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SOLVING FUZZY TRANSPORTATION PROBLEM USING DIFFERENT METHODS

DR.M.MUTHULAKSHMI , M.PRIYA , P.REVATHI , K.V.PRIYANKA

***Abstract*—** A variety of methods are proposed for solving fuzzy transportation problems but all the methods in literature, demonstrate the parameters by normal fuzzy numbers. In most of the work it is quite impossible to limit the membership function to the normal form. So in this paper a generalized approach for fuzzy numbers for transportation problem is proposed. In proposed work, a new approach is presented for solving real life fuzzy transportation problems by assuming that a decision maker is uncertain about the accurate values of the demand, availability as well as the transportation cost of the given product. In this paper Vogel's Approximation Method (VAM) is introduced which provide optimum initial solution rather than northwest corner method and intuitive low cost method. In the proposed method demand, availability as well as the transportation cost of the product are represented by generalized trapezoidal fuzzy numbers. The proposed VAM method is very easy to understand and easy to apply on real life fuzzy transportation problems for the decision makers.

***Keywords*—** Ranking function, fuzzy numbers, Vogel's Approximation Method (VAM)

I. INTRODUCTION

The transportation problem has many application in solving problems of the real world. As an example, the transportation problem play a significant role in the logistics and management of the supply chain. Parameters of the transportation problem consist of amounts of cost, supply and demand. The origin of the transportation methods dates back to 1941 when F. L. Hitchcock presented a study entitled *The Distribution of a Product from Several Sources to Numerous Localities*.

Dr.M.Muthulakshmi , Assistant Professor / ECE , Jayshriram Engineering College , Tirupur .
(Email ID : Kathirmuthu29@gmail.com)
M.Priya , Assistant Professor / ECE , Jayshriram Engineering College , Tirupur .
(Email ID : priyaamohandass@gmail.com)
P.Revathi , Assistant Professor / ECE , Jayshriram Engineering College , Tirupur
(Email ID : revathitamil73@gmail.com)
K.V.Priyanka Assistant Professor / ECE , Jayshriram Engineering College , Tirupur .

This presentation is considered to be the first important contribution to the solution of the Transportation Problems.

Generalized trapezoidal fuzzy number

A new concept for ranking of generalized trapezoidal fuzzy number is presented using trapezoid as reference point. This Ranking methods map fuzzy number directly in to the real line.

To Find R (A) = [(a1+b1+c1+d1)/4]

Different method

Any optimize solution for a given transportation problem is solved in two phases:

1. Finding the initial basic feasible solution in first phase.
2. Second phase involves optimization of the initial basic feasible solution (IBFS) obtained in phase 1.

In order to find the initial basic feasible solution we can use North-west corner cell method, least cost cell method and Vogel's approximation method (VAM).In order to optimizing initial basic feasible solution u-v method is used in this paper.

Problem:

For the balanced fuzzy transportation problem given below:

	Destination				**Supply**
SOURCE	(1,2,3,4)	(7,5,4,3)	(3,7,8,7)	(3,2,9,8)	(5,6,8,7)
	(4,3,8,7)	(1,5,7,2)	(2,3,1,1)	(5,4,1,7)	(4,7,3,3)
	(7,5,2,7)	(2,2,5,1)	(3,2,6,4)	(5,2,7,3)	(4,7,3,3)
Demand	(3,4,2,4)	(9,8,1,7)	(1,3,2,1)	(3,4,6,8)	

By using the ranking procedure the trapezoidal fuzzy transportation problem is reduced to the normal fuzzy transportation problem.

2.2	4.75	6.25	5.5	6.5
5.5	3.75	1.75	4.25	4.25
5.25	2.5	3.75	4.25	5.25
3.25	5.75	1.75	5.25	

Method 1: North west corner method:

The North West Corner method is one of the method to solve fuzzy transportation problem. Before we solve the problem we must clear the part is the given problem is balanced. Otherwise we use the dummy row as well as column.

By using North west corner method we have the solution is given below

3.25 / 2.5	3.25 / 4.75	6.25	5.5	6.5
5.5	2.5 / 3.75	1.75 / 1.75	4.25	4.25
5.25	2.5	0 / 3.75	5.25 / 4.25	5.25
3.25	5.75	1.75	5.25	

3.25	3.25		
	2.5	1.75	
		0	5.25

we get the solution as 58.312

Method 2: Vogel's Approximation Method:

Vogel's Approximation Method (VAM) is very powerful method to solve the transportation problems. Here we are taking the trapezoidal fuzzy numbers to construct the fuzzy transportation problem. By using this method we have the solution is given below.

3.25 / 3.25	0.5 / 4.75	6.25	2.75 / 5.5	6.5
5.5	3.75	1.75 / 1.75	2.5 / 4.25	4.25
5.25	5.25 / 2.5	3.75	4.25	5.25
3.25	5.75	1.75	5.25	

3.25	0.5		2.75
		1.75	2.5
	5.25		

Then we get the solution as 52.4375

Method 3: Least Cost Method

The Least Cost Method (LCM) is used to obtain the initial basic feasible solution for the given transportation problem. Here, the allocation begins with the cell which has the minimum cost. The lower cost cells are chosen over the highercost cell with the aim to have the least cost of transportation.

3.25 / 2.5	4.75	6.25	3.25 / 5.5	6.5
5.5	0.5 / 3.75	1.75 / 1.75	2 / 4.25	4.25
5.25	5.25 / 2.5	3.75	4.25	5.25
3.25	5.75	1.75	5.25	

3.25			3.25
	0.5	1.75	2
	5.25		

Here the solution is not optimal.

To check Optimality:

To optimize basic solution U-V method is applied on this problem. First find out the U values (u1,u2,u3) for rows and V values (v1,v2,v3,v4) for columns. The steps to find U-V values is

Step 1:

$U_1 + V_j = C_{ij}$ and $M + N \square 1 = No.of\ allocated\ cells$

$\Rightarrow 3 + 4 \square 1 = 6$

Assume $U_1 = 0$ & C_{ij} values are given in the problem (2.5, 5.5, 3.75, 1.75, 4.25 and 2.5).

By using this we get the values are u1=0, u2= -1.25, u3=3.5, v1=3.25, v2=1.75, v3=3, v4=3.25.

Step 2:

To calculate penalties for unallocated cells we use the formula as

$P_{ij} = U_i + V_j - C_{ij}$

P12= 0 + 1.75 - 4.75= -3

P13= 0 + 3 – 6.25 = - 3.25

P21 = - 1.125 + 3.25 – 5.5 = - 3.375

P31 = 3.5 + 3.25 – 5.25 = 1.5

P33 = 3.5 - 3 – 3.375 = 3.125

P34 = 3.5 + 3.25 – 4.25 = 2.

If we get zero or less than zero the optimality is reaching and find out the maximum value among Pij. So P33 gives the maximum positive value and it is the starting point of basic cell. We draw a closed path from this cell and assign negative & positive values shown in above figure. Now by adding and subtracting the new values matrix is shown below

	v1=3.25	v2=1.75	v3=3	v4=3.25
u1=0	3.25			3.25
u2=-1.25		0.5 +	1.75 –	2
u3=3.5		– 5.25	+	

Step 3:

Again with same procedure the new pij values are

P12= -1.25

P13= - 4.5

P21 = - 3.5

P23 = - 1.25

P31 = -5.25

P34 = - 2.

Now all the values are negative optimality is reached. So total cost can be calculated by this new matrix

	v1=3.25	v2=3.5	v3=1.75	v4=3.25
u1=0	3.25			3.25
u2= -1.25		2.25		2
u3= 0		3.5	1.75	

The Transportation cost is = 58.25 Which is an optimal solution.

II. CONCLUSION

In this proposed work, the transportation costs are taken as generalized Trapezoidal fuzzy numbers. Mathematical formulation of fuzzy transportation problem is discussed with suitable numerical example for different basic feasible solution finding methods. Numerical example shows that using this formulation one can have the optimal solution as well as the crisp and Trapezoidal fuzzy optimal total cost with a particular method. To illustrate the north-west corner method, least cost method and VAM method a numerical example is solved and transportation cost is calculated. However, believing that the results obtained in this paper gives us the optimum cost for the fuzzy transportation problems.

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