SOLVING FUZZY TRANSPORTATION PROBLEM USING DISTANCE RANKING METHOD FOR TRAPEZOIDAL FUZZY NUMBERS

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Abstract: Ranking fuzzy numbers play a indispensable role in decision making problems, data analysis and socio economics systems. Ranking fuzzy numbers is a inevitable step in many mathematical models. Many of the methods proposed so far are not comparable. This paper introduces a new Distance ranking method and using which we convert the fuzzy transportation problem to a crisp valued transportation problem which then can be solved by MODI Method to find the fuzzy optimal solution. Numerical examples show that the fuzzy Distance ranking method offers a awesome tool for handling the fuzzy transportation problems.

Index Terms - distance Method, Ranking of Trapezoidal Numbers, Ranking Function, Trapezoidal Fuzzy Numbers, and Fuzzy Transportation Problem.

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1. Introduction

Transportation problem is found globally in solving certain real world problems. A transportation problem plays a essential role in production industry and many other purposes. The transportation problem is a special case of Linear programming problem, which permit us to regulate the optimum shipping patterns between origins and destinations. The solution of the problem will give strength us to determine the number of things to be transported from a particular origin to a particular destination so that the price obtained is minimum or the time consumption is minimum or the profit obtained is maximum. Let a_i be the number of units of a product available at origin i and b_j be the number of units of the product required at destination j. Let C_{ij} be the cost of transporting one unit from origin i to destination j and let X_{ij} be the amount of quantity carried or moved from origin i to destination j. A fuzzy transportation problem is a transportation problem in which the transportation expenditures, supply and demand quantities are fuzzy quantities. Ranking fuzzy number is a done in many mathematical models. The concepts of fuzzy sets were first introduced by Zadeh [12]. Since its inception several ranking procedure have been elaborated. Eventually many authors presented various approaches for solving the FTP problems [1],[2],[4]. Few of these ranking approaches have been reviewed and compared by Bortolan and Degani [3]. Presently Chen and H Wang [5] reviewed the existing method for ranking fuzzy numbers and each approach has demerits in some aspects such as indiscrimination and finding not so easy to understand. As of now none of them is completely accepted.

Ranking normal fuzzy number was first launched by Jain [6] for decision making in fuzzy situations. Chan stated that in many situations it is impossible to restrict the membership function to the general form and introduced the concept of generalized fuzzy numbers. Since then extraordinary phenomenal efforts are made on the development of numerous methodologies. The development in ordering fuzzy numbers can even be found in [7],[8],[9],[10],[11].Fuzzy numbers must be ranked before a decision is taken by a decision maker.

In this paper a new method is proposed for the ranking of generalized fuzzy trapezoidal numbers. To illustrate this proposed method, an instance is discussed. As the proposed Distance ranking method is very direct and simple it is very easy to understand and using which it is simple to find the fuzzy optimal solution of fuzzy transportation problems occurring in the real life situations.

This paper is organized as follows: Section 2 includes the basic definition of fuzzy numbers. In section 3, a new Distance ranking procedure is introduced. In section 4, MODI method is adopted to solve Fuzzy transportation problems. To demonstrate the proposed method a numerical example is solved. Finally the paper ends with a conclusion.

2. Preliminaries

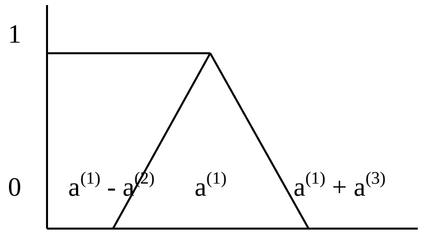
In this section we define some basic definitions which will be used in this paper by Yahya [14].

2.1 Definition

A fuzzy number A in R is said to be a triangular fuzzy number if its membership function $\mu_A : R \to [0,1]$ has the following characteristics.

$$\mu_A(\mathrm{x}) = \begin{cases} \dfrac{x-a_1}{a_2-a_1}, & a_1 \le x \le a_2 \\ 1, & x = a_2 \\ \dfrac{a_3-x}{a_3-a_2}, & a_2 \le x \le a_3 \\ 0, & otherwise \end{cases}$$

It is denoted by $A=(a^{(1)},a^{(2)},a^{(3)})$ where $a^{(1)}$ is Core (A), $a^{(2)}$ is left width and $a^{(3)}$ is right width. The geometric representation of Triangular Fuzzy number is shown in figure. Since, the shape of the triangular fuzzy number A is usually in triangle it is called so.



2.2 Membership function of triangular fuzzy number

The Parametric form of a triangular fuzzy number is represented by $A=\left[a^{(1)}-a^{(2)}(1-r),\ a^{(1)}+a^{(3)}(1-r)\right]$

3. Main Results

Ranking of Triangular Fuzzy number with distance method

Let all of fuzzy numbers be either positive or negative. Without less of generality, Assume that all of them are positive. The membership function of , $a \in R\ is\ u_0(x)=1$ if $x=a:\ and\ u_0(x)=0, if\ x \neq a. Hence\ if\ a=0$ we have the following

$$u_0(x)=\begin{cases}1 & x=0\\ 0 & x\neq 0.\end{cases}$$

Since $u_0(x)\in E$, left fuzziness σ and right fuzziness β are 0, so for each $u_0(x)\in E$

$$d_2(u,u_0)=\left[\int_0^1 \underline{u}(r)^2\,dr+\int_0^1 \overline{u}(r)^2\,dr+\right]^{\frac{1}{2}}$$

Thus we have the following definition.

Definition 3.1 For $u\ and\ v\in E$, define the ranking of $u\ and\ v$ by saying

$$d(u,u_0)>d(v,u_0) \quad if\ and\ only\ if\ \ u\succ v$$
$$d(u,u_0)<d(v,u_0) \quad if\ and\ only\ if\ \ u\prec v$$
$$d(u,u_0)=d(v,u_0) \quad if\ and\ only\ if\ \ u\approx v.$$

Property 3.1 Suppose $u\ and\ v\in E$ are arbitrary then:

1. If $u=v\, then\, u\approx v$
2. If $v\subseteq u\, and\, \underline{u}(r)^2+\overline{u}(r)^2>\underline{v}(r)^2+\overline{v}(r)^2\ \ for\, all\, r\in[0,1]\, then\, v\prec u.$

Remark 3.1 the distance triangular fuzzy number $u=(x_0,\sigma,\beta)\, of\ u_0$ is defined as following

$$d(u,u_0)=\left[2x_0^2+\sigma^2/3+\beta^2/3+x_0(\beta-\sigma)\right]^{\frac{1}{2}}$$

Remark 3.2 the distance trapezoidal fuzzy number $u=(x_0,y_0,\sigma,\beta)\, of\ u_0$ is defined as following

$$d(u,u_0)=\left[x_0^2+y_0^2+\sigma^2/3+\beta^2/3-x_0\sigma+y_0\beta\right]^{\frac{1}{2}}$$

Remark 3.3 if $u\approx v$, it is not necessary that $u=v$. Since if $u\neq v$ and

$$\left(\underline{u}(r)^2+\overline{u}(r)^2\right)^{\frac{1}{2}}=\left(\underline{v}(r)^2+\overline{v}(r)^2\right)^{\frac{1}{2}}\ \ then\, u\approx v.$$

4. Numerical Example

We shall present a solution to fuzzy transportation problem involving shipping cost, customer demand and availability of products using trapezoidal Fuzzy numbers. Consider the following transportation problem by Malini [13]

S	DESTINATION				SUPPLY
O	(1,2,3,4)	(1,3,4,6)	(9,11,12,14)	(5,7,811)	(1,6,7,12)
U	(0,1,2,4)	(-1,0,1,2)	(5,6,7,8)	(0,1,2,3)	(0,1,2,3)
R C	(3,5,6,8)	(5,8,9,12)	(12,15,16,19)	(7,9,10,12)	(5,10,12,17)

E					
DEMAND	(5,7,8,10)	(1,5,6,10)	(1,3,4,6)	(1,2,3,4)	

Step 1: Now by using Distance Ranking Method, we convert the given fuzzy problem in to a crisp valued problem. The FTP is

4.2817	6.4291	19.0088	13.1403	12.8970
3.4156	1.9149	10.5672	2.8868	2.8868
9.4516	14.6629	25.8392	15.7903	19.4764
12.5963	10.7393	6.4291	4.2817	

Step 2: Using VAM procedure we obtain the initial solution as

9.2387	69.0440			
			8.3361	
98.6614		166.1331	22.0258	0

The crisp value of the optimum Fuzzy Transportation by VAM method is Rs 373/-. This is not an optimal solution.

Step 3: Hence by using the MODI method we shall get the optimal solution as

9.2387	69.0440			
		30.5053	0	
98.6614		91.5405	67.6093	0

The crisp value of the optimum Fuzzy Transportation for given problem is Rs 366/-.

5. Conclusions

Ranking fuzzy numbers is a enormous task in a fuzzy decision making process. Each ranking method represents a different point of view on fuzzy numbers. This work formulated a new ranking method which is simple and efficient. As mentioned by Wang and Kerre, it is a tough task to decide whether on which fuzzy ranking method is the best. Most of the time choosing a method rather than another is a matter of preference. The result obtained in this paper gives us the optimum cost for the fuzzy transportation problems.

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