A Revolutionary Strategy To Address Fuzzy Mobility Dilemma By Measure Mean Ranking

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Abstract
In this article we concentrate in finding least mobility cost for commodities through a centralized network when supply and demand of nodes and capacity with cost of edges are made or noted as fuzzy numbers. We are solving the mobility dilemma using various classical ranking methods like Centroid Mean, PERT, Robust's and our proposed new method Measure mean ranking method. Here we take all the observations of assignment problem with payoff matrix as a triangular fuzzy number. Finally, the proposed method optimal total minimum cost of the fuzzy mobility dilemma as compared to other the three different ranking techniques.

Key words: Fuzzy mobility dilemma, Centroid Mean Rank, PERT Rank, Robust's rank, Measure Mean Rank method.

1.Introduction

One of the first issues to use linear programming problem was the transportation problem. In transportation and supply chains, mobility models are widely used to reduce costs. When the balance between demand and supply quantities and cost coefficients are precisely understood, effective algorithms are designed to solve the transportation problem. Because of certain unforeseen, unpredictability and imprecision are unavoidable in the real world. In certain situations, certain uncontrollable circumstances may cause the expense ratios and the supply and demand proportions of a mobility dilemma to be unpredictable. Bellman et al. established the concept of fuzziness to deal numerically with ambiguous information in decision making. Consequently, it is more feasible to model and resolve the mobility dilemma using fuzzy logic.

Fuzzy method for solving multi objective assignment problem was described by Kagade et.al[1]. Optimal solution of fuzzy assignment problem with centroid methods was discussed by D. Gurukumaresan et.al.,[3]. Modeling and Applications in Operations Research was developed by Jyotiranjan Nayak[8]. Using fuzzy concept to sovle the modelling by Venkatesh et.al.,[5, 10,12]. Application of fuzzy ranking method for solving assignment problem with fuzzy costs sovled by Basu et .al., [2,4] Recently Paul described algorithms for solving fuzzy transportation problem[9].

In mobility dilemma, we allocate the different resources to the different commodities basis is minimizing the total cost and it is used to solve real valued dilemmas. Suppose the cost values of mobility dilemma with fuzzy numbers it results in transformation of fuzzy numbers to crisp values and then only solve the mobility dilemma easily using concern method.

2.Basic Results

In this topic deals with Fuzzy set, Fuzzy number, L-R fuzzy numbers, α-cut of L-R fuzzy number, Hungarian method for solving fuzzy combinatorial optimization dilemma.

2.1 Fuzzy Set

Let $\widetilde{A}$ be the subset of X where, X is the universe of objects then traits function by

$$\mu_{\widetilde{A}} = \begin{cases} 1 \ if \ x \in \widetilde{A} \\ 0 \ if \ x \notin \widetilde{A} \end{cases}$$

The fuzzy set $\widetilde{A}$ will be the function $\mu_{\widetilde{A}}$: X → [0, 1], $\mu_{\widetilde{A}}$ is called the integration function which is a desirability on the unit interval that measures the degree to each $x \in \widetilde{A}$

2.2 Fuzzy number

A Fuzzy set defined on universal of real numbers R is said to be a fuzzy number has the following attributes:

(i). $\widetilde{A}$ is convex,
$\mu_{\widetilde{A}}(\beta a + (1-\beta) b \beta) \geq \min imum(\mu_{\widetilde{A}}(a), \mu_{\widetilde{A}}(b)) \forall a, b \in R \, and \; 0 \leq \beta \leq 1$

(ii). $\widetilde{A}$ is normal, (i.e.) the integration function of $\widetilde{A}$ has at least one element x ∈ X whose Integration desirability is unity.

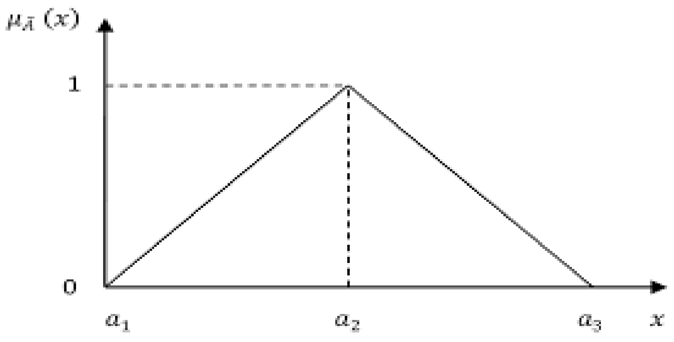
(iii). $\mu_{\widetilde{A}}$ is continuous except at a finite number of points in its domain.

(iv). The duration or the expenses of the generalised fuzzy number is
$[A_{ij}] A_{ij} = (A_{ij}^{(1)}, A_{ij}^{(2)} A_{ij}^{(3)} A_{ij}^{(4)}; W_{ij})$

2.3 L-R fuzzy number with α -cut

Let Ã = (m, n, α, β)$_{LR}$ be an L-R fuzzy number and α ∈ [0, 1], then the crisp number set A_{α} = {x ∈ X : $\mu_{\tilde{A}}$(x)≥ α } = {m - α L^{-1}(α), n + β R^{-1}(α)} is said to be α -cut of Ã.

Figure 1 Triangular Fuzzy Number



2.4 Mobility Dilemma

Mobility dilemma deals with transporting products or particulars to one destination from another destination. It also investigates the cost due to mobility. Principally, mobility dilemma studies mobility of products or particulars stored at several sources to different destinations.

2.5 Mathematical Formulation of Mobility Dilemma

Let us consider that m be the number of sources and n be the number of destinations. Let a_i be the number of supply units available at source and b_j be the number of demand units required at the destinations where let c_{ij} be the unit mobility dilemma for transporting. x_{ij} be number of units shipped from source i to destination j. Then mobility dilemma follows as like below:

$$Minimize\ T = \sum_{i=1}^{m}\sum_{j=1}^{n} C_{ij}\, x_{ij}$$

Subject to

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

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

The necessary and sufficient condition (RIM condition - the total supply equals the total demand) to have a feasible solution to

$$Supply = \sum_{i=1}^{n} a_i = \sum_{j=1}^{m} b_j = Demand$$

3. Fuzzy Mobility Dilemma

Table 1 Fuzzy Assignment Dilemma with Cost Payoff Matrix

Factory	**Warehouse**				
	1	**2**	**3**	**…j…**	**Supply**
1	S_{11}	S_{12}	S_{13}	.. S_{1j} ..	R_1
2	S_{21}	S_{22}	S_{23}	.. S_{2j} ...	R_2
-					
i	S_{i1}	S_{i2}	S_{i3}	.. S_{ij} ..	R_i
. . .	. . .	. . .	. . .	. . .	. . .
Demand	T_1	T_2	T_3	.. T_j ..	**Total**

3.1 Mathematical rendition for FTP

The fuzzy mobility dilemma with cost matrix is modify into mathematically representation is as follows:

Minimum $\tilde{w} = \sum_{i=1}^{n}\sum_{j=1}^{n} \tilde{c}_{ij} x_{ij}$

Subject to

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

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

and each allocation $x_{ii} \geq 0$, where c_{ij} is the cost of mobility of an unit from the i^{th} source to the j^{th} destination and the quantity x_{ij} is to be some positive integer or zero which is to be transported from the

i^{th} source to the j^{th} destination. The necessary and sufficient condition for the linear programming dilemma given to have a solution is that

$$\sum_{i=1}^{n} a_i = \sum_{j=1}^{m} b_j$$

then the fuzzy mobility dilemma is balanced.

3.2 Measure Mean Ranking Method

Steadily for creating ranking for fuzzy numbers have been used widely with various implementation. Getting new tricks in this citation Measure Mean Ranking traits are implemented for sorting trapezoidal fuzzy numbers. Hence these technique deals with course of action to instruct fuzzy sets in which a sorting approach $\Re(\tilde{A})$ is calculated for the fuzzy numbers $\tilde{A} = (m, n, \alpha, \beta)_{LR}$ from its σ-level cut is

$\tilde{A}_\sigma = [m - \alpha L^{-1}(\sigma), n + \beta R^{-1}(\sigma)]$ according to the formula

$$M(\tilde{A}) = \frac{5\left(m - \alpha L^{-1}(\sigma)\right) + 4b + 3(n + \beta R^{-1}(\sigma))}{12}$$

3.3 Robust's Ranking Method

Give a convex fuzzy number a, the Robust's sorting method is defined by $R(a) = \frac{1}{2}\int_0^1 (a_L, a^U)da$, where (a_L, a^U) is the σ level cut of the fuzzy number a. The Robust's ranking index R(a) gives the desirability of the fuzzy number, it satisfies the magnitude and additive property.

$$R(a) = \frac{1}{2}\int_0^1 (a_L, a^U)da$$

3.4 PERT Ranking Method

A project evaluation review technique procedure involves implementations like ordering fuzzy sets in which sorting approach $P(\tilde{A})$ is intended to triangular fuzzy number $\tilde{A} = (m, n, \alpha, \beta)_{LR}$ from its σ-level cut is

$\tilde{A}_\sigma = [m - \alpha L^{-1}(\sigma), n + \beta R^{-1}(\sigma)]$ look on to formula

$$P(\tilde{A}) = \frac{(m - \alpha L^{-1}(\sigma)) + 4b + (n + \beta R^{-1}(\sigma))}{6}$$

3.5 Centroid Mean Ranking Method

The centroid mean sorting proceeds for ordering fuzzy sets wherein sorting approach $C(\tilde{A})$ is calculated for the fuzzy number $\tilde{A} = (m, n, \alpha, \beta)_{LR}$ from its σ-level cut is

$\tilde{A}_\sigma = [m - \alpha L^{-1}(\sigma), n + \beta R^{-1}(\sigma)]$look on to formula

$$C(\tilde{A}) = \frac{(m - \alpha L^{-1}(\sigma)) + b + (n + \beta R^{-1}(\sigma))}{3}$$

4. Numerical Example

A Lakshmi & Co., manufacturing company must transport goods from factories (Trichy , Madurai, Palani, Erode and Karur) to warehouses (Chennai, Goa, Mumbai, Bangalore and Pune) in a cost-effective manner. Each factory has a limited production capacity, and each warehouse has a specific demand. Mobility costs vary based on the distance and mode of transport between each factory and warehouse. The aim is to determine a successful mobility technique that minimises aggregate costs while ensuring that all demand is met without exceeding the supply capacities of the factories.

Table 2 Fuzzy Transportation Value

		Warehouse

		Chennai	Goa	Mumbai	Bangalore	Pune	Supply
Factory	Trichy	(25 35 50)	(70 85 90)	(30 40 54)	(85 90 97)	(60 72 80)	(400 440 500)
	MaduraI	(64 72 78)	(28 40 48)	(80 84 92)	(52 60 70)	(44 56 64)	(310 350 400)
	Palani	(38 48 54)	(66 70 80)	(24 32 40)	(42 50 60)	(63 69 78)	(650 680 700)
	Erode	(70 78 90)	(56 60 66)	(48 52 55)	(30 36 44)	(73 75 85)	(260 300 320)
	Karur	(59 64 67)	(43 48 55)	(51 55 60)	(70 76 85)	(22 32 40)	(380 430 480)
	Demand	(580 620 650)	(300 350 390)	(460 490 540)	(300 340 370)	(360 400 450)	(2000 2200 2400)

Solution

Considering that the combined amount of supply and demand is equal, the mobility dilemma is balanced. Nowadays, the quadratic fuzzy number's membership function in cost payoff matrix is defined by

$$\mu_{\tilde{A}}(x) = \begin{cases} L\left(\frac{m-x}{\alpha}\right), x \le m, \alpha > 0 \\ R\left(\frac{x-n}{\beta}\right), x \ge n, \beta > 0 \\ 1 \quad \text{otherwise} \end{cases}$$

and L-R representation of $[a \ \ b \ \ c\ ] = [m - \alpha L^{-1}(\beta), n + \beta R^{-1}(\alpha)]$ is α level cut of fuzzy number The optimum mobility dilemma schedule using method of Measure mean ranking method is

Table 3

		Warehouse				
		Chennai	Goa	Mumbai	Bangalore	Pune
Factory	Trichy	438.33333				
	MaduraI		339.16667		6.66666	
	Palani	172.5		490	10	
	Erode				288.33333	
	Karur				25.83334	395.83333

Thus, the minimum optimum mobility cost is = 75991/-

The optimum mobility dilemma schedule using method of Robust's ranking method is

Table 4

	Warehouse				
	Chennai	Goa	Mumbai	Bangalore	Pune

Factory	**Trichy**	445				
	Madurai		347.5		5	
	Palani	172.5		495	10	
	Erode				295	
	Karur				27.5	402.5

Thus, the minimum optimum mobility cost is = 79996/-
The optimum mobility dilemma schedule using method of PERT ranking method
Is

Table 5

		Warehouse				
		Chennai	**Goa**	**Mumbai**	**Bangalore**	**Pune**
Factory	**Trichy**	443.33333				
	Madurai		348.33333		3.33334	
	Palani	175		493.33333	10	
	Erode				296.66667	
	Karur				28.33333	401.66667

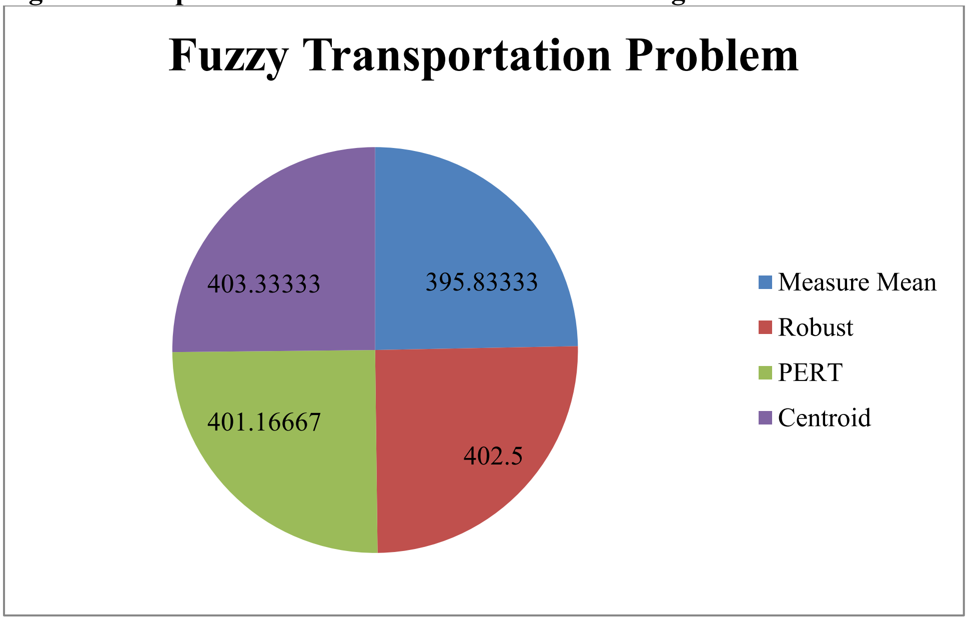
Thus, the minimum optimum mobility cost is = 80028/-
The optimum mobility dilemma schedule using method of Centroid mean ranking method is

Table 6

		Warehouse				
		Chennai	**Goa**	**Mumbai**	**Bangalore**	**Pune**
Factory	**Trichy**	446.66667				
	Madurai		346.66667		6.66666	
	Palani	170		496.66667	10	
	Erode				293.33333	
	Karur				26.66667	403.33333

Thus, the minimum optimum mobility cost is = 79967/-

Figure 2 Comparison of results with different Ranking methods



5.Conclusion

The four ranking techniques to approach the all yield the same optimal fuzzy mobility dilemma schedule; however, our suggested Measure Mean ranking method yields the triangular fuzzy number ranking value, which will be least expensive approach for the problem comparing to other three.

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