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Fuzzy Transportation Problem of Hexagon Number with α - cut and Ranking Technique

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Abstract

In this paper we are presenting a ranking technique with alpha cut optimal solution for solving transportation problem, where fuzzy demand and supply are all in the form of Hexagonal fuzzy number. The main aim of this paper is to introduce a new operation for addition, subtraction, multiplication of Hexagonal fuzzy numbers on the basis of alpha cuts sets of fuzzy numbers. In an organisation, where a number of alternatives and variables such as production, inventory, financial management, costing and various other parameters are involved. This ranking procedure serves as an efficient method wherein a numerical example is also taken and the inference is given.

Keywords

Robust Ranking method, Hexagonal fuzzy numbers, α-optimal solution, Fuzzy transportation problem.

1. Introduction

The Fuzzy Transportation Problem (FTP) is one of the special kinds of fuzzy linear programming problems. A fuzzy transportation problem is a transportation problem in which the transportation costs, supply and demand quantities are fuzzy quantities. To deal quantitatively with imprecise information in making decisions Bellman and Zadeh and Zadeh introduced the notion of fuzziness. Fuzzy transportation is the transportation of fuzzy quantity from the fuzzy origin to fuzzy destination in such a way that the total fuzzy transportation cost is minimum. The objective of the fuzzy transportation problem is to determine the shipping schedule that minimizes the total fuzzy transportation cost, while satisfying fuzzy supply and demand limits.

The Fuzzy set Theory has been applied in many fields such as Management, Engineering etc. In this paper a new operation on Hexagonal Fuzzy number is defined where the methods of addition, subtraction, and multiplication has been modified with some conditions.

2. Preliminaries

2.1 Definition

Let X be a nonempty set. A fuzzy set A in X is characterized by its membership function $A : X \rightarrow [0, 1]$, where A(x) is interpreted as the degree of membership of element x in fuzzy A for each other $x \in X$.

2.2 Interval Number

Let R be the set of real numbers. Then closed interval [a, b] is said to be an interval number, where $a, b \in R$, $a \leq b$.

2.3 Fuzzy Number

A Fuzzy set A of the real line R with membership function

$\mu\tilde{A}$ (X) : $R \rightarrow [0, 1]$ is called fuzzy number if

i. A must be normal and convex fuzzy set;

ii. The support of $\tilde{A}$, must be bounded

iii. α_A must be closed interval for every $\alpha \in [0, 1]$

3. Hexagon Fuzzy Number

The Fuzzy number H is a hexagonal fuzzy $\tilde{A}_H$ is a hexagonal fuzzy number denoted $\tilde{A}$H (a, b, c, d, e, f; 1) and its member function $\mu\tilde{A}_H(x)$ is give below.

$$\mu\tilde{A}H(x) = \begin{cases} y - a / b - a & a \leq y \leq b \\ 1 & b \leq y \leq c \\ d - y / d - c & c \leq y \leq d \\ 0 & \text{Otherwise} \\ y - c / d - c & c \leq y \leq d \\ 1 & d \leq y \leq e \\ f - y / f - e & e \leq y \leq f \\ 0 & \text{Otherwise} \end{cases}$$

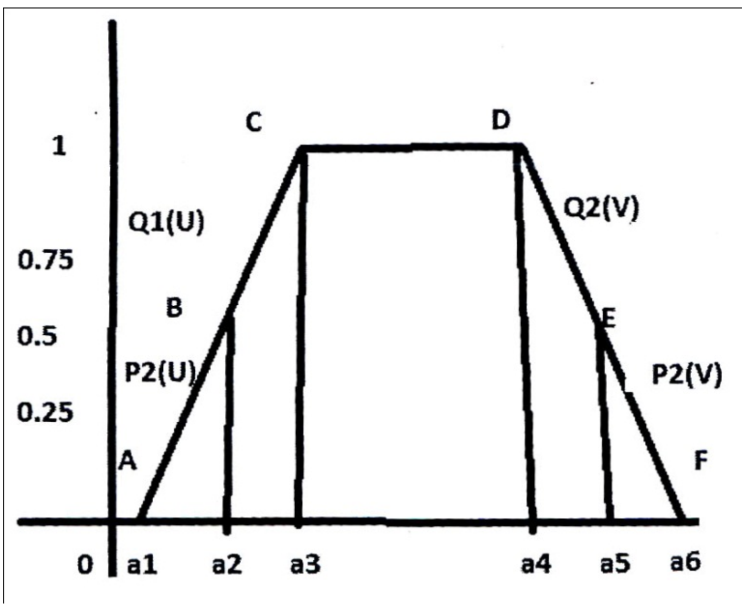

Figure 1 : Graphical representation of a Hexagonal fuzzy number

3.1 Arithmetic operations on Hexagonal fuzzy number

Let $\tilde{A}_H = (a_1, a_2, a_3, a_4, a_5, a_6)$ and $\tilde{N}_H = (n_1, n_2, n_3, n_4, n_5, n_6)$ be two hexagonal fuzzy numbers, then

i. $\tilde{A}_H (+)\tilde{N}_H = (a_1 + n_1, a_2 + n_2, a_3 + n_3, a_4 + n_4, a_5 + n_5, a_6 + n_6)$

ii. $\tilde{A}_H (-)\tilde{N}_H = (a_1 + n_1, a_2 + n_2, a_3 + n_3, a_4 + n_4, a_5 + n_5, a_6 + n_6)$

iii. $\tilde{A}_H (*)\tilde{N}_H = (a_1 + n_1, a_2 + n_2, a_3 + n_3, a_4 + n_4, a_5 + n_5, a_6 + n_6)$

3. Robust Ranking Technique

Robust Ranking Technique satisfies the following properties,

i. Compensation
ii. Linearity
iii. Additivity

It provides results which are consist human intuition . If $\tilde{A}$ is a fuzzy number then the Robust ranking is defined by

$$R(\tilde{A}_H) = {}_0\int^1 (0.5)\,(a_{h\alpha}{}^L, a_{h\alpha}{}^U)\, d\alpha \text{ where } (a_{h\alpha}{}^L, a_{h\alpha}{}^U)$$

Is the α level cut of the fuzzy number $\tilde{A}_H$. In this paper we find the rank of the objective

Numerical Example

A Company has six sources S_1, S_2, S_3, S_4, S_5 and S6 and six destination D_1, D_2, D_3, D_4, D_5 and D_6 ; the fuzzy transportation cost for unit quantity of the product from i^{th} source j^{th} destination is

B_{ij} Where $[b_{ij}]$ 3x4 = (1,2,3,4,5,6) (1,3,4,6,7,8) (8,9,7,8,6,5,4) (2,6,5,4,3,2)
(3, 6, 5, 4, 3, 2) (2,3,5,6,7,5) (4,7,6,5,2,1) (3,4,5,6,7,5)
(1,5,6,7,6,2) (1,8,7,6,5,6) (5,9,4,6,7,6) (8,7,1,0,6,5)

And fuzzy availability of the product at source are (2,3,5,6,2,1), (5,10,12,17,11,10), (8,10,12,12,6,4) and the fuzzy demand of the product at destination are (5,8,8,7,5,4), (5,1,6,7,5,4,2), (2,3,1,3,5,7) and (3,6,9,12,15,13,18).

Then the problem becomes as

Table – 1

	FD1	FD2	FD3	FD4	Supply
FS_1	(1,2,3,4,5,6)	(1,3,4,6,7,8)	(8,9,7,6,5,4)	(2,6,5,4,3,2)	(2,3,5,6,2,1)
FS_2	(3,6,5,4,3,2)	(2,3,5,6,7,5)	(4,7,6,5,2,1)	(3,4,5,6,7,5)	(5,10,12,17,11,10)
FS_3	(1,5,6,7,6,2)	(1,8,7,6,5,6)	(5,9,4,6,7,6)	(8,7,1,0,6,5)	(8,10,12,12,6,4)
Demand	(5,8,8,7,5,4)	(5,1,6,7,5,2)	(2,3,1,3,5,7)	(3,6,9,12,15,18)	

Solution

The fuzzy transportation problem can be formulated in the following mathematical programming from

Min x = R(1,2,3,4,5,6) $y_1$1 + R(1,3,4,6,7,8) y_{12} + R(8,9,7,6,5,4) y_{13} + R(2,6,5,6,7,5) y_{14} + R(3,6,5,4,3,2) y_{21} + R(2,3,5,6,7,5) y_{22} + R(4,7,6,5,2,1) y_{23} + R(3,4,5,6,7,5) y_{24} + R(1,5,6,7,6,2) y_{31} + R(1,8,7,6,5,6) y_{32} + R(5,9,4,6,7,6) y_{33} + R(8,7,0,6,5) y_{34}

R (H) = $0\int^1 (0.5) (a_{h\alpha}{}^L, a_{h\alpha}{}^U) d\alpha$

Where = $\{(b\text{-}a)\ \alpha + a,\ d - (d\text{-}c)\ \alpha\} + \{(d\text{-}c)\ \alpha + c,\ f - (f\text{-}e)\ \alpha\}$

R (1, 2, 3, 4, 5, 6) = $_0\int^1 (0.5) (\alpha + 1 + 4 - \alpha + \alpha + 3 + 6 - \alpha) d\alpha$

Similarly

R(1,3,4,6,7,8) = 9.75; R(8,9,7,6,5,4) = 13; R(2,6,5,4,3,2)=7.75; R(3,6,5,4,3,2)=8 R(2,3,5,6,7,8) = 9.75; R(4,7,6,5,2,1) = 9; R(3,4,5,6,7,5) = 10.25; R(1,5,6,7,6,2) = 10; R(1,8,7,6,5,6) = 11.5; R(5,9,4,6,7,6) = 11.75; R(8,7,1,0,6,5) = 7;

Rank of all supply

R(8,10,12,12,6,4) = 19; R(2,3,5,6,2,1) = 9.75; R(2,3,1,3,5,7) = 6.25;

R (3, 6, 9, 12, 15,18) = 21;

Table after ranking

Table 2

	FD_1	**FD_2**	**FD_3**	**FD_4**	**Supply**
FS_1	7	9.75	13	7.75	19
FS_2	8	9.75	9	10.25	7.5
FS_3	10	11.5	11.25	7	23.5
Demand	13	9.75	6.25	21	

Table after applying Matrix Minima method

Table 3

	FD_1	FD_2	FD_3	FD_4	Supply
FS_1			**7**		
	7	9.75	13	7.75	19
FS_2		**6**		**9.75**	
	8	9.75	9	10.25	7.5
FS_3		**2.5**		**21**	
	10	11.5	11.25	7	23.5
Demand	13	9.75	6.25	21	

The Transportation cost is

$$(13)\ (7) + (9.75)\ (6) + (1025)\ (9.75) + (11.5)\ (205) + (7)\ (21)$$

$$= 393.6875$$

$$= 393.7$$

Conclusion

We have thus obtained an optimal solution for fuzzy transportation problem using hexagon fuzzy numbers. The new arithmetic operations of hexagon fuzzy numbers are employed to get the fuzzy optimal solutions. Moreover the fuzzy transportation problem using Robust's ranking indices, numerical example show that by this method we can have the optimal solution as well as the crisp and fuzzy optimal total cost. By using Robust's [10] ranking method we have shown that the total cost obtained is optimal. We can conclude that the solution of fuzzy transportation problems can be obtained by Robust's ranking method effectively.

References

1. Abbasbandy, s and Hajjari, T. (2009): "A new approach for ranking "computers and mathematics with application, 57 pp 413-419.

2. Fortemps P. and Roubens M. (1996): "Ranking and defuzzification methods based area compensation" Fuzzy sets and system, Vol 82 pp 319-330.
3. Gani, A. Nagoor and Rajak, K. Abdul (2006): "Two stage fuzzy transportation problem", Journal of physical science, Vol. 10, 63-69.
4. Lin, Feng_Tse and Tsai, Tzong-Ru (2009): "A two stage genetic algorithm for solving the transportation problem with fuzzy demands and fuzzy supplies", Int. J. of innovative computing information and control Vol.5.
5. Lu, Shiang_Tai and Chiang, Kao (2004): "Solving fuzzy transportation problem based on extension principle", European Journal of Operational Research, 153 pp 661-674.
6. M.Sakawa, I.Nishizaki, Y.Uemura (2001): "Interactive fuzzy programming for two level linear and linear fractional production and assignment problems' a case study, European J. Oper. Res. 135 pp 142-157.
7. Pandian, P. and Nataraja, G. (2010): "An optimal More or Less solution to fuzzy transportation problem with mixed constrints" Applied mathematical sciences, vol 4, no.29, 1405-1415.
8. Pandian, P. and Natarajan G. (2010): "A New algorithm for finding a fuzzy optimal solution for fuzzy transportation problem", applied mathematical sciences, vol.4, No.2, 79-90.
9. R. R. Yager (1981): "A procedure for ordering fuzzy subsets of the unit interval", Information Sciences, 24, 143-161.
10. R. Nagarajan and A. Solairaju (2010): "Computing improved fuzzy optimal Hungarian Assignment Problems with Fuzzy Costs under

Roubest Ranking Techniques” international journal of computer application, vol 6, no.4.

11. Ritha, W. and Vinoths, J. Merline (2009): “Multi-objective two stage fuzzy transportation problem”, journal of physical science, vol.13, pp 107-120.
12. S.H.Chen (1985), “Ranking fuzzy numbers with maximizing set and minimizing set”, Fuzzy Sets and System, 17 pp 113-129.
13. S. Chanas, D. Kuchta (1996), A concept of the optimal solution of the transportation problem with fuzzy cost coefficients, Fuzzy Sets and Systems 82 pp 299-305.
14. S. Chanas, D. Kuchta (1999): “Fuzzy integer transportation problem”,. European J. operation research 118 pp 95-126.
15. Sonia, and Malhotra, Rita (2003): “A plynomial algorithm for a two stage time minimizing transportation problme”, OPSEARCH, 39, No.5 and 6, pp 251-266.
16. Zadeh, L.A (1965): “Fuzzy sets, Information and Control”, 8, pp 338-353.