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OPTIMIZATION OF FUZZY TRANSPORTATION PROBLEM WITH NANOGONAL NUMBER

Statistics

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ABSTRACT

In this study, a fuzzy transportation problem optimization is dealt with cost, demand and supply as a nanogonal numbers. The present research study, the ranking method is used to solve transportation problem to make it optimum one. An algorithm is proposed here, that gives more preferred solution as compared with the existing methods. Further, a comparative analysis is executed with other existing techniques to establish the efficacy of the proposed methodology.

KEYWORDS

Transportation problem, ranking method, optimization, Nanogonal Fuzzy Number.

1. INTRODUCTION

In today's life, transportation problem is one of the emerging area in the optimization according to supply chain aspect. Patra (2022) proposed another way of thinking for arranging of summed up trapezoidal fuzzy numbers. In this new procedure the mean position, region and edge of the fuzzy numbers has been considered as fundamental issue. Further, it has been separated and existing various strategies for summed up trapezoidal fuzzy numbers. At long last, a bet evaluation of a confirmation of creation house has been displayed to show the possibility of the proposed technique. Ghosh et al. (2022) outlined a multi-objective strong transportation model of waste association problem in agribusiness field and woods division for metropolitan or typical turn of events. Bharati (2021) introduced an overall portrayal of IVIFSs utilizing actual disengaging during Coronavirus to figure out the huge idea of IVIFSs. They considered transportation problem with IVIFSs limits, and for its reaction, a crucial computational methodology is made and tended to. Sun (2020) zeroed in on a cargo organizing problem considering both delicate development time windows and sales and cutoff shortcoming in a street rail multi-reason transportation structure is examined. Kashav et al. (2021) propounded an arranged structure where Fuzzy Insightful Progressive system Cycle is cleaned to evaluate the stacks and positions the hindrances and Fuzzy Procedure for Request of Inclination by Likeness to Ideal Arrangement methodology is gotten to determine the spots of the techniques. Their evaluation propounds an exact, sensible, and made method structure for stage-wise executing the procedures to help the adequacy and capacity. Sarkar and Biswas (2021) watched out for an arranged procedure containing sensible moderate structure correspondence and method for request propensity by similitude to ideal game-plan in Pythagorean fuzzy climate to manage multi-rules dynamic problems with completely dull stores of models. In their proposed approach, another distance measure considering cross-evaluation of Pythagorean fuzzy sets knows all about defeat the loads of existing distance measures. Nishad and Abhishekh (2020) presented an arranging strategy for intuitionistic fuzzy numbers by utilizing distance minimiser between two intuitionistic fuzzy numbers, with the assistance of their depicted selection and non-collaboration limits. The proposed arranging framework for intuitionistic fuzzy numbers fulfills the overall proverbs of arranging limits.

Further, they have applied the idea up arranging strategy to deal with absolutely intuitionistic fuzzy transportation problems in which cost, supplies and necessities all are in term of intuitionistic fuzzy numbers. Baykasoğlu (2019) introduced a finesse direct strategy approach for absolutely fuzzy transportation problems in which every one of as far as possible as well as choice variables are considered as fuzzy numbers. Palanivel (2016) zeroed in on a procedure that bargain business explorer problem with the help of trapezoidal help works and its number-crunching tasks. Watching out for framework has been applied from the methodology of fuzzy task problem utilizing Strong Ranking system. They saw that the Strong arranging system offers a suitable contraption for managing the business wayfarer problem. Singh Yadav (2015) considered a transportation problem having shortcoming and swaying in market income. They proposed intuitionistic fuzzy procedures to find beginning crucial reasonable strategy concerning TIFNs. Intuitionistic fuzzy adjusted dissipating technique has been proposed to track down ideal game-plan. Ebrahim nejad (2016) presents a course of action of TP including stretch respected trapezoidal fuzzy numbers for the transportation expenses and possible increases of game plans and sales. They proposed a fuzzy straight programming approach for taking care of length respected trapezoidal fuzzy numbers transportation problem considering evaluation of stretch respected fuzzy numbers by the assistance of stepped distance arranging. Samanta and Jana (2019) utilized trapezoidal stretch sort 2 fuzzy numbers to manage equivocalness and absence of clearness problem.

They proposed a procedure for managing multi-standards dynamic problem to supervise studying and arranging decisions from the best to the most unquestionably horrible concerning choice maker(s) propensities of multi-thing transportation problem with that of inclined in the direction of methodology for transportation. A defuzzification approach is utilized to change over multi-objective into a solitary objective transportation problem with fuzzy objective programming strategy and raised mix technique.

Then, at that point, they got ideal plans of the decreased problem is settled by summed up diminished propensity system and later on introduced graphically. Kundu et al. (2017) proposed fuzzy multi-standards pleasant dynamic strategy considering arranging stretch sorts 2 fuzzy components. They have empowered an arranging technique by relative propensity record utilizing summed up authenticity measure to rank stretch sort 2 fuzzy factors. Starting there on, proposed another strategy to deal with fuzzy multi-models total dynamic problems where phonetic appraisals of various decisions and the standards loads are would in general by navigate type-2 fuzzy components. Chakraborty et al. (2015) developed a summed up intuitionistic fuzzy number and its number-crunching works out.

They proposed a methodology to manage summed up intuitionistic fuzzy transportation problem utilizing arranging limit. Mahmoodirad et al. (2019) regulated structure of changed transportation problem having factors are of three-sided intuitionistic fuzzy qualities. They performed computational starters to get the force of the proposed approach over those of the organization from the outcomes' quality. Gupta and Mehlawat (2007) considered a multi-objective transportation problem to present another sort of coal in a steel producing unit in India. A transportation calculation is made to find the non-oversaw manages serious outcomes in regards to the defuzzified problem and further, showed by mathematical models worked from the gathering unit information. A proliferation based unwavering quality appearance is made to evaluate the getting through nature of the update results given by various fuzzy techniques under various breaking point settings in a reenactment climate.

2. Experimental

Nanogonal fuzzy numbers

A fuzzy number $\tilde{N}$ in R is said to be Nanogonal fuzzy number if its membership $\mu_N \rightarrow R[0,1]$ function has the following characteristics: We denote the Nanogonal fuzzy number by $\tilde{N} = (N_1, N_2, N_3, N_4, N_5, N_6, N_7, N_8, N_9)$

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$$\mu_N(x) = \begin{cases} 0 & for\ x < N_1 \\ \frac{1}{2}\frac{(x-N_1)}{(N_2-N_1)} & for\ N_1 \le x \le N_2 \\ \frac{1}{2}\frac{(x-N_2)}{(N_3-N_2)} & for\ N_2 \le x \le N_3 \\ \frac{1}{2}+\frac{1}{2}\frac{(x-N_3)}{(N_4-N_3)} & for\ N_3 \le x \le N_4 \\ \frac{1}{2}+\frac{1}{2}\frac{(x-N_4)}{(N_5-N_4)} & for\ N_4 \le x \le N_5 \\ \frac{1}{2}+\frac{1}{2}+\frac{1}{2}\frac{(x-N_5)}{(N_6-N_5)} & for\ N_5 \le x \le N_6 \\ \frac{1}{2}+\frac{1}{2}+\frac{1}{2}\frac{(x-N_6)}{(N_7-N_6)} & for\ N_6 \le x \le N_7 \\ \frac{1}{2}+\frac{1}{2}+\frac{1}{4}\frac{(x-N_7)}{(N_8-N_7)} & for\ N_7 \le x \le N_8 \\ \frac{1}{2}\frac{(x-N_9)}{(N_9-N_8)} & for\ N_8 \le x \le N_9 \\ 0 & for\ x \ge N_9 \end{cases}$$

Arithmetic operations on Nanogonal fuzzy numbers

Let, $\tilde{A}_N = (a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9)$ and $(b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9)$ be two Nanogonal fuzzy numbers then addition and subtraction can be performed as:

$$\tilde{A}_N + \tilde{B}_N = (a_1 + b_1, a_2 + b_2, a_3 + b_3, a_4 + b_4, a_5 + b_5, a_6 + b_6, a_7 + b_7, a_8 + b_8, a_9 + b_9)$$
$$\tilde{A}_N - \tilde{B}_N = (a_1 - b_1, a_2 - b_2, a_3 - b_3, a_4 - b_4, a_5 - b_5, a_6 - b_6, a_7 - b_7, a_8 - b_8, a_9 - b_9)$$

Proposed methodology

Algorithm

Step1: Convert the given Nanogonal fuzzy numbers to crisp number using following ranking

Function:

$$R_A(x) = \frac{a_1 + 2a_2 + 3a_3 + 4a_4 + 5a_5 + 4a_6 + 3a_7 + 2a_8 + a_9}{25}$$

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: Discover, first smallest amount and second smallest of each row and make the difference between them. i.e. (2^{nd} smallest-1^{st} smallest) and the difference is divided by of row in the given table in each iteration.

Step 4: Find the First smallest and second smallest of each column and make the difference between them. i.e. (2^{nd} smallest -1^{st} smallest) and the difference is divided by number of columns in the given table in each iteration.

Step 5: After simplifying step 3 and 4, select the largest difference and allocate as much as possible to the smallest element in the respective row (Column).

Step 6: If maximum difference 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: Locate the smallest value obtained from the certain row or column then allot the maximum possible quantity to fulfill the demand or to exhaust the availability.

Step 8: Repeat the step 3 to 7, until all the availability and demand will get exhausted or fulfilled.

Step 9: To check the allocations are equal to 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.

Numerical Example

Consider, a company has three sources S_1, S_2, S_3 and three destinations D_1, D_2, D_3. The fuzzy transportation cost for unit quantity of the product from i^{th} source to j^{th} destination is.

Cij.Where

$$C_{ij} = \begin{bmatrix} (2,4,6,8,10,12,14,16,18) & (1,2,3,4,5,6,7,8,9) & (3,5,7,9,11,13,15,17,19) \\ (1,3,5,7,9,11,13,15,17) & (4,6,8,10,12,14,16,18,20) & (5,7,9,11,13,15,17,19,21) \\ (3,5,7,9,11,13,15,17,19) & (0,1,2,3,4,5,6,7,8) & (-2,-1,0,1,2,3,4,5,6) \end{bmatrix}$$ and

The fuzzy availability of the supply is:

$[(1,3,5,7,9,11,13,15,17)\ \ (0,1,2,3,4,5,6,7,8)\ \ (2,4,6,8,10,12,14,16,18)]$

The fuzzy requirement of the demand is:

$[(2,4,6,8,10,12,14,16,18)\ \ (1,3,5,7,9,11,13,15,17)\ \ (0,1,2,3,4,5,6,7,8)]$

Solution:

Construction of fuzzy transportation table and inspect whether it is balanced or not.

Table (1)

	D_1	D_2	D_3	Supply
S_1	(2,4,6,8,10,12,14,16,18)	(1,2,3,4,5,6,7,8,9)	(3,5,7,9,11,13,15,17,19)	(1,3,5,7,9,11,13,15,17)
S_2	(1,3,5,7,9,11,13,15,17)	(4,6,8,10,12,14,16,18,20	(5,7,9,11,13,15,17,19,21)	(0,1,2,3,4,5,6,7,8)
S_3	(3,5,7,9,11,13,15,17,19)	(0,1,2,3,4,5,6,7,8)	(−2,−1,0,1,2,3,4,5,6)	(2,4,6,8,10,12,14,16,18
Demand	(2,4,6,8,10,12,14,16,18)	(1,3,5,7,9,11,13,15,17)	(0,1,2,3,4,5,6,7,8)	

Using ranking method, the fuzzy transportation problem is converted into a crisp one as:

Table (2)

	D_1	D_2	D_3	Supply	$\frac{2nd\ Minimum - 1st\ Minimum}{row}$
S_1	10	4.88	11	6.96	1.7066
S_2	9	12	13.4	4	1
S_3	11	4	4 2	10	0.6666
Demand	10	6.96	4		
$\frac{2nd\ Minimum - 1st\ Minimum}{column}$	0.3333	0.2933	3 ↑		

Table (3)

	D_1	D_2	Supply	$\frac{2nd\ Minimum - 1st\ Minimum}{row}$
S_1	10	4.88	6.96	1.7066
S_2	9	12	4	1
S_3	11	6 4	6	2.3333←
Demand	10	6.96		
$\frac{2nd\ Minimum - 1st\ Minimum}{column}$	0.5	0.44		

After, simplification the final iterative table, we obtained as follows:

Table (4)

	D_1	D_2	Supply	$\frac{2nd\ Minimum - 1st\ Minimum}{row}$
S_1	6 10	0.96 4.88	6.96	2.56
S_2	4 9	12	4	1.5
Demand	10	0.96		
$\frac{2nd\ Minimum - 1st\ Minimum}{column}$	0.5	3.56 ↑		

Total Cost = $4 \times 2 + 6 \times 4 + 0.96 \times 4.88 + 6 \times 10 + 4 \times 9 = 132.6848$

Table (5)

Comparative results

Method	Optimum solution
North West Corner Method	1,623
Least Cost Method	1,508
Russell's Method	1,508
Proposed Method	132.6848

3. CONCLUSIONS

In this study, an algorithm is proposed for fuzzy transportation problem with nanogonal numbers. It is observed that, the proposed system gives significantly better results as differentiated and the ongoing ones (Table 5). This simply figures out the capability of the proposed estimation. To show authenticity and relevance of the proposed approach, numerical model on fuzzy transportation case is overseen and handled. The computational result has shown the way that reasonably more accurate and information powerful courses of action can be obtained from the proposed approach. Additionally, the proposed approach is in like manner prepared to convey fuzzy courses of action with serious degree of weakness like various methods available in the composition. In future, expecting the estimation is executed on the reasonable data will be valuable in saving the cost and will be useful to fabricate the upside of the vehicle region.

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