Advances and Applications in Mathematical Sciences
Volume 21, Issue 2, December 2021, Pages 749-754

A NEW APPROACH FOR SOLVING FUZZY TRANSPORTATION PROBLEM WITH LR FLAT FUZZY NUMBERS

S. SATHYA GEETHA[1] and K. SELVAKUMARI[2]

[1]Research Scholar
[2]Assistant Professor
Department of Mathematics
Vels Institute of Science,
Technology and Advanced Studies
Chennai, Tamil Nadu, India
Email: selvafeb6@gmail.com
geethuk911@gmail.com

Abstract

In this paper, we propose a fuzzy transportation problem (TP) in which all parameters such as supply, demand and transportation costs are taken as LR flat fuzzy numbers. We apply the new concept for finding the minimum transportation cost.

1. Introduction

We studied a new approach which we named as maxmin-minmax method that is having proposed saddle point and not having proposed saddle point in transportation cost for solving transportation problems with the help of LR flat fuzzy numbers.

2. Preliminaries

Definition 2.1. LR flat fuzzy number

A fuzzy number $\overline{A}$, is defined on a universal set of real numbers R,

2020 Mathematics Subject Classification: 03B52, 90C29.
Keywords: LR flat fuzzy number, Ranking of LR flat fuzzy number, maxmin-minmax method.
Received May 17, 2021; Accepted June 7, 2021

represented as $\overline{A} = (\alpha_1, \alpha_2, \alpha_3, \alpha_4)_{LR}$ is said to be LR flat fuzzy number with the following membership function

$$\mu_{\overline{A}}(x) = \begin{cases} L\left(\dfrac{\alpha_2 - x}{\alpha_2 - \alpha_1}\right) & \text{if } \alpha_1 \le x \le \alpha_2 \\ 1, & \text{if } \alpha_2 \le x \le \alpha_3. \\ R\left(\dfrac{x - \alpha_3}{\alpha_4 - \alpha_3}\right) & \text{if } \alpha_3 \le x \le \alpha_4 \end{cases}$$

3. Ranking of LR Flat Fuzzy Number

We proposed Yager's ranking technique for ranking of trapezoidal fuzzy numbers. Let $\overline{A} = (\alpha_1, \alpha_2, \alpha_3, \alpha_4)_{LR}$ and its $\lambda-$cut, $\overline{A}_\lambda = [\alpha_1 - \alpha_3 L^{-1}(\lambda),$ $\alpha_2 = \alpha_4 R^{-1}(\lambda)]$ according the following formula

$$R(\overline{A}) = \frac{1}{2}\left(\int_0^1 (\alpha_1 - \alpha_3 L^{-1}(\lambda))d\lambda + \int_0^1 (\alpha_2 - \alpha_4 R^{-1}(\lambda))d\lambda\right)$$

If $\overline{A}$ and $\overline{B}$ are two fuzzy numbers such that

(i) $\overline{A} > \overline{\text{B}}$ if $R(\overline{A}) > R(\overline{B})$

(ii) $\overline{A} = \overline{\text{B}}$ if $R(\overline{A}) = R(\overline{B})$

(iii) $\overline{A} \ge \overline{\text{B}}$ if $R(\overline{A}) \ge R(\overline{B})$

To calculate $R(\overline{A})$ from the extreme values of λ-cut of $\overline{A}$ rather than its membership functions. By using this approach, the value of $R(\overline{A})$ for any parameter, denoted as trapezoidal fuzzy number $\overline{A} = (\alpha_1, \alpha_2, \alpha_3, \alpha_4)_{LR}$ with $L(X) = R(X) = \max[0, 1 - x]$, we obtained by using the succeeding formula

$$R(\overline{A}) = \frac{1}{2}\left[\alpha_1 + \alpha_2 - \frac{\alpha_3}{2} + \frac{\alpha_4}{2}\right].$$

4. Algorithm

Minmax-maxmin method

Step (1):

We construct the given transportation problem into two types namely, type-1 and type-2. First, we choose the type-1 then type-2 to solve the fuzzy transportation problem using LR flat fuzzy numbers.

Step (1a):

If it is type-1 fuzzy transportation problem, then LR flat fuzzy numbers having proposed saddle point converted into crisp value by applying Yager's ranking function, we obtain the classical transportation problem.

Step (2):

To examine the balance of given transportation problem, if $\sum_{i=0}^{m} a_1 = \sum_{j=0}^{n} b_j$, then, we go to the step (3) and if $\sum_{i=0}^{m} a_1 \neq \sum_{j=0}^{n} b_j$ then, add dummy row or column and make it balance and proceed with balanced transportation problem.

Step (3):

We have computing the maxmin-minmax method. If max-min value = min-max value, to find the minimum of rows and maximum of columns, then finding maximum along the row minimum and finding minimum along the column maximum.

Step (4):

We proceed with the first allocation in that particular cost cell by coinciding min-max and max-min value for reducing the corresponding minimum row or column.

Step (5):

Again, we have computing the next allocation by coinciding min-max and max-min value and do the next allocation in the cost cell, then reducing the corresponding minimum row or column.

Step (6):

Repeat the same procedures step (3), step (4) and step (5) until we complete all the allocations.

5. Numerical Example

The unit cost of the transportation quoted in terms of LR flat fuzzy numbers which are given in the matrix below. Find the transportation plan such that the total transportation cost is minimum.

	S1	**S2**	**S3**	**S4**	**Capacity**
C1	(13,16,20,24)	(11,14,20,21)	(8,12,15,16)	(19,20,26,30)	(24,25,28,30)
C2	(13,15,20,22)	(8,9,10,17)	(4,10,12,16)	(10,11,12,16)	(29,30,34,36)
C3	(20,22,24,30)	(4,5,6,7)	(5,6,8,11)	(3,4,6,9)	(16,19,22,24)
C4	(8,12,14,16)	(4,5,6,8)	(6,7,8,12)	(8,10,12,14)	(22,24,26,30)
Demand	(27,28,30,32)	(34,35,38,40)	(12,16,20,24)	(18,19,22,24)	

Solution:

Since the given problem is a balanced fuzzy transportation problem. Applying the proposed algorithm, the solution of problem is as follows:

We convert the given fuzzy transportation problem with LR flat fuzzy numbers into crisp value by applying Yager's ranking function, we obtain the classical transportation problem.

First, we find the minimum of rows and maximum of columns, then finding maximum along the row minimum and finding minimum along the column maximum by coinciding max-min and min-max value.

We proceed with the first allocation in that particular cost cell on that saddle point and reducing the corresponding minimum row or minimum column

	1	**S2**	**S3**	**4**	**Capacity**	**Max(min)**
C1	5.5	12.75	**15** 10.25	20.5	**25**	**10.25** ←
C2	14.5	10.75	8	11.5	**30**	**8**
C3	22.5	4.75	6.25	5.25	**18**	**4.75**
C4	10.5	5	7.5	9.5	**24**	**5**

Demand	28	35	15	19		
Min(max)	22.5	12.75	↑ 10.25	20.5		

In the same way, we have computing the saddle point again by coinciding min-max and max-min value and do the next allocation in the cost cell, then reducing the corresponding minimum row or column. We apply the same technique repeatedly, the final allocation is

	S1	**S2**	**S3**	**S4**	**Capacity**
C1	15.5	10 12.75	15 10.25	20.5	**25**
C2	14.5	25 10.75	8	5 11.5	**30**
C3	18 22.5	4.75	6.25	5.25	**18**
C4	10 10.5	5	7.5	14 9.5	**24**
Demand	**28**	**35**	**15**	**19**	

The Transportation Cost

$$Z = 10.25*15+12*10+10.75*25+11.5*5+9.5*14+22.5*18+10.5*10$$

$$Z = 1,250.50$$

6. Conclusion

The ranking of LR flat fuzzy numbers given to the fuzzy transportation problem is helpful for choosing the best of all possible alternatives. Hence, we conclude that the new approach developed in the current research is the simplest and the alternative approach for getting minimum transportation cost with LR flat fuzzy numbers.

References

[1] S. Chanas and D. Kuchta, A concept of the optimal solution of the transportation problem with fuzzy cost coefficients, Fuzzy Sets Syst. 82 (2) (1996), 299-305.

[2] J. Chiang, The optimal solution of the transportation problem with fuzzy demand and fuzzy product, J. Inf. Sci. Eng. 21 (2005), 439-451.

[3] D. Dubois and H. Prade, Operations on fuzzy numbers, Int. J. Syst. Sci. 9(6) (1978), 613-626.