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Fuzzy Transportation Problem in Icosikaitetragonal Fuzzy Number

V.Varun[1] and S.Senthil[2]

[1]Research Scholar, Department of Mathematics,

Vels Institute of Science, Technology and Advanced Studies (VISTAS),

Chennai-600 117, Tamil Nadu, India

[2]Assistant Professor, Department of Mathematics

Vels Institute of Science, Technology and Advanced Studies (VISTAS),

Chennai-600 117, India

E-mail: senthils.sbs@velsuniv.ac.in

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Abstract

The transportation problem is one of the special type and the applications of linear programming problems.The usual transportation problem is unspecifiedthat the decision maker is sure about the accurate values of transportation cost, supply and demand of the product. In some situations decision maker is not in the position to specify the objective precisely but rather than which can be specified in fuzzy concepts. We study fuzzy transportation problem (FTM) using Icosikaitetragonal fuzzy number and its membership function. We have defined the ranking to the Icosikaitetragonal fuzzy numbers to convert the fuzzy valued transportation to crisp valued transportation problem. To illustrate these approaches, a real life problem has been solved using the Least Cost Method

Keywords: Fuzzy transportation problem (FTM),Icosikaitetragonal fuzzy number, membership function, least cost method.

1. Introduction:

The fuzzy set was offered to the world by Zadeh[1]. The fruits of fuzzy setsare extended to engineering and technology, management and economics by many researchers .The transportation problem originally developed by Hitchcock. The transportation problems are most useful to the industries and others to reduce the cost and maximize the profit. The transportation problem is a special case of linear programming problem. In a fuzzy transportation problem, costs, supply and demand values are fuzzy values. There are many approaches to solve the fuzzy transportation problem by different Authors.In many real life situations, it is not possible to determine both transportation unit cost and quantities, but the fuzzy numbers give best approximation of them. Raju and Jayagopal [2] introduced the Icosikaitetragonal fuzzy numbers and its membership function.Because there is always no possible to restrict the membership function in a particular form. Icosagonal fuzzy number is complex when it is compared to the triangular and trapezoidal fuzzy number both in form and computation. Using Icosikaitetragonal fuzzy numbers to solve the fuzzy transportation problem gives best optimal value when we compared with triangular and trapezoidal fuzzy numbers. Michael has proposed algorithm for solving transportation problem with fuzzy constraints and has investigated the relationship between the fuzzy algebraic structure of the optimum solution of the deterministic problem and its fuzzy equivalent. In this paper, we have solved fuzzy transportation problem using Icosikaioctagonal fuzzy number. We have illustrated fuzzy transportation problem using ranking technique with Icosikaitetragonal fuzzy numbers.

2. PRELIMINARIES

In this section, we give the preliminaries that are required for this study.

Definition 2.1. *A fuzzy set A is defined by* $A = \{(x, \mu_A(x)) : x \in A, \mu_A(x) \in [0,1]\}$.

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Here x is crisp set A and $\mu_A(x)$ is membership function in the interval $[0,1]$.

Definition 2.2. *The fuzzy number A is a fuzzy set whose membership function must satisfy the following conditions.*

(i) A fuzzy set A of the universe of discourse X is convex

(ii) A fuzzy set A of the universe of discourse X is a normal fuzzy set if $x_i \in X$ exists

(iii) $\mu_A(x)$ is piecewise continuous

Definition 2.3*An α-cut of fuzzy set A is classical set defined as $^{\alpha}[A] = \{x \in X | \mu_A(x) \geq \alpha\}$*

Definition 2.4*A fuzzy set A is a convex fuzzy set iff each of its α-cut $^{\alpha}A$ is a convex set.*

Definition 2.5Mathematical formulation of a fuzzy transportation problem

The general form of Transportation problem is

Minimize (totalcost) $z = \sum_{i=1}^{m}\sum_{j=1}^{n} C_{ij} X_{ij}$

Subject to the constraints

$$\sum_{j=1}^{n} x_{ij} = a_i,\ i = 1,2,3.......m$$

$$\sum_{i=1}^{m} x_{ij} = b_j,\ j = 1,2,3.......n$$

$x_{ij} \geq 0$ For all i *and* j

2.6 Ranking of Icosikaitetragonal fuzzy number:

Let N be a normal Icosikaitetragonal fuzzy number. The value $V\ (M)$, called as measure of M is calculated as

$$M(P) = \frac{1}{2}\int_{1}^{k_1}(J_1 + J_2)dJ + \frac{1}{2}\int_{k_1}^{k_2}(A_1 + A_2)dA + \int_{k_2}^{k_3}(S_1 + S_2)dS + \int_{k3}^{k_4}(T_1 + T_2)dT +$$

where $0 \leq k_1 \leq k_2 \leq k_3 \leq k_4 \leq 1$

$$M(P) = \frac{1}{4}\begin{bmatrix} (r_1 + r_2 + r_{27} + r_{28})k_1 + (r_3 + r_4 + r_{25} + r_{26})(k_2 - k_1) + (r_5 + r_6 + r_{23} \\ (r_7 + r_8 + r_{21} + r_{22})(k_4 - k_3) + (r_9 + r_{10} + r_{19} + r_{20})(k_5 - k_4) + (r_{11} + \\ +(r_{13} + r_{14} + r_{15} + r_{16})(1 - k_6) \end{bmatrix}$$

where $0 \leq k_1 \leq k_2 \leq k_3 \leq k_4 \leq k_5 \leq k_6 \leq 1$

we take the values for $k_1 = \frac{1}{7}, k_2 = \frac{2}{7}, k_3 = \frac{3}{7}, k_4 = \frac{4}{7}, k_5$

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Definition 2.7 [2]

A fuzzy number A = $\left(a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9, a_{10}, ... a_{24}\right)$ is Icosikaitetragonal fuzzy number and its membership function is given by

$$\mu_A(x) = \begin{cases} 0, \ for \ x < a_1 \\ k_1\left(\dfrac{x - a_1}{a_2 - a_1}\right), \ for \ a_1 \le x \le a_2 \\ k_1, \ for \ a_2 \le x \le a_3 \\ k_1 + (k_2 - k_1)\left(\dfrac{x - a_3}{a_4 - a_3}\right), \ for \ a_3 \le x \le a_4 \\ k_2, \ for \ a_4 \le x \le a_5 \\ k_2 + (k_3 - k_2)\left(\dfrac{x - a_5}{a_6 - a_5}\right), \ for \ a_5 \le x \le a_6 \\ k_3, \ a_6 \le x \le a_7 \\ k_3 + (k_4 - k_3)\left(\dfrac{x - a_7}{a_8 - a_7}\right), \ for \ a_7 \le x \le a_{8/} \\ k_4, \ for \ a_8 \le x \le a_9 \\ k_4 + (k_5 - k_4)\left(\dfrac{x - a_9}{a_{10} - a_9}\right), \ for \ a_9 \le x \le a_{10} \\ k_5, \ for \ a_{10} \le x \le a_{11} \\ k_5 + (1 - k_5)\left(\dfrac{x - a_{11}}{a_{12} - a_{11}}\right), \ for \ a_{11} \le x \le a_{12} \\ 1, \ for \ a_{12} \le x \le a_{13} \\ k_5 + (1 - k_5)\left(\dfrac{a_{14} - x}{a_{14} - a_{13}}\right), \ for \ a_{13} \le x \le a_{14} \\ k_5, \ for \ a_{14} \le x \le a_{15} \\ k_4 + (k_5 - k_4)\left(\dfrac{a_{16} - x}{a_{16} - a_{15}}\right), \ for \ a_{15} \le x \le a_{16} \\ k_4, \ for \ a_{16} \le x \le a_{17} \\ k_3 + (k_4 - k_3)\left(\dfrac{a_{18} - x}{a_{18} - a_{17}}\right), \ for \ a_{17} \le x \le a_{18} \\ k_3, \ for \ a_{18} \le x \le a_{19} \\ k_2 + (k_3 - k_2)\left(\dfrac{a_{20} - x}{a_{20} - a_{19}}\right), \ for \ a_{19} \le x \le a_{20} \\ k_2, \ for \quad a_{20} \le x \le a_{21} \\ k_1 + (k_2 - k_1)\left(\dfrac{a_{22} - x}{a_{22} - a_{21}}\right), \ for \ a_{21} \le x \le a_{22} \\ k_1, \ for \ a_{22} \le x \le a_{23} \\ k_1\left(\dfrac{a_{24} - x}{a_{24} - a_{23}}\right), \ for \ a_{23} \le x \le a_{24} \\ 0, \ for \ x > a_{24} \end{cases}$$

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3.1 Balanced transportation problem:

The general form of Transportation problem is

Minimize (total cost) $z = \sum_{i=1}^{m}\sum_{j=1}^{n} C_{ij} X_{ij}$

Subject to the constraints $\sum_{j=1}^{n} x_{ij} = a_i,\ i = 1,2,3.......m$

$$\sum_{i=1}^{m} x_{ij} = b_j,\ j = 1,2,3.......n$$

$x_{ij} \geq 0$ For all $i\ and\ j$

If total supply from all the sources is equal to the total demand in all destinations, then it is called as balanced transportation problem

3.2Unbalanced transportation problem:

The general form of Transportation problem is

Minimize (total cost) $z = \sum_{i=1}^{m}\sum_{j=1}^{n} C_{ij} X_{ij}$

Subject to the constraints $\sum_{j=1}^{n} x_{ij} = a_i,\ i = 1,2,3.......m$

$$\sum_{i=1}^{m} x_{ij} = b_j,\ j = 1,2,3.......n$$

$x_{ij} \geq 0$ For all $i\ and\ j$

If in a transportation problem total supply from all the sources is not equal to the total demand in all destinations, then it is called as unbalanced transportation problem. But for a feasible solution to exist, total supply must be equal to the total demand thus it is necessary convert unbalanced problem into balanced problem.

3.3 Procedure for solving Least cost method (LCM)

Step 1: Select the cell having minimum unit cost C_{ij} and allocate as much as possible,

i.e., $\min\ (s_i, d_j)$

Step 2: Subtract this minimum value from supply S_i and demand d_j

Step 3: If the supply is S_i is zero then strike out that row and if the demand d_j is zero then strike that column

Step 4: If minimum unit cost cell is not unique, then select the cell where maximum allocation can be possible

Step 5: Repeat this steps for all uncrossed rows and columns until all supply and demand values are zero

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4. Numericalexample:

Consider the following fuzzy transportation problem

	Destination			Supply
Origin	(-6,-5,-4,-3, -2,-1,0,1, 2,3,4,5, 6,7,8,9, 10,11,12,13, 14,15,16,17)	(-8,-7,-6,-5, -4,-3,-2,-1, 0,1,2,3, 4,5,6,7, 8,9,10,11, 12,13,14,15)	(1,2,3,4, 5,6,7,8, 9,10,11,12, 13,14,15,16, 17,18,19,20, 21,22,23,24)	(-4,-3,-2,-1, 0,1,3,5, 6,7,8,10, 12,13,15,17, 19,20,21,22, 24,25,26,27)
	(-6,-5,-4,-3, -2,-1,0,1, 2,3,4,5, 6,7,8,9, 10,11,12,13, 14,15,16,18)	(-11,-10,-9,-7, -6,-5,-4,-3, -2,-1,0,1, 2,3,4,5, 6,7,8,9, 10,11,12,13)	(0,1,2,4, 5,6,7,8, 9,10,11,12, 13,14,16,18, 20,22,24,26, 27,28,29,30)	(-10,-9,-8,-7, -6,-4,-2,-1, 0,1,2,3, 4,5,6,7, 9,10,11,12, 14,16,18,20)
	(0,1,2,3, 4,5,6,7, 9,10,11,13, 14,15,17,19, 21,22,24,25, 26,27,28,29)	(1,2,3,6, 8,9,10,12, 13,15,16,17, 19,20,22,23, 25,28,30,32, 34,35,37,39)	(-5,-4,-3,-2, -1,01,2, 3,4,5,6, 7,8,9,10, 11,12,13,14, 15,1617,18)	(2,4,5,6, 8,10,12,13, 15,17,18,19, 20,22,23,24, 25,26,28,30, 31,32,33,34)
Demand	(2,3,4,6, 7,8,9,10, 11,12,13,14, 15,16,17,18,	(-8,-7,-6,-4, -3,-2,-1,0, 1,2,3,5, 6,7,8,9,	(-7,-6,-5,-4, -3,-2,-1,0, 1,2,3,4, 5,6,7,8,	

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	19,20,21,22, 23,24,25,26)	10,11,12,13, 14,15,16,17)	9,10,11,12, 14,16,18,20)	

This problem is solved by taking the values *for* $k_1=\frac{1}{7},k_2=\frac{2}{7},k_3=\frac{3}{7},k_4=\frac{4}{7},k_5=\frac{5}{7},k_6=\frac{6}{7}$.

We obtain the values of Measureof matrix A and is denoted by $\mu_{Icskoct}\,(a_{ij})$

a_{11}	$-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17$	$\mu_{Icskoct}\,(a_{11}) = 5.43$
a_{12}	$-8,-7,-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15$	$\mu_{Icskoct}\,(a_{12}) = 2.36$
a_{13}	$1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24$	$\mu_{Icskoct}\,(a_{13}) = 16.57$
a_{21}	$-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,18$	$\mu_{Icskoct}\,(a_{21}) = 5.67$
a_{22}	$-11,-10,-9,-7,-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6,7,8,9,10,11,12,13$	$\mu_{Icskoct}\,(a_{22}) = 9.25$
a_{23}	$0,1,2,4,5,6,7,8,9,10,11,12,13,14,16,18,20,22,24,26,27,28,29,30$	$\mu_{Icskoct}\,(a_{23}) = 22.43$
a_{31}	$0,1,2,3,4,5,6,7,9,10,11,13,14,15,17,19,21,22,24,25,26,27,28,29$	$\mu_{Icskoct}\,(a_{31}) =14.5$
a_{32}	$1,2,3,6,8,9,10,12,13,15,16,17,19,20,22,23,25,28,30,32,34,35,37,39$	$\mu_{Icskoct}\,(a_{32}) = 17.04$
a_{33}	$-5,-4,-3,-2,-1,0,1,2,3,4,5,6\ 7,8,9,10,11,12,13,14,15,16,17,18$	$\mu_{Icskoct}\,(a_{33}) = 6.5$

Fuzzy supplies are noted as follows

S_1	-4,-3,-2,-1,0,1,3,5,6,7,8,10,12,13, 15,17,19,20,21,22,24,25,26,27	11.32
S_2	-10,-9,-8,-7,-6,-4,-2,-1,0,1,2,3, 4,5,6,7,9,10,11,12,14,16, 18,20	4.07
S_3	2,4,5,6,8,10,12,13,15,17,18,19,20, 22,23,24,25,26,28,30,31,32,33,34	21.54

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And Fuzzy demands are depicted as follows

D_1	2,3,4,6,7,8,9,10,11,12,13,14,15,16, 17,18,19,20,21,22,23,24,25,26	16.39
D_2	-8,-7,-6,-4,-3,-2,-1,0,1,2,3,5,6, 7,8,9,10,11,12,13,14,15,16,17	4.86
D_3	-7,-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6, 7,8,9,10,11,12,14,16,18,20	5.25

And Total fuzzy supply and the total fuzzy demands are shown as follows

S	-12,-8,-5,-2,2,7,13,17,21,25,28,32,36,40,44,48,53,56,60,64,69,73,77,81	36.93
D	-13,-10,-7,-2,1,4,7,10,13,16,19,23,26,29,32,35,38,41,44,47,51,55,59,63	26.50

The crisp valued transportation is as follows

	Destination			Supply
Source	5.43	2.36	16.57	11.32
	5.67	9.25	22.43	4.07
	14.5	17.04	6.5	21.54
Demand	16.39	4.86	5.25	

Then the solution is explained in the following tables

	Destination				Supply
Source	5.43	2.36 0.89	16.57	0 10.43	11.32
	5.67 4.07	9.25 3.6	22.43	0	4.07
	14.5 12.32	17.04 3.97	6.5 5.25	0	21.54
Demand	16.39	4.86	5.25	10.43	36.93

The initial basic feasible solution is obtained by least cost method. We get the solution containing 8 non negative independent allocations equal to m+n-1

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	Destination			Supply
Origin	5.43	2.36 $\boxed{0.89}$	16.57	~~0.89~~ 0
	5.67	9.25	22.43	4.07
	14.5	17.04	6.5	21.54
Demand	16.39	~~4.86~~ 3.97	5.25	

	Destination			Supply
Origin	5.67 $\boxed{4.07}$	9.25	22.43	~~4.07~~ 0
	14.5	17.04	6.5	21.54
Demand	~~16.39~~ 12.32	3.97	5.25	

	Destination			Supply
Origin	14.5	17.04	6.5 $\boxed{5.25}$	~~21.54~~ 16.29
Demand	12.32	3.97	~~5.25~~ 0	

	Destination		Supply
Origin	14.5	17.04 $\boxed{3.97}$	~~16.29~~ 12.32
Demand	12.32	~~3.97~~ 0	

	Destination	Supply
Origin	14.5 $\boxed{12.32}$	~~12.32~~
Demand	~~12.32~~	

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The transportation cost is

$$(2.36\times 0.89)+(0\times 10.43)+(5.67\times 4.07)+(14.5\times 12.32)+(17.04\times 3.97)+(6.5\times 5.25)$$

= 2.1004 + 0 + 23.0769 + 178.64 + 67.6488 + 34.125

Total cost = 305.5911

5. Conclusion:

In this paper, unbalanced transportation problem has been solved with Icosikaitetragonalfuzzy number.The use of Icosikaitetragonal fuzzy number in fuzzy transportation problem is given. Fuzzy transportation problem converted to crisp valued problem and is illustrated by an example Optimal value obtained using Icosikaitetragonal fuzzy numbers are more optimal than the solution obtained by using hexadecagonal and Icosagonal fuzzy numbers.

References:

[1] L.A. Zadeh, , Fuzzy sets, Information and Control, 8(3) ,1965, 338-353.

[2] R.E.Bellman and L.A.Zadeh, Decision making in fuzzy environment, Management Science, 17, 1970, 141-164.

[3] V. Raju and R. Jayagopal, ''A new operation on Icosikaitetragonal fuzzy number'', Journal of Combinatorial Mathematics and Combinatorial Computing ,Volume 112(2020), Page no : 127- 136

[4] V.Raju and S.Ramachandran "Icosagonal fuzzy number in decision making problem

International Journal of Trend in Scientific Research and Development , Volume 5,Issue 6,2021, Page no : 1194-1199

[5] S. Sasikumar and V.Raju '' Study on Fuzzy game problem in Icosikaitetragonal Fuzzy number'' Annals of Romanian Society for Cell biology , Volume 25,Issue 6, 2021, Page No : 10500-10508

[6] V.Raju and S.Maria Jesu Raja ''An Approach on Fuzzy game problem in Icosikaioctagonal Fuzzy number'' Journal of Xidian University, Volume 14, Issue 4, 2020, Page no: 1009-1016

[7]V.Raju and S.Arul Amirtha Raja " Study on fuzzy sequencing problem in Icosikaioctagonal Fuzzy Numbers'' Journal of Xidian University, Volume 14, Issue 4, 2020, Page no: 3829-3837

[8] V.Raju and S.Maria Jesu Raja '' Fuzzy decision making problem in Icosikaioctagonal Fuzzy number'' Journal of Xidian University, Volume 14, Issue 5, 2020, Page no: 3240-3248

[9]R. Deepa and V. Raju ''Solving Fuzzy Transportation Problem using Icosikaioctagonal Fuzzy Numbers'' Journal of Shanghai Jiaotong University, Volume 16, Issue 7,2020 Page No: 162-173

JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 2, 2022, p. 3415-3425
https://publishoa.com
ISSN: 1309-3452

[10] S.Maria Jesu Raja and V.Raju ‘’Elucidating Fuzzy Assignment problem Employing Icosikaioctagonal Fuzzy Number ‘’ Journal of Xi’an University of Architecture and Technology , Volume 12, Issue 6, 2020 ,Page no : 1681-1688

[11] V.Ashok Kumar and V.Raju ‘’ An Approach on Fuzzy Assignment problem in Icosagonal Fuzzy Number ‘’ Journal of Xi’an University of Architecture and Technology, Volume 12, Issue 5, 2020 ,Page no : 3487-3493

[12] V.Raju and M.ParuvathaVathana “Discourse on Fuzzy Game Problem in Icosagonal Fuzzy Number ‘’ International journal of scientific research and review volume 8, Issue 3, 2019, Page no: 1384-1390

[13] V.Raju , Ranking Function on Icosagonal Fuzzy Number for Solving Fuzzy Transportation Problem, ‘’Journal of Applied Science and Computations ‘’ Volume VI, Issue IV, 2019, Page No: 3631-3640

[14] V.Raju and M.ParuvathaVathana “An Icosagonal Fuzzy Number for solving Fuzzy Sequence Problem‘’ International journal of Research in Engineering, ITand Social Sciences’’ Volume 9, Issue 5, 2019. Page no: 37-40

[15] V.Raju and M.ParuvathaVathana “ Fuzzy Critical path method with Icosagonal Fuzzy Numbers using Ranking Method’’ A Journal of Composition Theory, Volume 12, Issue 9, 2019, Page no: 62-69

[16] V. Raju and R. Jayagopal “An Approach on Icosikaioctagonal Fuzzy number-Traditional Operations on Icosikaioctagonal fuzzy number” A Journal of composition theory, Vol.XII, Issue X, 2019, Page No: 727-734

[17] V. Raju and R. Jayagopal “An Arithmetic Operations of Icosagonal fuzzy number Using Alpha cut ”International Journal of Pure and Applied Mathematics. Volume120, No. 8, 2018, 137-145

[18]V. Raju and R. Jayagopal‘’ A Rudimentary Operations on Octagonal Fuzzy Numbers ‘’ International Journal of Research in Advent Technology Vol.6, No.6, June 2018,Page No: 1320-1323

[19] V.Raju and M.Paruvatha Vathana ‘’ Graceful labeling for some complete bi partite garaph’’ Journal of computer and Mathematical sciences , Volume 9,Issue 12 ,2018, Page no : 2147-2152

[20] R.Jayagopal and V.Raju ‘’Domination Parameters in shadow graph and Path connected graph’’ International Journal of mathematics and its Applications , volume 6, Issue 2B,2018 , Page no : 167-172

[21] K. Arulmozhi , V. Chinnadurai ‘’Bipolar fuzzy soft hyper ideals of ordered – hypersemigroups Γ ‘’International Journal of Scientific Research and Review Volume 8, Issue 1, 2019, Page No: 1134-1140