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On Solving Generalized Exponential Trapezoidal Fuzzy Numbers Using Ranking Functions

S.Muthuperumal[1], P.Titus [2] and M.Venkatachalapathy[3]

[1,3]*K. Ramakrishnan College of Engineering, Samayapuram, Trichirappalli-621 112*
[1]*smuthuperumal@gmail.com*, [3]*mvenkatmath@yahoo.com*
[2]*University College of Engineering Nagercoil, Nagercoil-629004,*
titusvino@yahoo.com

Abstract

This paper focuses on ranking of fuzzy numbers which plays an important role in decision making & optimization. There are several papers in the literature in which generalized fuzzy numbers are used for solving real life problems. Our main aim of this paper is proposed a new approach for generalized exponential trapezoidal fuzzy transportation problem under fuzzy environment using ranking functions.

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1 Introduction

In today's highly competitive market, the pressure on organizations is to find better ways to create and deliver value added service to the customers in order to become stronger. How and when to send the products to the customers in quantities in a cost-effective manner becomes more challenging. Transportation models provide a powerful framework to meet the challenge. They ensure the efficient movement and timely availability of raw materials and finished goods.

The basic transportation problem was originally developed by Hitchcock [5]. The transportation problems can be modeled as a standard linear programming problem, which can be solved by the simplex method. Because it is very special mathematical structure, which was recognized early that the simplex method applied to the transportation problem can be made quite efficient in terms of how to evaluate the necessary simplex method information (Variable to enter the basis, variable to leave the basis and optimality conditions). An Initial Basic Feasible Solution (IBFS) for the transportation problem can be obtained by using the North-West Corner rule, Row Minima, Column Minima, Matrix Minima, or Vogel's Approximation Method. The Modified Distribution Method is useful for finding the optimal solution of the transportation problem. In general, the transportation problems are solved with the assumptions that the coefficients or cost parameters are specified in a precise way i.e., in crisp environment.

Fuzzy modified distribution method is proposed to find the optimal solution in terms of fuzzy numbers. Pandian and Natarajan [7] proposed a new algorithm namely, fuzzy zero point method for finding a fuzzy optimal solution for a FTP, where the transportation cost, supply and demand are represented by trapezoidal fuzzy numbers. A. Edward Samuel and M. Venkatachalapathy [2, 3, 4] proposed a new method for finding an optimal solution for the transportation problems.

In this paper, a proposed method namely, on solving generalized exponential trapezoidal fuzzy numbers using ranking functions is used for solving a special type of exponential fuzzy transportation problem by assuming that a decision maker is uncertain about the precise values of transportation cost only but there is uncertainty about the supply and demand of the product. In the proposed algorithm transportation costs are represented by generalized exponential trapezoidal fuzzy numbers. To illustrate the proposed algorithm a numerical example is solved. The proposed method is easy to understand and to apply in real life transportation problems for the decision makers.

2 Preliminaries

Definition 1 (Exponential Fuzzy Number)**.** Generally, a generalized fuzzy number A is described as any fuzzy subset of the real line $\mathbb{R}$, whose membership function satisfies the following conditions,

[(i)]

1. $\mu_{\tilde{A}}$ is a continuous mapping from $\mathbb{R}$ to the closed interval $[0, 1]$.
2. $\mu_{\tilde{A}}(x) = 0, -\infty < u \leq c,$
3. $\mu_{\tilde{A}}(x) = L(x)$ is strictly increasing on $[c, a]$.
4. $\mu_{\tilde{A}}(x) = co, a \leq x \leq b,$
5. $\mu_{\tilde{A}}(x) = R(x)$ is strictly decreasing on $[b, d]$, $\mu_{\tilde{A}}(x) = 0, d \leq x < \infty$

Where $0 < \omega \leq 1$ and a, b, c and d are real numbers. We call this type of generalized fuzzy number a trapezoidal fuzzy number, and it is denoted by $\tilde{A} = (c, a, b, d; \omega)_{LR}$.

However, these fuzzy numbers always have a fix range as $[c, d]$. Here, we define its general from as follows:

$$\mu_{\tilde{A}}(x) = \begin{cases} \omega e^{-\left[\frac{a-x}{\gamma}\right]}, & x \leq a \\ \omega, & \leq x \leq b \\ \omega e^{-\left[\frac{x-b}{\beta}\right]}, & b \leq x \end{cases}$$

where $0 < \omega \leq 1, a, b$ are real numbers and γ, β are positive real numbers.

Theorem 2. *Let $\tilde{A} = (a, b, \gamma, \beta; \omega)_E$, be generalized exponential number with $0 < \omega \leq 1$ and γ, β are positive real numbers, a, b are real numbers, then the graded mean integration representation of A is $R(A) = \frac{a+b}{2} + \frac{\beta-\gamma}{4}$.*

Remark 3. *When $\gamma = \beta, R(A) = \frac{a+b}{2}$.*

2.1 Arithmetic operations of exponential fuzzy numbers

Definition 4 (Arithmetic Operations)**.** Suppose that $\tilde{A} = (a_1, b_1, \ \gamma_1, \beta_1; \omega_1)_E$ and $\tilde{A} = (a_2, b_2, \gamma_2, \beta_2; \omega_2)_E$ are two generalized exponential fuzzy numbers. Let $\omega = \min(\omega_1, \omega_2)$, according to the essential of the second function principle, some arithmetical operations results could be well define as follows.

[(i)]

1. Addition of $\tilde{A}_1$ and $\tilde{A}_2$: $\tilde{A}_1 \oplus \tilde{A}_2 = (a_1 + a_2, b_1 + b_2, \gamma_1 + \gamma_2, \beta_1 + \beta_2; \omega)_E$
   Where $\gamma_1, \gamma_2, a_1, a_2, b_1, b_2, \beta_1, \beta_2$ are real numbers and $\gamma_1, \gamma_2, \beta_1, \beta_2$ are positive.

2. Subtraction of $\tilde{A}_1$ and $\tilde{A}_2$: $\tilde{A}_1 - \tilde{A}_2 = (a_1 - b_2, b_1 - a_2, \gamma_1 + \beta_2, \beta_1 + \gamma_2; \omega)_E$

3. Multiplication of $\tilde{A}_1$ and $\tilde{A}_2$: $\tilde{A}_1 \otimes \tilde{A}_2 = (a, b, \gamma, \beta; \omega)_E$.

Where $T = \{a_1a_2, a_1b_2, b_1a_2, b_1b_2\}, T_1 = \{\gamma_1\gamma_2, \gamma_1\beta_2, \beta_1\gamma_2, \beta_1\beta_2\}$ and $a = \min T =$ k^{th} element of T, and $b = \max \mathrm{T} = l^{th}$ element of T, then $\gamma = k^{th}$ element of T_1 and $\beta = l^{th}$ element of T_1, where $1 \leq k \leq 4, 1 \leq l \leq 4$.

3 Proposed Algorithm

GETFN was improved by using the ranking of cost matrix by considering alternative allocation costs. The ranking of cost matrix is obtained by the "row opportunity cost matrix" (row opportunity cost matrix: for each row, the smallest cost of that row is subtracted from each element of the same row) and the "column opportunity cost matrix" (column opportunity cost matrix: for each column ofthe resultant matrix the smallest cost ofthat column is subtracted from each element of the same column). Proposed algorithm is applied to the ranking of cost matrix that considers single zero cell allocation costs in the VAM procedure. Then it is selected from the minimum among them. Detailed processes are given below[Step 1:]

Table 1:

	D_l	D_2	D_3	Availability(a_i)
S_l	(1,4,9,19;.5)	(1,2,5,9;.4)	(2,5,8,18;.5)	10
S_2	(8,9,12,26;.5)	(3,5,8,12;.2)	(7,9,13,28;.4)	14
S_3	(11,12,20,27;.5)	(0,5,10,15;.8)	(4,5,8,11;.6)	15
Demand(b_j)	15	14	10	

1. Balance the given exponential trapezoidal fuzzy transportation problem if either (total supply>total demand) or(total Supply<total demand).
2. Obtain the exponential trapezoidal fuzzy numbers using ranking functions.
3. Obtain the row opportunity cost matrix of exponential trapezoidal fuzzy transportation problem using ranking function.
4. Obtain the resultant matrix for column opportunity cost matrix of exponential trapezoidal fuzzy transportation problem using ranking function.
5. To select the single zero cell for each row and column (breaking ties arbitrarily or choosing the lowest-cost cell).
6. Compute transportation costs for selected rows or columns in Step 4 by allocating as much as possible to the feasible cell with the lowest transportation cost.
7. Repeat Steps 3-5 until all requirements have been meet.
8. Compute total transportation cost for the feasible allocations using the original balanced transportation cost matrix.

4 Numerical Example

A company has three refineries S_1, S_2, S_3 with maximum daily capacity of 10,14,15 million galleries of petroleum supply per day. It has three distribution areas D_1, D_2, D_3 which have daily demand of 15,14,10 million galleries respectively. The petroleum is transported through of pipe lines. The trapezoidal fuzzy transportation costs are give below

Determine the minimum cost transportation schedule.

[Step 1.]

1. Since $\sum_{i=1}^{3} a_i = \sum_{j=1}^{3} b_j = 39$, so the chosen problem is a balanced FTP.
2. Obtain the exponential trapezoidal fuzzy numbers using ranking functions (using the above proposed algorithm).

Table 2:

	D_1	D_2	D_3	Supply
S_1	10 (1,4,9,19;.5)	(1,2,5,9;.4)	(2,5,8,18;.5)	10
S_2	(8,9,12,26;.5)	14 (3,5,8,12;.2)	(7,9,13,28;.4)	14
S_3	5 (11,12,20,27;.5)	0 (0,5,10,15;.8)	10 (4,5,8,11;.6)	15
Demand	15	14	10	

To select a single zero cell for any row or column then to identify the cost of transportation table after allocate the $\min(a_i, b_j)$.

Repeat the process of the above transportation table then to get the optimal solution.

The optimal solution of Exponential Trapezoidal Fuzzy transportation cost is
=10(1,4,9,19;.5)+14(3,5,8,12;.2)+5(11,12,20,27;.5)+0(0,5,10,15;.8)+10(4,5,8,11;.6)
=(147,220,382,603;.2)

5 Conclusion

A new approach for solving generalized exponential trapezoidal fuzzy numbers is introduced and also it is used for that ranking function. Our proposed ranking method can be used and to solve real life applications transportation problems of decision making.

References

[1] Amit Kumar, Pushpinder Singh and Amarpreet Kaur, Ranking of Generalized Exponential Fuzzy Numbers using Integral Value Approach, *International Journal ofAdvance Soft Comput.Appl.*, **2**, No.2(2010),1-10.

[2] A. Edward Samuel and M. Venkatachalapathy, Modified Vogel's Approximation Method for Fuzzy Tranportation Problems, *Applied Mathematical Sciences*, **5**, No.28(2011),1367-1372.

[3] M. Venkatachalapathy and A. Edward Samuel, An Alternative Method for Solving Fuzzy Transportation Problem using Ranking Function, *International Journal of Applied Mathematical Sciences*, **9**, No.1 (2016), 61-68.

[4] A. Edward Samuel and M. Venkatachalapathy, Improved Zero Point Method For Solving Fuzzy Transportation Problems Using Ranking Function,*Far East Journal of Mathematical Sciences*, **75**, No.1 (2013), 85-100.

[5] F.L. Hitchcock, The Distribution of a Product From Several Sources to Numerous Localities, *Journal ofMathematical Physics*, **20**, (1941), 224-230.

[6] A. Kaufmann and M.M. Gupta, *Introduction to Fuzzy Arithmetic: Theory and Applications*, New York: Van Nostrand Reinhold, (1991).

[7] P. Pandian and G. Natarajan, A New Algorithm For Finding a Fuzzy Optimal Solution for Fuzzy Transportation Problems, *Applied Mathematical Sciences*, **4**, (2010), 79-90.

[8] H.J. Zimmermann, Fuzzy Programming and Linear Programming with Several Objective Functions, *Fuzzy Sets and Systems,* **1**, (1978), 45-55.