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Solution of Fuzzy Transportation Problem Using Hexagonal Number

Madhav Fegade[1] , Aniket Muley[2]
[1]Department of Statistics, Digambarrao Bindu Arts, Commerce and Science College, Bhokar-431801 (M. S.) India
[2]School of Mathematical Sciences, Swami Ramanand Teerth Marathwada University, Nanded-431606 (M. S.) India
mrfegade@gmail.com, aniket.muley@gmail.com

Abstract : In this paper, we have proposed another calculation to track down ideal answers for the fuzzy transportation problem. Here, positioning system is utilized to defuzzify the Hexagonal fuzzy numbers. This article gives technique that cuts down the ideal arrangement. The mathematical model represents the legitimacy of our proposed strategy.

IndexTerms - Transportation, fuzzy, optimality, ranking, Hexagonal fuzzy numbers.

I. Introduction

Operations Research is a condition of workmanship approach utilized for problem-addressing and independent direction. It assists any association with accomplishing their best exhibition under the given imperatives or circumstances. The transportation problem is one of the extraordinary regions observed overall which is useful to tackle genuine problems. Transportation problems assume a significant part underway, circulation and so on purposes and are a unique instance of straight programming problems. It helps in limiting the expense work. There are various things that choose the expense of transport. It incorporates the distance between the two areas, the way followed, method of transport, the quantity of units that are shipped, the speed of transport, and so forth. In this way, the concentration here is to ship the items with least transportation cost with practically no split the difference in market interest. The transportation model can likewise be utilized in settling on the spot choices. In this paper, it is seen that there are a few examination studies to carry the best ideal answer for the transportation problems. The problem that should be settled is, to arrive at financially savvy creation in different creation organizations. [1-17]

Bagheri et al. (2020) examined a transportation problem with fuzzy expenses within the sight of different and clashing goals utilizing fuzzy information envelopment examination approach. Kacher and Singh (2021) played out a deliberate and coordinated outline of different existing transportation problems and their augmentations created by various analysts. The principal motivation behind the survey paper is to summarize the current type of different sorts of transportation problems and their precise advancements for the direction of future specialists to assist them with characterizing the assortments of problems to be tackled and select the standards to be enhanced. Bagheri and Behnamian (2022) played out an orderly writing audit on the multi-production line booking problems in the beyond eleven years and announced research holes.

Polat and Topaloğlu (2022) proposed an original numerical model for the assortment of various kinds of milk from makers by multi-tank big haulers with split conveyances, unsure interest, administration time and vehicle speed conditions. A genuine contextual analysis from a dairy organization is addressed under various gamble evaluation situations. To be sure, a few fresh out of the box new benchmark examples for the center problem are introduced and tackled by using a proficient heuristics approach called improved iterative neighborhood search. Their discoveries of the review showed that coordinated factors leaders ought to plan their assortment networks with low, yet non-zero, risk levels. Sleiman et al. (2022) laid out a control technique to forestall the clog in the transportation network subject to added substance vulnerabilities. Qamsari et al. (2022) proposed a clever methodology towards stock steering problems with fuzzy time windows thinking about consumer loyalty for appearance spans. Their review isolated into three classes as indicated by their highlights. These highlights have various levels of significance according to the distributer's viewpoint. The fulfillment level of clients assumes a significant part in the choice of the provider to satisfy their interest in every period. At long last, they have considered and proposed a certifiable contextual analysis of a blood appropriation framework model for Tehran. Verma (2022) concentrated on fuzzy most limited way problem gives the briefest way to the leader having least conceivable separation from source to objective. They proposed total positioning strategy to take care of the fuzzy most brief way problem. The proposed approaches guarantee that the fuzzy briefest distance is equivalent among all conceivable most limited ways. Bharati (2022) characterizes the reluctant fuzzy enrollment work and non-participation capacity to handle the vulnerability and wavering of the boundaries. Another arrangement called reluctant intuitionistic fuzzy Pareto ideal arrangement is characterized, and a few hypotheses are expressed and demonstrated. Taghavi et al. (2022) proposed another model for the transport terminal area problem utilizing information envelopment examination with multi-objective programming approach. Their attention is on to observe productive designation designs for allocating stations terminals. Additionally, they researched the ideal areas for sending terminals involving a hereditary calculation for addressing proposed model.

Bera and Mondal (2022) managed multi-objective transportation problem under cost-subordinate credit period strategy. Here, the things are moved from a creation house to the retailers by wholesalers who go about as arbiters. For satisfactory vulnerability in the expense boundary, it is viewed as Gaussian fuzzy number. The impact of fluffiness on the model arrangement has been broke down to further develop their benefit construction and retailers can lessen their expense structure under the pre-owned cost subordinate credit time frame strategy.

II. PRELIMINARIES

Definitions:

Fuzzy set: $\tilde{A}$ is fuzzy set on R is defined as a set ordered pairs$\tilde{A} = \{X_0, \mu_A(X_0) | \, X_0 \in \tilde{A}\, , \mu_A(X_0) \to [0,1]\}$, where $\mu_A(X_0)$is said to be the membership function.

Fuzzy number: $\tilde{A}$ is fuzzy set on R, likely bounded to the stated conditions given beneath

$\mu_A(X_0)$ is part by continuous

There exist at one $X_0 \in R$ with $\mu_A(X_0) = 1$

$\tilde{A}$ is a regular and convex

Hexagonal fuzzy number: A fuzzy number $\tilde{A}$ on R is said to be the hexagonal fuzzy number or linear number which is names as $(\tilde{a}_1 \tilde{a}_2, \tilde{a}_3, \tilde{a}_{4,} \tilde{a}_5, \tilde{a}_6)$ if it membership function $\mu_A(X_0)$ has the following characteristic

$$\mu_A(X) = \begin{cases} 0, \ X < \tilde{a}_1 \\ \frac{1}{2}\left(\frac{X - \tilde{a}_1}{\tilde{a}_2 - \tilde{a}_1}\right), \tilde{a}_1 \le X \le \tilde{a}_2 \\ \frac{1}{2} + \frac{1}{2}\left(\frac{X - \tilde{a}_2}{\tilde{a}_3 - \tilde{a}_2}\right) \ , \tilde{a}_2 \le X \le \tilde{a}_3 \\ 1, \ \tilde{a}_3 \le X \le \tilde{a}_4 \\ 1 - \frac{1}{2}\left(\frac{X - \tilde{a}_4}{\tilde{a}_5 - \tilde{a}_4}\right), \tilde{a}_4 \le X \le \tilde{a}_5 \\ \frac{1}{2}\left(\frac{\tilde{a}_6 - X}{\tilde{a}_6 - \tilde{a}_5}\right), \tilde{a}_5 \le X \le \tilde{a}_6 \\ 0, X > , \tilde{a}_6 \end{cases}$$

III. METHODOLOGY

Algorithm

Step 1: Convert the given hexagonal fuzzy numbers to crisp number using following function:

$$R(\tilde{a}) = \frac{2a_1 + 3a_2 + 4a_3 + 4a_4 + 3a_5 + 2a_6}{18}$$

Step 2: Check whether the given transportation problem is balanced or unbalanced.

2.1: If it is balanced, then go to step 3.

2.2: If it is unbalanced, then add a dummy row or dummy column to fulfil the requirement.

Step 3: Find the First minimum and maximum of each row and take the difference of them and the difference is divided by the number of rows in the given table of respective iteration.

Step 4: Find the First minimum and maximum of each column and take the difference of them and the difference is divided by the number of columns in the given of respective iteration.

Step 5: After simplifying step 3 and 4, select the largest ratio and allocate as much as possible to the smallest element in the respective row (column) to fulfill the demand or to exhaust the availability.

Step 6: If maximum ratio value may occur more than once in the rows or columns then arbitrarily select any one row or column but not both.

Step 7: Repeat the step 3 to 6, until all the availability and demand will get exhausted or fulfilled.

Step 9: To check if the number of allocations is m+n-1 or not. If it is less than m+n-1, then apply the MODI method to check the optimality of the given problem.

IV. RESULTS AND DISCUSSION

Numerical example: A resolution that affirms the fuzzy transportation problem which involves transportation cost, customer needs and demands and existence of products using hexagonal fuzzy numbers. Observe the following transportation problem as stated in Table 1 [13]:

Table 1: Given dataset

	D_1	D_2	D_3	D_4	Availability
O_1	(3,7,11,15,19,24)	(13,18,23,28,33,40)	(6,13,20,28,36,450	(15,20,25,31,38,45)	(7,9,11,13,16,20)
O_2	(16,19,24,29,34,39)	(3,5,7,9,10,12)	(5,7,10,13,17,21)	(20,23,26,30,35,40)	(6,8,11,14,19,25)
O_3	(11,14,17,21,25,30)	(7,9,11,14,18,22)	(2,3,4,6,7,9)	(5,7,8,11,14,17)	(9,11,13,15,18,20)
Demand	(3,4,,5,6,8,10)	(3,5,7,9,12,15)	(6,7,9,11,13,16)	(10,12,14,16,20,24)	

By using (Step 1) we have defuzzified the given transportation problem and represented Table 2. The given problem is a balanced one.

Table 2: Defuzzified Transportation problem

	D_1	D_2	D_3	D_4	Availability
O_1	13.11	25.72	69.5	28.77	12.5
O_2	26.72	7.72	12	28.77	13.5
O_3	19.5	13.27	5.11	10.94	14.28
Demand	5.89	8.39	10.22	15.78	

Table 3: Iteration I

	D_1	D_2	D_3	D_4	Supply	$\frac{max - \min}{row}$
S_1	13.11	25.72	69.5	28.77	12.5	5.22
S_2	26.72	7.72	12	28.77	13.5	7.01
S_3	19.5	13.27	**10.22** 5.11	10.94	14.28	14.39
Demand	5.89	8.39	10.22	15.78		
$\frac{max - \min}{columnn}$	3.40	4.50	16.09 ↑	4.457		

Table 4: Iteration II

	D_1	D_2	D_4	Supply	$\frac{max - \min}{row}$
S_1	13.11	25.72	28.77	12.5	5.22
S_2	26.72	**8.39** 7.72	28.77	13.5	7.01←
S_3	19.5	13.27	10.94	4.06	2.85
Demand	5.89	8.39	15.78		
$\frac{max - \min}{columnn}$	4.53	6	5.94		

Table 5: Iteration III

	D_1	D_4	Supply	$\frac{max - \min}{row}$
S_1	13.11	28.77	12.5	5.22
S_2	26.72	28.77	5.11	0.68
S_3	19.5	**4.06** 10.94	4.06	2.85←
Demand	5.89	15.78		
$\frac{max - \min}{columnn}$	6.805	8.915		

Table 6: Iteration IV

	D_1	D_4	Supply	$\frac{max - \min}{row}$
S_1	**5.89** 13.11	28.77	12.5	7.83
S_2	26.72	28.77	5.11	1.025
Demand	5.89	11.72		
$\frac{max - \min}{columnn}$	6.805 ↑	0		

Table 7: Final Iteration

	D_4	Supply
S_1	**6.61** 28.77	6.61
S_2	**5.11** 28.77	5.11
Demand	11.72	

$$\text{Total Cost} = 10.22 \times 5.11 + 8.39 \times 7.72 + 4.06 \times 10.94 + 5.89 \times 13.11 + 6.61 \times 28.77 + 5.11 \times 28.77 = 575.8137$$

Table 8: Comparative results

Method	Optimum solution
Ranking method [13]	7618
Proposed Method	575.8137

In this review, the proposed calculation gives the most ideal suitability of the fuzzy transportation problem for hexagonal fuzzy numbers. By and large, this calculation can be helpful for a wide range of fuzzy transportation problems. This approach could be summed up to determine comparative sorts of transportation problems. The proposed calculation helps in finding another office, an assembling plant or an office when at least two areas are getting looked at. Basically, the absolute transportation cost, dissemination cost or delivery cost and creation costs are to be limited by applying the model to the comparative sort of examinations.

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