International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 4, Issue 11 [July 2015] PP: 07-10

Two Stage Fuzzy Transportation Problem Using Symmetric Trapezoidal Fuzzy Number

[1]Dr.M.S.Annie Christi, [2]Shoba Kumari.K
Department of mathematics, Providence College for women,Coonoor-643201,India.

Abstract: -The transportation problem is one of the earliest applications of linear programming problems. In the literature, several methods are proposed for solving transportation problems in fuzzy environment but in all the proposed methods, the parameters are normal fuzzy numbers. In this paper, a general fuzzy transportation problem is discussed. In the proposed method, transportation cost, availability and demand of the product are represented by symmetric trapezoidal fuzzy numbers. Robust ranking technique is usedfor finding fuzzy optimal solution of fuzzy transportation problem. A numerical example is given to show the efficiency of the method

Keywords: Fuzzy *set; Symmetric Trapezoidal fuzzy number; Robust ranking method; zero suffix method*

I. INTRODUCTION

The Transportation problem is a special type of linear programming problem which deals with the distribution of single product (raw or finished) from various sources of supply to various destination of demand in such a way that the total transportation cost is minimized. There are effective algorithms for solving the transportation problems when all the decision parameters, i.e. thesupply available at each source, the demand required at each destination as well as the unit transportation costs are given in a precise way

In some circumstances due to storage constraints, designations are unable to receive the quantity in excess of their minimum demand. After consuming part of whole of this initial shipment, they are prepared to receive the excess quantity in the second stage. According to Sonia and Rita Malhotra [1], in such situations the product transported to the destination has two stages. Just enough of the product is shipped in stage-I so that the minimum requirements of the destinations are satisfied and having done this the surplus quantities (if any) at the sources are shipped to the destinations according to cost consideration. In both the stages the transportation of the product from sources to the destinations is done in parallel. The aim is to minimize the sum of the transportation costs in two stages. Here, a ranking technique is used for solving two stage fuzzy transportation problem, where transportation cost, demand and supply are in the form of symmetric trapezoidal fuzzy numbers.

II. PRELIMINARIES

Zadeh[2] 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, μ_A(x) ; x Є X}, Hereμ_A : X →[0,1] is a mapping called the degree of membership function of the fuzzy set A and μ_A(x) is called the membership value of x ϵ 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 ϵ X such that μ_A (x) = 1.

2.3 Definition (*Symmetric trapezoidal fuzzy number*):

A fuzzy number $A = (a, b, c, c)$ is said to be symmetric Tapezoidal fuzzy number if its membership function $\mu_A(x)$ is given by

$$\mu_A(x) = \begin{cases} \dfrac{x + (c - a)}{c}, & (c - a) \le x \le c \\ 1, & a < x < b \\ \dfrac{-x + (b + c)}{c}, & b \le x \le (b + c) \\ 0, & otherwise \end{cases}$$

III. ROBUST RANKING TECHNIQUES:

Robust ranking technique[6] which satisfies compensation, linearity, and additivity properties and provides results which are consistent with human intuition. Give a convex fuzzy number ã, the Robust Ranking Index is defined by

$\boldsymbol{R(\tilde{a}) = \int_0^1 0.5(a_\alpha^L, a_\alpha^U)d\alpha}$, *where* (a_α^L, a_α^U) is a α-level cut of a fuzzy number ã.

In this paper we use this method for ranking the objective values. The Robust ranking index R (ã) gives the representative value of the fuzzy number ã.

IV. ZERO SUFFIX METHOD

The zero suffix method proceeds as follows.

Step 1: Construct the transportation table for the given TP and check the balanced condition. If not, convert it into balanced one.

Step 2: Subtract each row entries of the transportation table from the row minimum.

Step 3:subtract each column entries of the resulting transportation table after using the Step 2 from the column minimum.

Step 4: In the reduced cost matrix there will be atleast one zero in each row and column, then find the suffix value of all the zeros in the reduced cost matrix by following simplification, the suffix value is denoted by S,

S = Add the costs of nearest adjacent sides of zero **/** No. of costs added

Step 5: Choose the maximum of S, if it has one maximum value then supply to that demand corresponding to the cell. If it has more equal values then select {ai,bj } and supply to that demand maximum possible.

Step 6: After the above step, the exhausted demands (column) or supplies (row) are to be trimmed. If $a_i = b_j$, cross out either ith row or jth column but not both. The resultant matrix must possess atleast one zero is each row and each column, else repeat step2 and step3.

Step 7: Repeat Step 4 to Step 6 until the optimal cost is obtained.

V. NUMERICAL EXAMPLE

Consider the Fuzzy transportation problem. Here cost value, supplies and demands are trapezoidal fuzzy number. Herea_i and b_j are Fuzzy Supply and Fuzzy Demand. Robust Ranking technique is used to finding the initial basic feasible solution.

	$\mathbf{D_1}$	$\mathbf{D_2}$	$\mathbf{D_3}$	$\mathbf{D_4}$	**SUPPLY**
$\mathbf{S_1}$	(1,2,3,3)	(1,3,4,4)	(9,11,12,12)	(5,7,8,8)	(1,6,7,7)
$\mathbf{S_2}$	(0,1,2,2)	(-1,0,1,1)	(5,6,7,7)	(0,1,2,2)	(2,1,3,3)
$\mathbf{S_3}$	(3,5,6,6)	(5,8,9,9)	(12,15,16,16)	(7,9,10,10)	(5,10,12,12)
DEMAND	(5,7,8,8)	(1,5,6,6)	(1,3,4,4)	(1,2,3,3)	

Here,$\sum_{i=1}^{n} a_i = \sum_{j=1}^{m} b_j$ the problem is balanced fuzzy transportation problem. There exists a fuzzy initial basic feasible solution. Now apply Robust Ranking Technique for the above fuzzy transportation problem.

$$\boldsymbol{R(\tilde{a}) = \int_0^1 0.5(a_\alpha^L, a_\alpha^U)d\alpha}$$

Where $(a_\alpha^L, a_\alpha^U) = [c\alpha - (c-a), (b+c) - c\alpha]$

$$R(1,2,3,3) = \int_0^1 (0.5)[3\alpha - (3-1), (2+3) - 3\alpha]d\alpha$$

$$= \int_0^1 (0.5)\,(-2+5)d\alpha$$

$$= \int_0^1 (0.5)(3)\,d\alpha = 1.5$$

Similarly

R(1,3,4,4)=2, R(9,11,12,12)=10, R(5,7,8,8)=6, R(0,1,2,2)=0.5,
R(-1,0,1,1)= -0.5, R(5,6,7,7)=5.5, R(0,1,2,2)=0.5, R(3,5,6,6)=4,
R(5,8,9,9)=6.5 , R(12,15,16,16)=13.5 , R(7,9,10,10)=8

Rank of all supply

R(1,6,7,7)=3.5, R(2,1,3,3)=1.5, R(5,10,12,12)=7.5

Rank of all demand

R(5,7,8,8)=6, R(1,5,6,6)=3, R(1,3,4,4)=2, R(1,2,3,3)=1.5

Table after ranking

	D_1	D_2	D_3	D_4	SUPPLY
S_1	1.5	2	10	6	3.5
S_2	0.5	-0.5	5.5	0.5	1.5
S_3	4	6.5	13.5	8	7.5
DEMAND	6	3	2	1.5	

Stage I:

Take $a_1 = 2,\ a_2 = 1,\ a_3 = 4$

$b_1 = 4\ ,\ b_2 = 1,\ b_3 = 1,\ b_4 = 1$

	D_1	D_2	D_3	D_4	SUPPLY
S_1	1.5	2	10	6	2
S_2	0.5	-0.5	5.5	0.5	1
S_3	4	6.5	13.5	8	4
DEMAND	4	1	1	1	

After applying Zero suffix method, we get

	D_1	D_2	D_3	D_4	SUPPLY
S_1	1.5	2 **[1]**	10 **[1]**	6	2
S_2	0.5	-0.5	5.5	0.5 **[1]**	1
S_3	4 **[4]**	6.5	13.5	8 **[0]**	4
DEMAND	4	1	1	1	

Min Z =2 x 1 + 10 x 1 + 0.5 x 1 + 4 x 4 + 8 x 0
= 28.5

Stage II:

Take $a_1 = 1.5, a_2 = 0.5, a_3 = 3.5$

$b_1 = 2,\ b_2 = 2,\ b_3 = 1,\ b_4 = 0.5$

	D_1	D_2	D_3	D_4	SUPPLY
S_1	1.5	2	10	6	1.5
S_2	0.5	-0.5	5.5	0.5	0.5
S_3	4	6.5	13.5	8	3.5
DEMAND	2	2	1	0.5	

After applying Zero suffix method, we get

	D_1	D_2	D_3	D_4	SUPPLY
S_1	1.5	2 **[1.5]**	10	6	1.5
S_2	0.5	-0.5	5.5	0.5 **[0.5]**	0.5
S_3	4 **[2]**	6.5 **[0.5]**	13.5 **[1]**	8	3.5
DEMAND	2	2	1	0.5	

Min Z = 2 x 1.5 + 0.5 x 0.5 + 4 x 2 + 6.5 x 0.5 + 13.5 x 1
= 28

Therefore the optimal value for the given problem is
Minimum (28.5+28) =56.5

VI. CONCLUSION

The transportation cost is considered as imprecise fuzzy numbers in this paper. Here, the fuzzy transportation has been changed into crisp transportation using Robust ranking technique[6]. Later, an optimal solution has been originated from crisp and fuzzy optimal total cost of given example. Moreover, using Robust ranking Method and Zero suffix method can conclude that the solution of fuzzy problem obtained more accurately and effectively.

REFERENCE

[1] Sonia and Rita Malhotra, "A polynomial for a Two-Stage Time Minimizing Transportation problem".OPsearch, 39, No.5&6,(2003).

[2] L.Zadeh and R.Bellman, "Decision making is a fuzzy environment", Management Science, 17(1970).

[3] A.Gani and K.A.Razok (2006), "Two stage fuzzy transportation problem", Journal of Physical Science.

[4] P. Jayaraman and R. Jahiehussian (2013), "Fuzzy optimal transportation problem by improved zero suffix method via robust ranking techniques" International journal of fuzzy mathematics and system.

[5] Shugani Poonam, Abbas S.H and Gupta V.K(2012), "Fuzzy transportation problem of trapezoidal numbers with α-cut & ranking techniques" International journal of fuzzy mathematics and system.

[6] Nagarajan .R and Solairaju.A (2010), "A computing improved fuzzy optimal Hungarian. Assignment problem with fuzzy cost under Robust ranking Techinique", internal journal of computer application volume 6, no 4.

[7] Pandian, P. and Natrajan, G. (2010): "A new algorithm for finding a fuzzyoptimal solution for fuzzy transportation problem'', applied mathematicalsciences, vol.4, No.2.

[8] Ganesan,K., &Veeramani,P.,(2006), An approach to solve a fuzzy linear programming problem involving symmetric trapezoidal fuzzy numbers without converting it into crisp linear programming problem, *Annals of Operation Research*, 143

[9] K. Kalaiarasi, S. Sindhu, M. Arunadevi (2014) "Optimization of trapezoidal balanced Transportation problem using zero-suffix and Robust Ranking Methodology with fuzzy demand and fuzzy supply models" International journal of computer science and technology,vol2(2).