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Some relative concept fuzzy transportation problem operation

A Seetha Banu[1], M Ramesh Kumar[2]
[1] Research Scholar, Department of Math's, Prist University, Puducherry, India
[3] Associate Professor of Math's, (Dean) Prist University, Puducherry, India

Abstract
In this investigation, we propose a new algorithm called Modified Fuzzy Russell's method to obtain the initial basic feasible of a Fuzzy transportation problem. Thus, some fuzzy numbers are not directly comparable. A numerical illustration is also discussed and new ranking of fuzzy number is introduced.

Keywords: fuzzy, method [vam] (or) least cost methods [lcm] (or) northwest corner

Introduction

Ranking of trapezoidal fuzzy numbers

In this section, a new approach for ranking of generalized trapezoidal number is proposed using trapezoid as reference point. Ranking methods mapfuzzy number directly in to the real line. That is, $M : F \to R$ which associate every fuzzy number with a real number and then use the ordering $\geq$ on the realline.
Let $A = (a1, b1, c1, d1 : \omega1)$ be generalized trapezoidal fuzzy numbers then
(A) is calculated as follows:

Step 1: Findω= minimum $(\omega1, \omega2)$
Step2: Find $(A) = \omega\ [K(a + d\ ) + 2(1 - k)(b + c\ )]$,Where $k \in (0,1)$
4 1 1 1 1

Example: 4.1
We shall present a solution to fuzzy transportation problem involving shipping cost, customer demand and availability of products using trapezoidal fuzzy numbers. Consider the following fuzzy transportation problem.

S	Destination				Supply
O	(1,2,3,4)	(1,3,4,6)	(9,11,12,14)	(5,7,8,11)	(1,6,7,12)
U R	(0,1,2,4)	(-1,0,1,2)	(5,6,7,8)	(0,1,2,3)	(0,1,2,3)
C E	(3,5,6,8)	(5,8,9,12)	(12,15,16,19)	(7,9,10,12)	(5,10,12,17)
Demand	(5,7,8,10)	(1,5,6,10)	(1,3,4,6)	(1,2,3,4)	

Step 1: Now by using the ranking technique, we convert the given fuzzy problem in to a crisp valued problem. The problem is done by taking the value of k as 0.5 and = 1.
The FTP is

1.875	2.625	8.625	5.75	4.875
1.25	0.375	4.875	1.125	1.125
4.125	6.375	11.625	7.125	8.25
5.625	4.125	2.625	1.875	

Step 2: Hence by using the MODI method we shall get the optimal solution as

	4.125	0.75	
		1.125	
5.625		0.75	1.875

The crisp value of the optimum fuzzy transportation for the given problem is Rs 68

Mathematical formulation of a fuzzy transportationproblem

Mathematically a transportation problem can be stated as follows:

Minimize

$$Z = \sum_{i=1}^{m} \sum_{j=1}^{n} C_{ij} x_{ij}$$

Subject to $\sum_{j=1}^{n} X_{ij} = a_j \; j = 1,2,\ldots\ldots n$

$\sum_{i=1}^{m} X_{ij} = b_i \; i = 1,2,\ldots\ldots m$

$X_{ij} \geq 0 \; i = 1,2,\ldots\ldots, j = 1,2,\ldots\ldots n$

Where $X_{ij} = (X_{ij1}, X_{ij2}, \ldots, X_{ijp})$ $p = 3, 4 \ldots$ be the fuzzy number of units shifted from origins i to sinks j

$C_{ij} = (C_{ij1}, C_{ij2}, \ldots, C_{ijp})$ $p = 3, 4 \ldots$be the unit FTC from the origins i to sinks j

$a_j = (a_{j1}, a_{j2}, \ldots, a_{jp})$ $p = 3, 4 \ldots$be the supply at origins point j and

$b_i = (b_{i1}, b_{i2}, \ldots, b_{ip})$ $p = 3, 4 \ldots$ be the demand at sinks point i.

Note 1: In balanced FTPs ,the two set of constraints will be consistent if

$$\sum_{j=1}^{n} a_j = \sum_{i=1}^{m} b_i$$

, otherwise it is unbalanced FTP

Note 2: The basic feasible solution of the FTPs that contains no more than $(m + n - 1)$ non-negative allocations.

Note 3: The non-degenerate basic feasible solution if it contains exactly $(m + n - 1)$ non-negative allocations.

Note 4: The basic feasible solutions(BFS) contains the non negative allocations of the

i. More than $(m + n - 1)$ is calledBFS.

ii. Exactly $(m + n - 1)$ is called non-degenerateBFS.

iii. Less than $(m + n - 1)$ is called BFS $m + n - 1$,iscalled degenerate BFS. Note 5: A feasible solution have the minimized the total FTCis called the fuzzy optimalsolution.

5 Procedure for solving FTP

The following procedure is used to find the solution of FTP using OFN and DDFNin the trapezoidal shape.

Step 1: The balanced FTP,then DDFN converted into crisp values and DDFN reduced to the OFN is converted into crispvalues

Step 2: To findthe any one of the initial basic feasible solutions.i.e.,)Vogels Approximation Method [VAM] (or) Least Cost Methods [LCM] (or) NorthWest Corner Rule [NWCR],then using MODI alogorithums till an optimum solution is obtained.

Example

This problem is done by taking the value of $\alpha 1 = 0.1$, $\alpha 2 = 0.3$, $\alpha 3 = 0.5$and $\alpha 4 = 0.7$ we obtain the values of the $MD(C_{ij})$, $MDDFN(a_i)$ and $MDDFN(b_j)$as

Table 1: Input Data Dodecagonal Fuzzy Transportation Problem

	D_1	D_2	D_3	D_4	Supply
S_1	−3, −2, −1, (0,1,2,3,4,)	−2, −1,0, (1,2,3,4,)	6,7,8,9, (10,11,12,13,)	2,3,4,5, (6,7,8,9,10,)	−1, 0, 1, 3, (5, 6,7,8,10,)
	5,6,7,8	5,6,7,8,9	14,15,16,17	11,12,13	12,13,14
S_2	−4, −3, −2, (−1,0,1,2,3,)	−5, −4, −3, (−2, −1,0,1,)	0,1,2,4, (5,6,7,8,9,)	−5, −4, −3 (−1,0,1,2,4)	−4, −3, −2, (−1,0, 1,2,)
	4,5,6,7	2,3,4,5,6	11,12,13	5,6,7,9,	3,4,5,6,7
S_3	0,1,2,3, (4,5,6,7,8,)	1,2,3,6,7, (8,9,10,12,)	8,9,11,12, (14,15,16,17,)	2,3,5,6,8,9, (10,11,12,)	2,4,5,6,8, (10,12,13,)
	9,10,11	13,15,16	18,21,22,23	15,16,17	15,17,18,19
Demand	2,3,4,5,6,	−2,0,1,2,	−2, −1,0,	−3, −2, −1,	
	(7,8,9,10,)	(3,5, 6,7,8,)	(1,2,3,4,5,)	(0,1,2,3,4,)	
	11,12,13	10,11,12	6,7,8,9	5,6,7,8	

Table 2: After converting the crisp value problem

	D_1	D_2	D_3	D_4	Supply
S_1	2.5	3.5	11.5	7.5	6.5
S_2	1.5	0.5	6.5	1.75	1.5
S_3	5.5	8.5	15.5	9.5	10.75
Demand	7.5	5.25	3.5	2.5	

Using VAM in Table 2 and then using MODI method we get the optimal solution for the given FTP is
$x12$= (−2, 0, 1, 2, 3, 5, 6, 7, 8, 10, 11, 12), $x13$= (−14,−12,−9,−5,−2, 0, 2, 5, 8, 11, 14, 17),
$x23$= (−4,−3,−2, 1, 0, 1, 2, 3, 4, 5, 6, 7,), $x31$= (2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13),
$x33$= (−18,−16,−12,−9,−5,−1, 3, 6, 10, 14, 17, 20) $x34$=(−3,−2,−1, 0, 1, 2, 3, 4, 5, 6, 7, 8)
the fuzzy optimal value of z =(-773,-609,-416,-224,-73,58,188,333,516,773,990,1227) . And the crisp solution to the problem is Minimum cost is 163.25.

Table 3: Comparison method used for the Initial Fuzzy Basic Feasible Solutions [IFBFS] in DDFTP Also the different values of $\alpha1$, $\alpha2$, $\alpha3$and $\alpha4$we obtain the solutions in between 163.26.

Method used fort heIFBFS	**Number of iteration in IFBFS**	**Minimum FTC**	**Optimum FTC Proposedmethod**
Fuzzy	5	z =(-773,-609,-416,-224,-	
NWCW		73,58,188,333,516,773,990,1227)	163.25.
Fuzzy LCM	4		
Fuzzy VAM	3		

Ranking of DDFN reduced to OFN:
If $a4$, $a5$, $a6$, $a7$, $a8$ and $a9$ are exists (X) = 1 then the above dodecagonal FTP reduces to octagonal FTP and we get The given dodecagonal FTP reduces to octagonal FTP data is convert into a crisp value problem by we get Let $\alpha1$ = 0.2 and $\alpha2$ = 0.3

Table 4: Tabular representation dodecagonal FTP reduces to octagonal FTP data, we get the values of the ($_{ij}$) , M^{DDFN}(a_i) and M^{DDFN}(b_j) as and as converting

	D_1	D_2	D_3	D_4	Supply
S_1	−3, −2, −1, (0,1,2,3,4,)	−2, −1,0, (1,2,3,4,)	6,7,8,9, (10,11,12,13,)	2,3,4,5, (6,7,8,9,10,)	−1, 0, 1, 3, (5, 6,7,8,10,)
	5,6,7,8	5,6,7,8,9	14,15,16,17	11,12,13	12,13,14
S_2	−4, −3, −2, (−1,0,1,2,3,)	−5, −4, −3, (−2, −1,0,1,)	0,1,2,4, (5,6,7,8,9,)	−5, −4, −3 (−1,0,1,2,4)	−4, −3, −2, (−1,0, 1,2,)
	4,5,6,7	2,3,4,5,6	11,12,13	5,6,7,9,	3,4,5,6,7
S_3	0,1,2,3, (4,5,6,7,8,)	1,2,3,6,7, (8,9,10,12,)	8,9,11,12, (14,15,16,17,)	2,3,5,6,8,9, (10,11,12,)	2,4,5,6,8, (10,12,13,)
	9,10,11	13,15,16	18,21,22,23	15,16,17	15,17,18,19
Demand	2,3,4,5,6,	−2,0,1,2,	−2, −1,0,	−3, −2, −1,	
	(7,8,9,10,)	(3,5, 6,7,8,)	(1,2,3,4,5,)	(0,1,2,3,4,)	
	11,12,13	10,11,12	6,7,8,9	5,6,7,8	

Crisp value problem using VAM with MODI we get the optimal solution for the
given FTP is $x12$ = (−2, 0, 1, 2, 8, 10, 11, 12) , $x13$ = (−14, −12, −9, −5, 8, 11, 14, 17),
$x23$ = (−4, −3, −2, 1, 4, 5, 6, 7,),
$x31$ = (2, 3, 4, 5, 10, 11, 12, 13), $x33$ = (−18, −16, −12, −9, 10, 14, 17, 20) and
$x34$ = (−3, −2, −1, 0, 5, 6, 7, 8) and the fuzzy optimal value of
z = (−773, −609, −416, −224,516,773,990,1227). The minimum cost of the crisp solution to the problem is 187.6.

Table 5: The comparison of method is used for the Initial Fuzzy Basic Feasible Solutions [IFBFS in OFTP]

Method used fort he IFBFS	**Number of iteration in IFBFS**	**Minimum FTC**	**Optimum FTC Proposedmethod**
Fuzzy NWCW	6	z =(-773,-609,-416,-224,-73,58,188,333,516,773,990,1227)	187.6.
Fuzzy LCM	5		
Fuzzy VAM	2		

Ranking of Trapezoidal fuzzy numbers:
If $a3$, $a4$,5, $a6$, $a7$, $a8$ $a9$and $a10$are exists $\mu A(X)$ = 1 then the above $DDFTP$ reduces to $TpFTP$ and weget

Table 6: Tabular representation DDFTP reduces to TpFTP data

	D_1	D_2	D_3	D_4	Supply
S_1	(-3,-2,7,8)	(-2,-1,8,9)	(6,7,16,17)	(2,3,12,13)	(−1, 0, 13, 14)
S_2	(-4,-3,6,7)	(-5,-4,5,6)	(0,1,12,13)	(-5,-4,7,9)	(-4,-3,6,7)
S_3	(0,1,10,11)	(1,2,15,16)	(8,9,22,23)	(2,3,16,17)	(2,4,18,19)
Demand	(2,3,12,13)	(-2,0,11,12)	(-2,-1,8,9)	(-3,-2,7,8)	

Let α = 1, we get the values of the the$MDDFN(\ Cij)$, $MDDFN(\ ai)$ and $MDDFN(\ bj)$ as converting crisp value problem using VAM with MODI we get the optimal solution in [4] for the given FTP is $x12$ = (−2, 0, 11, 12) , $x13$ = (−14, −12, 14, 17), $x23$ = (−4, −3, 6, 7,),$x31$ = (2, 3, 12, 13),$x33$ = (−18, −16, 17, 20) and $x34$ = (−3, −2, 7, 8)and the fuzzy optimal value $of\ z$ = (−773, −609,990,1227) . And the Minimum cost of the crisp solution is 202.67. The TpFTP is solved by using [3] ,the Minimum cost of the crisp solution is 208.75

Result

Table 7: Comparison of results and proposed method with others

	D_1	D_2	D_3	D_4	Supply
FTPs	Proposed	Jatinder Pal Singh [7]	S.U Malini [6]	HadiBasirzadeh [3]	P.Pandian [4]
DDFN	163.26	173.7	-	-	-
OFN	157.8	-	159.4 [k =	z = −773, −609,	-
	α_1 = 0.2 [and]		0.4]	[−73,58, 188,333,] 990,1227	
	α_2 = 0.35				
					-
	187.6		187.3	z = −773, −609,	
	α_1 = 0.2 [and] α_2 = 0.35		[k=0.54] [Proposed]	[−73,58, 188,333,] 990,1227	
TpFN	-	-	-	208.75	202.67

Conclusion

In this work, the initial basic feasible solutionis obtained for transportation problem with the fuzzy numbers whether maximize or minimize objective functions. The optimal solution for a fuzzy transportation problem examined using octagonal fuzzy numbers and dodecagonal fuzzy numbers have been compared and discussed. Also, the ranking of fuzzy number is introduced where the parameters are dodecagonal and octagonal normal uncertain numbers having the trapezoidal shape and dodecagonal fuzzy numbers have been compared and discussed. A new ranking method and using which we convert the fuzzy transportation problem to a crisp valued transportation problem which then can be solved by using MODI Method to find the fuzzy optimal solution. Fuzzy modified Russell's method has been proposed and compared for Fuzzy Transportation Problem with a numerical example.

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