

RESEARCH ARTICLE



A Proposed Technique to Resolve Transportation Problem by Trapezoidal Fuzzy Numbers

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Abstract

Objectives: To find the best optimal solution of transportation problem in fuzzy environment **Method:** We proposed a new method to find the optimal solution. **Findings:** This study introduces a Median method. By applying the same we transform the fuzzy transportation problem to an exquisite valued one and subsequently into a new proposed process to uncover the fuzzy realistic solution. Also, we find a minimum transportation cost. **Novelty:** The numerical illustration demonstrates that the new projected method for managing the transportation problems on fuzzy algorithms.

AMS Mathematics Subject Classification (2010): 90C08, 90C90

Keywords: Median; Median of Trapezoidal Fuzzy Numbers; Median of Triangular Fuzzy Numbers; Trapezoidal Fuzzy Numbers; Transportation Problem; and Fuzzy Transportation Problem

1 Introduction

The transportation problem is found globally in solving certain real-world problems. This manuscript might be one of the novel methodologies that bring down the optimal solution value. Here I compared with existing methods named North – West Corner method, the Least cost method, and VAM method.

Consider \tilde{a}_i the number of items that available at the source \tilde{i} and \tilde{b}_j the number of items that necessary at the destination \tilde{j} . Consider $\tilde{\alpha}_{ij}$ as the price of transferring one item from source \tilde{i} to end terminal \tilde{j} and \tilde{X}_{ij} as the amount of item carried from source \tilde{i} to terminal end \tilde{j} . A fuzzy transportation problem is a progressive method in that we can get the expenditure of the transportation, Demand and supply facts are fuzzy quantities. The first introduced fuzzy set concept by Zadeh⁽¹⁾. Zimmerman⁽²⁾ devised fuzzy linear programming. Srinivasan et al.,⁽³⁻⁵⁾ recommended a novel algorithm to crack fuzzy transportation problems. Ghosh et al.,⁽⁶⁾ introduced a genetic algorithm to solve fully Intuitionistic fuzzy fixed-charge solid transportation problems. Bharati⁽⁷⁾ proposed a new algorithm namely, the impact of a new ranking. Progress in Artificial Intelligence

for finding a ranking of a fuzzy number. Muhammad Saman⁽⁸⁾ described a new fuzzy transportation algorithm for finding the fuzzy optimal solutions. Srinivasan et al.,⁽⁹⁾ have explored a two-stage cost-minimizing fuzzy transportation problem where supply and demand are trapezoidal fuzzy numbers using a stricture approach to reach a fuzzy solution. Karthikeyan and Mohamed⁽¹⁰⁾ proposed a novel algorithm to crack the fuzzy transportation problem for Trapezoidal fuzzy numbers. The proposed algorithm is to unravel a strong solution by using fuzzy transportation problems taking an account of supply, demand, and item transportation price as trapezoidal fuzzy numbers.

In this manuscript, an unsullied way is recommended for the Median of fuzzy trapezoidal numbers in a simplified way. To demonstrate this proposed method, a case is conferred. As the suggested process is awfully straight and effortless to understand and apply it is undemanding to make out the fuzzy most select viable outcome of fuzzy transportation troubles take place in the factual conditions.

This manuscript is sorted out as follows: In division 2 it is centered the crucial description of fuzzy figures. In section 3, a getting Median practice is initiated and show on a novel algorithm to resolve the transportation problem by fuzzy. In section 4, is to reveal the projected method a numerical design is solved. In section 5, a conclusion element is also encompassed.

2 Preliminaries

Here, in this division, we describe some crucial descriptions the same will be applied in this manuscript by Geetha and Selvakumari⁽¹¹⁾.

2.1 Definition: Fuzzy Set

\tilde{A} is a fuzzy set on R is defined as a set of ordered pairs

$$\tilde{A} = \{x_0, \mu_{\tilde{A}}(x_0) / x_0 \in \tilde{A}, \mu_{\tilde{A}}(x_0) \rightarrow [0, 1]\}$$

where $\mu_{\tilde{A}}(x_0)$ is said to be the membership function.

2.2 Definition: Fuzzy Number

\tilde{A} is a fuzzy set on R likely bound to the stated conditions given beneath

1. $\mu_{\tilde{A}}(x_0)$ is part by part continuous
2. There exist at least one $x_0 \in \mathfrak{R}$ with $\mu_{\tilde{A}}(x_0) = 1$
3. \tilde{A} is regular and convex

2.3 Definition: Trapezoidal Fuzzy Number

A fuzzy number \tilde{A} is a trapezoidal fuzzy number which is named as $(\tilde{a}_1, \tilde{a}_2, \tilde{a}_3, \tilde{a}_4)$ where $\tilde{a}_1, \tilde{a}_2, \tilde{a}_3, \tilde{a}_4$ affiliated function $\mu_{\tilde{A}}(\tilde{x})$ known

$$\mu_{\tilde{A}}(x) = \begin{cases} \frac{x-\tilde{a}_1}{\tilde{a}_2-\tilde{a}_1}, & \tilde{a}_1 \leq x < \tilde{a}_2 \\ 1 & \tilde{a}_2 \leq x < \tilde{a}_3 \\ \frac{\tilde{a}_4-x}{\tilde{a}_4-\tilde{a}_3}, & \tilde{a}_3 \leq x < \tilde{a}_4 \\ 0 & , 0.w \end{cases}$$

2.4 Fuzzy transportation problem utilizing Mathematical formulation

A transportation problem can be declared in mathematical form as follows:

Reduce $Z = \sum_{i=1}^s \sum_{j=1}^t \tilde{c}_{ij} \tilde{x}_{ij}$
 Subject to the constraints

$$\sum_{j=1}^t \tilde{x}_{ij} = \tilde{a}_i, j = 1, 2, \dots, t$$

$$\sum_{i=1}^s \tilde{x}_{ij} = \tilde{b}_j, i = 1, 2, \dots, s$$

$$\sum^s \tilde{a}_i = \sum^t \tilde{b}_j; i = 1, 2, \dots, s; j = 1, 2, \dots, t \text{ and}$$

$$\tilde{x}_{ij} \geq 0, i = 1, 2, \dots, s, \quad j = 1, 2, \dots, t$$

The fuzzy transportation problem is explicitly represented by the fuzzy transportation table:

	1	...	t	Supply
1	$\tilde{\alpha}_{11}$...	$\tilde{\alpha}_{1t}$	\tilde{a}_1
⋮	⋮	...	⋮	⋮
S	$\tilde{\alpha}_{s1}$...	$\tilde{\alpha}_{st}$	\tilde{a}_s
Demand	\tilde{b}_1	...	\tilde{b}_t	

3 Recommended algorithm

Step – 1: Verify given problem is stabled or not.

(i.e) $\sum^s \tilde{a}_i = \sum^t \tilde{b}_j$

If unstable, change into a stabled one by introducing a model source or model destination utilizing zero fuzzy item transportation expenses.

Step – 2: The median value is imparted to transform both demand and supply.

Step – 3: From the first row and first column, the minimum quantity of the fuzzy price is selected.

Step – 4: Finding the smallest amount of Inventory and Requirement and allocate it.

Step – 5: Follow the Third and fourth steps, till $(s + t - 1)$ groups are allocated.

4 Result and Discussion

4.1 Numerical example

A resolution that we affirm to fuzzy transportation problem which involves transportation cost, customer needs and demands and existence of products using trapezoidal Fuzzy figures. Observe the following transportation problem by Dipankar De⁽¹²⁾.

	Ra	Rb	Rc	Rd	Inventory
Ia	(-2,0,2,8)	(-2,0,2,8)	(-2,0,2,8)	(-1,0,1,4)	(0,2,4,6)
Ib	(4,8,12,16)	(4,7,9,12)	(2,4,6,8)	(1,3,5,7)	(2,4,9,13)
Ic	(2,4,9,13)	(0,6,8,10)	(0,6,8,10)	(4,7,9,12)	(2,4,6,8)
Requirement	(1,3,5,7)	(0,2,4,6)	(1,3,5,7)	(1,3,5,7)	(4,10,19,27)

4.2 Solution

Table 1. By using Median Technique, we have to convert fuzzy Trapezoidal numbers into a crisp value

	R _a	R _b	R _c	R _d	Inventory
I _a	1	1	1	0.5	3.0
I _b	10	8	5	4	6.5
I _c	6.5	7	7	8	5.0
Requirement	4.0	3.0	4.0	4.0	

Then find the minimum of the resultant values from the first row and column and allocate the particular cost cell of the given problem. If we have more than one minimum resultant value, we can choose anyone.

The same procedure will be followed again and again until we reach the final allocation. Finally, using the new proposed algorithm obtained gives the best possible resolutions are as follows.

Table 2. The given problem is unbalanced, and we are adding 0 rows to balance the given problem.

	R _a	R _b	R _c	R _d	Inventory
I _a	1	1	1	0.5	3.0
I _b	10	8	5	4	6.5
I _c	6.5	7	7	8	5.0
I _d	0	0	0	0	0.5
Requirement	4.0	3.0	4.0	4.0	

Table 3.

	R _a	R _b	R _c	R _d	Inventory
I _a	1	1	1	0.5	3.0
I _b	10	8	5	4	6.5
I _c	6.5	7	7	8	5.0
I _d	0.5				0
	0	0	0	0	
Requirement	3.5	3.0	4.0	4.0	15

Table 4.

	R _a	R _b	R _c	R _d	Inventory
I _a	3.0				
	1	1	1	0.5	3.0
I _b			2.5	4.0	
	10	8	5	4	6.5
I _c	0.5	3.0	1.5		
	6.5	7	7	8	5.0
I _d	0.5				
	0	0	0	0	0.5
Requirement	4.0	3.0	4.0	4.0	15

4.3 Result

Here (4+4-1) = 7 cells are allocated. Next, we can get the optimal solution by means proposed algorithm.

$$\text{Min } Z = 3(1) + 2.5(5) + 4(4) + 0.5(6.5) + 3(7) + 1.5(7) + 0.5(0)$$

$$\text{Min } Z = 66.25$$

4.4 Discussion

The Comparison of the new Proposed Technique with North – West Corner Method, the Least Cost Method, and Vogel’s Approximation Method is listed below, it’s clearly understood that the new proposed Technique affords the optimal results.

Methods	Optimal solutions
North – West Corner Method	88.00
Least Cost Method	70.75
VAM Method	66.50
New Proposed Method	66.25

5 Conclusion

A large number of transportation problems with different levels of sophistication have been studied in the literature. However, some of these problems have limited real-life applications because the conventional transportation problems generally assume crisp data for the transportation cost, the values of supplies and demands. Contrary to the conventional transportation problems, we investigated imprecise data in the real-life transportation problems and developed an alternative method that is simple and yet addresses these shortfalls in the existing models in the literature. In the FTP considered in this study, the values of transportation costs are represented by generalized trapezoidal fuzzy numbers and the values of supply and demand of products are represented by real numbers. Here we concluded that once the ranking function is chosen, the FTP is converted into a crisp one, which is easily solved by the standard transportation algorithms. Therefore, further research on extending the proposed method to overcome these shortcomings is an interesting stream future research. We shall report the significant results of these ongoing projects in the near future.

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