, choose any one arbitrary.

Step.2 For unoccupied cell, find $[\underline{u_i}, u_i, \overline{u_i}]$ and $[\underline{v_i}, v_i, \overline{v_i}]$

Step.3 Find out for each unoccupied cell the net evaluation;

$$\sum_{i,j} z_{ij} = [\underline{z_{ij}}, z_{ij,} \overline{z_{ij}}] = [\underline{c_{ij}}, c_{ij}, \overline{c_{ij}}] - \left\{ [\underline{u_i}, u_i, \overline{u_i}] + [\underline{v_j}, v_j, \overline{v_j}] \right\}$$

This step gives the optimality conclusion is:

(i) if $z_{ij} > 0$, the solution is optimal and a unique solution exists.

(ii) if $z_{ij} \geq 0$, the solution is optimal, but an alternate solution exists.

(iii) if $z_{ij}, < 0$, the solution is not fuzzy optimal. In this case, we go to next step.

To improve the cost of fuzzy transportation problem

Step.4 Select the unoccupied cell having the non negative value z_{ij}, draw a loop consists of successive horizontal and vertical segments whose corner cells are occupied cells which starts and ends at the designated unoccupied cell. This loop is unique. This process is summarized by positive and negative signs in the appropriate corners. This change will keep the supply and demand restrictions satisfied.

Step (5): The above step yield a better solution by making one (or) more occupied cell as unoccupied cell as occupied. For the new set of fuzzy basic feasible allocation, repeat the above procedure from step(i) till a fuzzy optimal basic feasible solution obtained.

4 Numerical Examples

To solve the following fuzzy transportation problem of minimal cost, starts with the initial fuzzy basic feasible solution obtained by Fuzzy Vogel's Approximation method whose fuzzy cost and fuzzy requirement table is given below. The given problem is balanced fuzzy transportation problem (total fuzzy capacity value equal to total fuzzy demand value) and then supply and demand costs are symmetric fuzzy triangular numbers (FTN). Reduce the above table and then consider the α level set. Cost of the cell (TFN) converted to ordinary number by using [2]

Table 4.1 the basic fuzzy transportation problem is

	D_1	D_2	D_3	D_4	Fuzzy capacity
O_1	[-2,0,2]	[0,1,2]	[-2,0,2]	[-1,0,1]	[0,1,2]
O_2	[4,8,12]	[4,7,10]	[2,4,6]	[1,3,5]	[2,4,6]
O_3	[2,4,6]	[4,6,8]	[4,6,8]	[4,7,10]	[4,6,8]
Fuzzy demand	[1,3,5]	[0,2,4]	[1,3,5]	[1,3,5]	

Since = $\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$ [6, 11, 16] = [3, 11, 19] =33. It is found by fuzzy VAM and it is represents in the table 4.2 (initial basic fuzzy feasible solutions)

Table 4.2 Initial Basic Fuzzy Feasible Solution

	D_1	D_2	D_3	D_4	Fuzzy capacity
O_1	[-2,0,2]	[0,1,2] [0,1,2]	[-2,0,2]	[-1,0,1]	[0,1,2]
O_2	[4,8,12]	[4,7,10]	[2,4,6] [-3,1,5]	[1,3,5] [1,3,5]	[,2,4,6]
O_3	[2,4,6] [1,3,5]	[4,6,8] [-2,1,4]	[4,6,8] [-4,0,6]	[4,7,10]	[4,6,8]
Fuzzy demand	[1,3,5]	[0,2,4]	[1,3,5]	[1,3,5]	

Here the number of occupied cells is (m + n -1 = 6) and these are independent. So, it is a non-degenerate basis feasible solution. The initial fuzzy transportation cost is

$$\sum_{i,j} z_{ij} = [\underline{z}_{ij}, z_{ij}, \overline{z}_{ij}] = [\underline{C}_{12}, C_{12}, \overline{C_{12}}][\underline{X}_{12}, X_{12}, \overline{X_{12}}] + [\underline{C}_{23}, C_{23}, \overline{C_{23}}][\underline{X}_{23}, X_{23}, \overline{X_{23}}] +$$

$$[\underline{C}_{24}, C_{24}, \overline{C_{24}}][\underline{X}_{24}, X_{24}, \overline{X_{24}}] + [\underline{C}_{31}, C_{31}, \overline{C_{31}}][\underline{X}_{31}, X_{31}, \overline{X_{31}}] +$$

$$[\underline{C}_{32}, C_{32}, \overline{C_{32}}][\underline{X}_{32}, X_{32}, \overline{X_{32}}] + [\underline{C}_{33}, C_{33}, \overline{C_{33}}][\underline{X}_{33}, X_{33}, \overline{X_{33}}]$$

$$\sum_{i,j} z_{ij} = [\underline{z}_{ij}, z_{ij}, \overline{z}_{ij}] = [0,1,2][0,1,2] + [2,4,6][-3,1,5] + [1,3,5][1,3,5] + [2,4,6][1,3,5] +$$

$$[4,6,8][-2,1,4] + [4,6,8][-4,0,6]$$

Using the fuzzy arithmetical operation

$$\sum_{i,j} z_{ij} = [\underline{z}_{ij}, z_{ij}, \overline{z}_{ij}] = [-28, 32, 166] \quad \text{-----------------} \quad (I)$$

4.3 moving to the optimality test:

Using the fuzzy modified distribution method, in proceed a set of triangular fuzzy numbers $[\underline{u}_i, u_i, \overline{u}_i]$ and $[\underline{v}_i, v_i, \overline{v}_i]$ are computerized such that $[\underline{c}_{ij}, c_{ij}, \overline{c}_{ij}] = [\underline{u}_i, u_i, \overline{u}_i] + [\underline{v}_i, v_i, \overline{v}_i]$ for each occupied cell. Since the 3rd row has maximum number of allocated cells, we start with the third row:

Let $[\underline{u}_3, u_3, \overline{u}_3]$ = [-1, 0, 1]. The remaining numbers can be obtained as given by:

$$[\underline{c}_{31}, c_{31}, \overline{c}_{31}] = [\underline{u}_3, u_3, \overline{u}_3] + [\underline{v}_1, v_1, \overline{v}_1]$$

$$[2, 4, 6] = [-1, 0, 1] + [\underline{v}_1, v_1, \overline{v}_1]$$

$$[\underline{v}_1, v_1, \overline{v}_1] = [3, 4, 5]$$

$$[\underline{c}_{32}, c_{32}, \overline{c}_{32}] = [\underline{u}_3, u_3, \overline{u}_3] + [\underline{v}_2, v_2, \overline{v}_2]$$

$$[\underline{v}_2, v_2, \overline{v}_2] = [3, 6, 7]$$

$$[\underline{c}_{33}, c_{33}, \overline{c}_{31}] = [\underline{u}_3, u_3, \overline{u}_3] + [\underline{v}_3, v_3, \overline{v}_3]$$

$$[\underline{v}_3, v_3, \overline{v}_3] = [3, 6, 7]$$

$$[\underline{c}_{23}, c_{23}, \overline{c}_{23}] = [\underline{u}_2, u_2, \overline{u}_2] + [\underline{v}_3, v_3, \overline{v}_3]$$

$$[\underline{u}_2, u_2, \overline{u}_2] = [-5, -2, 3]$$

$$[\underline{c}_{24}, c_{24}, \overline{c}_{24}] = [\underline{u}_2, u_2, \overline{u}_2] + [\underline{v}_4, v_4, \overline{v}_4]$$

$$[\underline{v}_4, v_4, \overline{v}_4] = [-2, 0, 1]$$

$$[\underline{c}_{12}, c_{12}, \overline{c}_{12}] = [\underline{u}_1, u_1, \overline{u}_1] + [\underline{v}_2, v_2, \overline{v}_2]$$

$$[\underline{u}_1, u_1, \overline{u}_1] = [-7, -5, -1]$$

The sum of $[\underline{u}_i, u_i, \overline{u}_i]$ and $[\underline{v}_i, v_i, \overline{v}_i]$ id found for each unoccupied cells. Next, the fuzzy net evaluation of $\sum_{i,j} z_{ij} = [\underline{z}_{ij}, z_{ij}, \overline{z}_{ij}]$ are found and entered in the table 4.5

4.4 It represents the unoccupied cells:

	D_1	D_2	D_3	D_4	Fuzzy capacity
O_1	[-2,0,2] *[-6,-1,6]	[0,1,2] [0,1,2]	[-2,0,2] *[-6,1,8]	[-1,0,1] *[-3,4,11]	[0,1,2]
O_2	[4,8,12] *[-4,6,14]	[4,7,10] *[-6,3,12]	[2,4,6] [-3,1,5]	[1,3,5] [1,3,5]	[,2,4,6]
O_3	[2,4,6] [1,3,5]	[4,6,8] [-2,1,4]	[4,6,8] [-4,0,6]	[4,7,10] *[1,6,8]	[4,6,8]
Fuzzy demand	[1,3,5]	[0,2,4]	[1,3,5]	[1,3,5]	

Where $\sum_{i,j} z_{ij} = [\underline{z_{ij}}, z_{ij,} \overline{z_{ij}}] = [\underline{c_{ij}}, c_{ij}, \overline{c_{ij}}] - \{[\underline{u_i}, u_i, \overline{u_i}] + [\underline{v_j}, v_j, \overline{v_j}]\}$,

By using [2], $[\underline{z_{ij}}, z_{ij}, \overline{z_{ij}}]$ >0, the solution is fuzzy optimal.

4.5 Computation of membership function:

Computation of membership functions of the fuzzy optimal solution of the fuzzy transportation problem. It is to find fuzzy membership functions of c_{ij} and x_{ij} for each cell (i, j).The membership function of fuzzy transportation cost for the occupied cells are fuzzy allocation and their α - level sets of fuzzy transportation cost and fuzzy allocation as follows:

$$\mu_{C12}(x) = \begin{cases} \dfrac{x-0}{1-0} & 0 \le x \le 1 \\ \dfrac{x-2}{2-1} & 1 \le x \le 2 \end{cases}, \quad \mu_{X12}(x) = \begin{cases} \dfrac{x-0}{1-0} & 0 \le x \le 1 \\ \dfrac{x-2}{2-1} & 1 \le x \le 2 \end{cases}$$

$$c_{12} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [\alpha, \alpha+2], \quad x_{12} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [\alpha, \alpha+2]$$

$$c_{12} \bullet x_{12} = [\alpha^2, (\alpha+2)^2] \text{----------} \quad (A)$$

$$c_{23} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [2\alpha+2, 6-2\alpha], \quad x_{23} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [4\alpha-3,, 5-4\alpha]$$

$$c_{23} \bullet x_{23} = [8\alpha^2 + 2\alpha - 6 \ , \ 8\alpha^2 - 34\alpha + 30] \text{----------} \quad (B)$$

$$c_{24} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [2\alpha+1, 5-2\alpha], \quad x_{23} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [2\alpha+1 \ , \ 5-2\alpha]$$

$$c_{24} \bullet x_{24} = [4\alpha^2 + 4\alpha + 1 \ , \ 4\alpha^2 - 20\alpha + 25] \text{----------} \quad (c)$$

$$c_{31} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [2\alpha+2, 6-2\alpha], \quad x_{31} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [2\alpha+1 \ , \ 5-2\alpha]$$

$$c_{31} \bullet x_{31} = [4\alpha^2 + 6\alpha + 2 \ , \ 4\alpha^2 - 22\alpha + 30] \text{----------} \quad (D)$$

$$c_{32} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [2\alpha+4, 8-2\alpha], \quad x_{32} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [3\alpha-2 \ , 4-3\alpha]$$

$$c_{32} \bullet x_{32} = [6\alpha^2 + 8\alpha - 8 \ , \ 6\alpha^2 - 32\alpha + 32] \text{----------} \quad (E)$$

$$c_{33} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [2\alpha+4, 8-2\alpha], \quad x_{33} = [x_1^{(\alpha)}, x_2^{(\alpha)}] = [4\alpha-4 \ , 6-6\alpha]$$

$$c_{33} \bullet x_{33} = [8\alpha^2 + 8\alpha - 16 \ , 12\alpha^2 - 60\alpha + 48] \text{---------} \quad (F)$$

The Fuzzy Transportation cost is z = A+B+C+D+E+F

z = $[31\alpha^2 + 26\alpha - 28 \ , \ 35\alpha^2 - 166\alpha + 164]$

Solving the equations:

$$31\alpha^2 + 26\alpha - 28 - x_1 = 0 \quad \text{--------------------------------} \quad (G)$$

$$35\alpha^2 - 166\alpha + 166 - x_2 = 0 \quad \text{--------------------------------} \quad (H)$$

We get $\alpha = \dfrac{[-26 + \{(31)^2 - 124(-28 - x_1)\}^{1/2}]}{56} \quad \alpha = \dfrac{[166 - \{(166)^2 - 140(166 - x_2)\}^{1/2}]}{70}$

and therefore

$$\mu_{.\cos t.Z(x))} = \begin{cases} \dfrac{-26 + \{(26)^2 - 124(-28 - X_1)\}^{1/2}}{62} & -28 \le x_1 \le 32 \\ \dfrac{166 - \{(166)^2 - 140(166 - X_2)\}^{1/2}}{70} & 32 \le x_2 \le 166 \end{cases}.$$

From the membership function of the optimal solution, we can find the grade of the fuzzy transportation cost which lies between

α	$[\underline{z}_{ij}, z_{ij}, \overline{z}_{ij}]$	$\sum_{i,j} z_{ij}$	α	$[\underline{z}_{ij}, z_{ij}, \overline{z}_{ij}]$	$\sum_{i,j} z_{ij}$
0	[-28, 32, 166]	50.5	0.5	[-7, 32, 91]	37
0.1	[-25, 32, 149]	47	0.6	[-1, 32, 79]	35.5
0.2	[-21, 32, 134]	44.25	0.7	[5, 32, 66]	33.75
0.3	[-17, 32, 119]	41.5	0.8	[12, 32, 55]	32.75
0.4	[-12, 32, 105]	39.25	0.9	[20, 32, 44]	32

- $\sum_{i,j} z_{ij}$ - *The fuzzy transportation cost by using the measure function*

5 Conclusions:

In this paper, it is obtained an optimal solution for Fuzzy Transportation Problem of minimal cost using Fuzzy triangular membership Function..This would be a new attempt in the Transportation problem in fuzzy environment. In future extension is to utilize the new optimization techniques in the literature. Anticipating Valuable comments and suggestions

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