ISSN: 0974-5823 Vol. 7 No. 4 April, 2022

International Journal of Mechanical Engineering

SOLVING FUZZY TRANSPORTATION PROBLEM USING TRAPEZOIDAL FUZZY NUMBER

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ABSTRACT:

The transportation problem is an important aspect which has been extensively studied in operational research and it is one among earliest application of linear programming problem. In the proposed approach of this method, the transportation cost, availability and demand of the product are represented by trapezoidal fuzzy number. We expand and develop a fuzzy version of Vogel's strategy for finding fuzzy optimal solution of fuzzy transportation problem. A numerical example is provided to expose the potency of the method of the transportation problem.

KEY WORDS AND PHRASES:

Fuzzy sets, Trapezoidal fuzzy numbers, Fuzzy Transportation problem, Ranking of fuzzy numbers.

1. INTRODUCTION AND PRELIMINARAIRIES

The transportation problem is a special type of linear programming problem which deals with the distribution of single product from various sources of supply to various destination of demand in such a way that the transportation cost is minimized. That is the supply available at each source, the demand required at each destination as well as the unit transportation cost are given in the precise way. A fuzzy transportation problem is a transportation problem in which the transportation cost, demand and supply are fuzzy quantities.

In this paper, we shall study fuzzy transportation problem, by using a Vogel's approximation method which is very useful tool for the transportation. Since the objective function is considered as a fuzzy number and the total transportation cost of the fuzzy transportation is minimized.

The concept of fuzzy set was introduced by Zadeh in 1965 and Bellman and Zadeh proposed the concept of decision making in fuzzy environment. In 1992 Halse reports that the vehicles transportation referred products by 76 percentage in 1989. Many papers claim that it effects to an increasing of goods, household expenses and accounts to the cost of each output unit in manufacturing. It claims that the transportation plays an vital role especially in business section. In the literature, a massive number existing theories and a huge number of algorithms have been published to solve transportation problem by many researches.

Saeid Abbasbandy and B.Asady proposed the concept of Ranking of fuzzy numbers , this include methods based on the co-efficient of variation, distance between fuzzy set and weighted mean value. Chanas.S and Waldemar Kolodziejczyk exposed a fuzzy approach to the transportation problem, this makes it possible to obtain not only the maximizing solution but also the other alternatives. Arsham.H and A.B.Khan examined a simple-type algorithm for general transportation problems,which reveals the use of the linear programming formulation to solve the transportation problem. Ching-Hsue Cheng proposed the concept called a new approach for ranking fuzzy numbers by distance method in fuzzy system. Abdul Quoddos, Shakeel javid, and M.Mkalid proposed the concept named, a new method for finding an optimal solution for transportation problems. Ahmed.M.M, Khan.A.R, Uddin.M.S,and Ahmed.F had exposed a new approach to solve transportation problems for finding an initial basic feasible solution to obtain an optimal solution for the transportation problems.Sharma.J and Swarup.K proposed the time minimizing transportation problem explicitly gives a basic feasible solution to another last solution arrives. Sushma Duraphe and Sarla Raigar exposed a new approach to solve transportation problems with the max-min total opportunity cost method which makes us to find the optimum solution of a transportation problem and is to minimize the cost. According to Zadeh's extension principle method Sanhita Banerjee and Tapan Kumar Roy had proposed the concept, Arithmetic operation on generalized trapezoidal fuzzy number and its applications. Pandian.P and Natarajan exposed a new algorithm for finding a fuzzy optimal solution for fuzzy transportation problems to find a fuzzy optimal solution where the shipping cost, supply and demand are trapezoidal fuzzy numbers of the transportation problem. H.J.Zimmermann exposed the fourth edition of Fuzzy set theory and its Applications which incepts the theory of fuzzy sets. Bablu Samanta and Tapan kumar Roy proposed the concept of multiobjective entropy transportation model with trapezoidal fuzzy number penalties, sources, and destinations. Akila.S and Robinson.J had proposed a bottle neck problem in multiple attribute group decision making with the application of Runge-kutta merson method and the concept MAGDM problems with correlation coefficient of intuitionistic fuzzy sets. NareshKumar.S and Kumara Ghuru.S had proposed the concept that, Solve fuzzy Transportation using Symmetric Triangular fuzzy number and this make us to solve a symmetric triangular fuzzy number in fuzzy transportation problem

2.PRELIMINARIES

The aim of this section is to present some notations, notions and results which are of useful in our further consideration.

DEFINITION 2.1. FUZZY NUMBERS

A Fuzzy set F is defined on the set of real numbers R is said to be a fuzzy number if its membership function μF:R→ [0,1] has the following characteristics.

- F is normal. Then there exists an x € R such that μF(x)=1
- F is convex. Then for every x1, x2 € R,
  μ(⅄X1+(1-⅄)x2)>= min μF(x1), μF(x2),⅄ € [0,1]
- μF is upper semi-continuous.
- sup(F) is bounded in R.

DEFINITION 2.2.TRAPEZOIDAL FUZZY NUMBERS

A Fuzzy number F=(a, b, c, d) is said to be a trapezoidal fuzzy number. If its membership function μF(x) is given by,

$$\mu F(x)= \begin{cases} 0, & if\ x \leq a \\ \frac{x-a}{b-a}, & if\ a \leq x \leq b \\ 1, & if\ b \leq x \leq c \\ \frac{d-x}{d-c}, & if\ c \leq x \leq d \\ 0, & otherwise \end{cases}$$

1, if b<=x<=c

Where (a, b, c, d) are real numbers.

DEFINITION 2.3.MEMBERSHIP FUNCTION OF TRAPEZOIDAL FUZZY NUMBER

The membership function depends on the relative values of b and c when c is greater than b, the result of the membership function is said to be trapezoidal and the membership function with parameters [abcd] where aibicidi

For addition, A+B=(a1,b1,c1,d1)+(a2,b2,c2,d2)

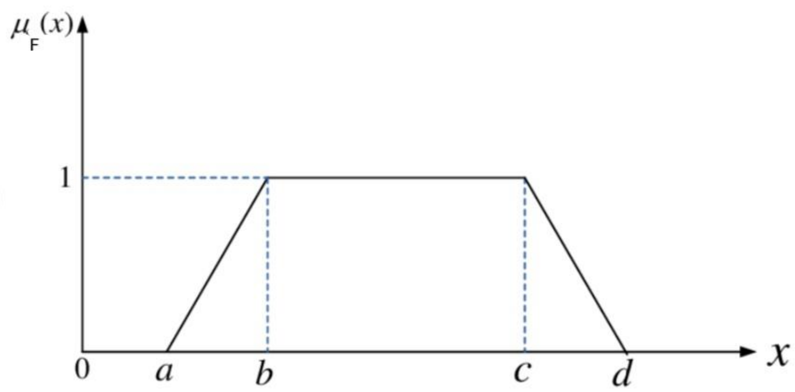
For subtraction, A-B=(a1-d2,b1-c2,c1-b2,d1-a2)

For Multiplication, AxB=(a1xb1,b1xb2,c1xc2,d1xd2)

For division, A/B=(a1/d2,b1/c2,c1/b2,d1/a2)

DEFINITION 2.4.RANKING OF TRAPEZOIDAL FUZZY NUMBER

Various classification for the ranking of fuzzy numbers has been projected in the literature. The efficient classification to examine the fuzzy numbers by the utilization of ranking function based on ranked mean. For any two trapezoidal fuzzy numbers,



$F1=(a^1,b^1,c^1,d^1)$ and $F2=(a^2,b^2,c^2,d^2)$ in F(R),then in the following we have,

i)F1< F2 ↔ R(F1<R(F2))

ii)F1 > F2 ↔ R(F1>R(F2))

iii)F1 ≈ F2 ↔ R(F1=F2)

iv)F1-F2 ↔ R(F1)-R(F2)=0

3.MAIN RESULTS

3.1.STRATEGY TO SOLVE A FUZZY TRANSPORTATION PROBLEM

We shall explicit a solution to the fuzzy transportation problem which includes the transportation cost, customer demand and availability of products from the manufactures by the usage of trapezoidal fuzzy numbers.

Step 1: First of all convert the transportation cost, supply and demand values which is represented as the trapezoidal fuzzy number into a net values through the usage of measure.

Step 2: Then check whether the given transportation problem is balanced or unbalanced transportation problem.

Step 3: After solving the transportation problem with net values with the aid of using the usage of Vogel's Approximation Method(VAM) process. We get the optimal solution and initial solution of the transportation problem.

Step 4: When the solution exists then apply in the allotment table.

Step 5: By using the rules of the allotments, the solution can be obtained in the form of trapezoidal fuzzy numbers.

And during the allotment of the transportation table determine the places of non-zero feasible solution in transportation problem and it must have atleast one allotments in each columns and rows of the transportation table in the transportation problem.

The assigned solution must be zero or a positive integer however but the resulting value can be an integer or not. Then, due to the fact that the given problem explicitly involves the fuzzy numbers as real numbers which is its values.

4.NUMERICAL EXAMPLE

Let us consider the Trapezoidal Fuzzy transportation problem,

		DESTINATION			SUPPLY
	(3,2,2,1)	(3,2,2,1)	(3,2,2,1)	(2,3,3,3)	(1,2,2,2)
	(5,1,1,1)	(6,5,5,5)	(1,5,5,6)	(2,3,3,3)	(1,12,12,11)
	(2,8,8,6)	(2,1,1,3)	(2,1,1,3)	(3,6,6,2)	(3,7,7,1)
DEMAND	(1,5,5,5)	(0,1,1,1)	(1,5,5,5)	(2,9,9,9)	

Convert the measure of the trapezoidal crisp value into a given transportation problem.

		DESTINATION			SUPPLY
	3.62	3.62	3.62	4.4	1.8
	9.27	8.61	5.5	4.4	10.5
	7.27	2.22	2.22	3.7	6
DEMAND	4.4	2.5	4.4	3.8	

Now we obtain a initial solution by using Vogel's approximation method,

	DESTINATION		SUPPLY
	9.27	5.5	3.5
DEMAND	2.6	0.9	

	DESTINATION	SUPPLY
	9.27	2.6
DEMAND	2.6	

Now we obtain the solution in the form of trapezoidal fuzzy numbers by using the rules of the allotments.

		DESTINATION			SUPPLY
	(3,2,2,1)				(1,2,2,2)
	(5,1,1,1)		(1,5,5,6)	(2,3,3,3)	(1,12,12,11)
		(2,1,1,3)	(2,1,1,3)		(3,7,7,1)
DEMAND	(1,5,5,5)	(0,1,1,1)	(1,5,5,5)	(2,9,9,9)	

Hence,the given transportation problem has the trapezoidal fuzzy optimal solution.That is,

X11=(3,2,2,1), X21=(5,1,1,1), X23=(1,5,5,6),

X24=(2,3,3,3), X32=(2,1,1,3) and X33=(2,1,1,3)

The crisp value of the given problem in Minimum cost = 65.6

5.CONCLUSION

In this paper a simple method to solve a fuzzy transportation problem using the classification of fuzzy numbers. The transportation cost, availability at origin and destination requirements are all trapezoidal fuzzy numbers(shipping cost, demand and supply)and the problem is resulted as the trapezoidal fuzzy number.

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