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A New Ranking Function of Nonagonal Fuzzy Numbers

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ABSTRACT

In this paper, a new ranking function of Nonagonal fuzzy number with membership function is introduced for solving transportation problem, where fuzzy demand and supply are all in the form of Nonagonal fuzzy number. Here the Nonagonal fuzzy transportation problem is converted in to a crisp valued transportation problem and solved using proposed Highest Cost Method to obtain the optimum transportation cost.

Keywords *Nonagonal fuzzy number, Ranking Function, Membership function Transportation Problem, Proposed Highest Cost Method.*

I. INTRODUCTION

The transportation problem is a special case of linear programming problem, which enable us to determine the optimum shipping patterns between origins and destinations. A fuzzy transportation problem is a transportation problem in which the transportation costs, supply and demand quantities are fuzzy quantities. The objective of the fuzzy transportation problem is to determine the shipping schedule that minimizes the total fuzzy transportation cost, which satisfying fuzzy supply and demand limits. The new function of Nanogonal fuzzy number is determined for solving Transportation Problem using proposed highest cost method to obtain the minimum transportation cost.

II. PRELIMINARIES

2.1 Definition

The characteristic function μ_A of a crisp set A ⊂ X assigns a value either 0 or 1 to each member in X. This function can be generalized to a function $\mu_{\tilde{A}}$ such that the value assigned to the element of the universal set X fall within a specified range i.e. $\mu_{\tilde{A}}$: X → [0,1]. The assigned value indicate the membership function and the set $\widetilde{A}$ = {(x, $\mu_{\tilde{A}}$ (x)); x ϵ X} defined by $\mu_{\tilde{A}}$ (x) for x ϵ X is called fuzzy set.

2.2 Definition

A fuzzy set A of the real line R with membership function $\mu_{\tilde{A}}$: X → [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 α ϵ[0,1]

2.3 Definition

A fuzzy is a Nonagonal fuzzy number denoted by $\widetilde{A_N}$=(a_1, a_2 , a_3 , a_4 , a_5 , a_6 , a_7 , a_8 , a_9) where (a_1, a_2 , a_3 , a_4 , a_5 , a_6 , a_7 , a_8, a_9) are real numbers and its membership function $\mu_{\widetilde{A_N}}$(x) is given below.

$$\mu_{\tilde{A}_N}(X) = \begin{cases} \frac{1}{4}\frac{x-a_1}{a_2-a_1} & a_1 \le x \le a_2 \\ \frac{1}{4}+\frac{1}{4}\frac{x-a_2}{a_3-a_2} & a_2 \le x \le a_3 \\ \frac{1}{2}+\frac{1}{4}\frac{x-a_3}{a_4-a_3} & a_3 \le x \le a_4 \\ \frac{3}{4}+\frac{1}{4}\frac{x-a_4}{a_5-a_4} & a_4 \le x \le a_5 \\ 1-\frac{1}{4}\frac{x-a_5}{a_6-a_5} & a_5 \le x \le a_6 \\ \frac{3}{4}-\frac{1}{4}\frac{x-a_6}{a_7-a_6} & a_6 \le x \le a_7 \\ \frac{1}{2}-\frac{1}{4}\frac{x-a_7}{a_8-a_7} & a_7 \le x \le a_8 \\ \frac{1}{4}\frac{a_9-x}{a_9+a_8} & a_8 \le x \le a_9 \\ 0 & otherwise \end{cases}$$

2.4 Definition

An effective approach for ordering the elements of F(R) is also to define a ranking function **R**: F(R) → R which maps each fuzzy number into the real line, where a natural order exists. We define orders on F(R) by:

$\tilde{a} \ge \tilde{b}$ if and only if R ($\tilde{a}$) ≥ R ($\tilde{b}$)

$\tilde{a} > \tilde{b}$ if and only if R ($\tilde{a}$) ≥ R ($\tilde{b}$)

$\tilde{a} = \tilde{b}$ if and only if R ($\tilde{a}$) = R ($\tilde{b}$)

III. NEW RANKING FUNCTION

3.1 Alpha Cut

The α- cut of a fuzzy number is defined as A (α) = { X: $\mu(x) \ge \alpha$ $\alpha \in [0,1]$}

R($\widetilde{A_N}$)= $\int_0^1 4(0.5)[\alpha(a_3 - a_1) + a_2 - \alpha(a_6 - a4+a5+\alpha a9-a7+ a8]$ dα

3.2 Numerical Example

Consider the following fuzzy transportation problem

Proposed Highest Cost Method:

	D₁	D₂	D₃	Supply
S₁	1,2,3, 4,5,6, 7,8,9	2,4,6, 8,10,12, 14,16,18	1,3,5, 7,9,11, 13,15,17	3,6,9, 12,15, 18,21, 24,27
S₂	2,5,8, 9,10,11, 14,17,18	3,4,5, 6,7,8, 9,10,11	7,8,9, 10,11,12, 13,14,15	5,6,7, 8,9,10, 11,12, 13
S₃	4,6,8,10,1 2,14,16,1 8,20	6,8,10, 12,14,16, 18,20, 22	9,10,11, 12,13,14, 15,16,17	5,7,9, 11,13, 15,17, 19,21
Demand	1,4,7, 10,13,16, 19,22, 25	2,4,6, 8,10,12, 14,16,18	10,11,12, 13,14,15, 16,17,18	

Solution:

Using the above ranking function problem can be reduced as follows:

R (1,2,3,4,5,6,7,8,9)

= $\int_0^1 4(0.5)[\alpha(3-1) + 2 - \alpha(6-4) + 5 + \alpha(9-7) + 8]$ dα = **62**

Similarly,

R(2,4,6,8,10,12,14,16,18) =64,

R(1,3,5,7,9,11,13,15,17) =58,

R(2,5,8,9,10,11,14,17,18) =72,

R(3,4,5,6,7,8,9,10,11) =46,

R(7,8,9,10,11,12,13,14,15) =48,

R(7,8,9,10,11,12,13,14,15) =76,

R(4,6,8,10,12,14,16,18,20) =88,

R(6,8,10,12,14,16,18,20,22)=80

Rank of all Supply

R(3,6,9,12,15,18,21,24,27)=96,

R(5,6,7,8,9,10,11,12,13) =56,

R(5,7,9,11,13,15,17,19,21) =82

Rank of all Demand

R(1,4,7,10,13,16,19,22,25) =84,

R(2,4,6,8,10,12,14,16,18) =64,

R(10,11,12,13,14,15,16,17,18)=86.

	D₁	D₂	D₃	Supply
S₁	62	64	58	96
S₂	72	46	48	56
S₃	76	88	80	82
Demand	84	64	86	

Algorithm:

Step: 1

Check whether the problem is balanced $\sum a_i = \sum b_j$ where a_i =supply b_j = demand.

Step: 2

Choose the highest value in each and every column then subtract to each element.

Step: 3

Assign as much as possible to the cell with the highest unit cost in the entire table. If there is a tie then choose arbitrarily.

Step: 4

Cross out the row or column which has satisfied supply or demand .If a row or column is both satisfied then cross out only one of them.

Step: 5

Adjust the supply and demand for those row and column which are crossed out.

Step: 6

When exactly one row or columns is left, all the remaining variable are basic and are assigned the only feasible allocation`

	D_1	D_2	D_3	Supply
S_1	14 **2**	24 **8**	22 **86**	96
S_2	4	42 **56**	32	56
S_3	0 **56**	0	0	82
Demand	84	64	86	

The Optimal solution obtained by Proposed Highest Cost Method is given as follows:

=(14)(2)+(24)(8)+(22)(86)+(42)(56)+(0)(56)

= **4464**

Comparison Table

Method	Optimum solution
North West Corner Method	15,020
Least Cost Method	14,512
Vogel's Approximation Method	14,432
Proposed Highest Cost Method	4464

The best method is **proposed Highest Cost Method**

IV. CONCLUSION

In this paper an optimal solution for a fuzzy transportation problem using Nonagonal fuzzy number is determined. The Proposed HCM method is very simple and easy approach compared to the usual method to solve transportation problem.

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