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Research Article

New ranking for picture fuzzy sets and novel way to address picutre fuzzy transportation problem

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ABSTRACT

A significant issue that is being extensively researched in the arena of operation research involves the issue of transportation. The primary objective of this hurdle is to figure out the lowest possible total transportation costs for commodities to provide the items from the origin and satisfy customer demands at destinations. In practical scenarios, the decision-maker might not be certain of the exact figures of the coefficients applicable to the transport issue. Transportation problems with ambiguous and uncertain information can be analyzed using a picture fuzzy set, an extension of an intuitionistic fuzzy set, specifically when extra-linguistic assessment elements are needed. This research combines picture fuzzy figures to represent each unit's availability, demand, and expense. In this study, picture fuzzy numbers are transformed into precise values using a proposed novel ranking way. Additionally, we developed an innovative approach for determining an initial basic feasible solution to the picture fuzzy transportation problem. To illustrate the proposed technique, we considered three types of numerical examples. The findings of the suggested algorithm were compared with existing tactics in the literature to establish its efficacy.

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INTRODUCTION

The ideal planning tool across many fields, such as finance, technology, economics, and enterprise, is linear programming. In every firm, decision-making is crucial. Depending on the circumstances and the information available, different decisions must be made. Individuals had to adjust their decision-making in earlier times to fit the situation. Uncertainty exists at present in every decision we make. As a result, making decisions is difficult. Zadeh proposed a set termed fuzziness to tackle uncertainty [1].

Transportation experts have difficulties at the start of the twenty-first century as a result of the complexity that is growing. To provide prompt, secure, and dependable transportation when minimizing the negative effects on the environment and societies, transportation experts must strive to meet certain desired outcomes. Capacity limitations, toxic emissions, a lack of reliability, poor safety records, and

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energy waste are some of the obstacles that transportation specialists must deal with. Taking into account these realities, transport systems are typically complicated systems with numerous components and various stakeholders, each with a variety of goals that are frequently at odds with one another [2]. Transporting raw materials or completed goods from a single manufacturer to another while attempting to keep the overall cost of shipping to a minimum is known as a transportation problem (TP). Hitchcock first came up with the fundamental transportation issue. The goal of the issue of transit is to establish the ideal quantity of a good to be delivered from multiple sources (origins) to several consumer points (destinations), such that the total expenditure associated with transport is lowered or the total gain from mobility is maximized [3]. Expense details are necessary for a minimization TP, and in this instance, the goal is to reduce overall costs. A maximization TP, on the other hand, uses revenue, turnover, or gain information; in this circumstance, the approach aims to maximize the overall revenue. Whenever precise data is offered, there exist traditional approaches to tackle those transportation issues. However, data might not have been known with precision in real-world transportation circumstances [4].

The uncertainty of any number of variables, which cannot be precisely determined in practical situations, can arise from a variety of factors, including the imprecise tool of measurement, perished and missing data, as well as computation mistakes. In these cases, standard techniques to resolve TP are no longer appropriate. Fuzzy mathematics has become necessary to solve this kind of problem [5]. To solve this issue, the issue's details are provided with fuzzy figures, which represent the uncertainties in the information being sought.

The concept of fuzzy sets originated by Zadeh [6] to deal with ambiguous data mathematically when making decisions, and it has been utilized effectively in a wide range of fields. Following the groundbreaking work by Bellman and Zadeh [7], the idea of fuzzy sets was applied in the optimization sector. However, hesitations are owing to a variety of reasons, including the need for greater interaction, inaccurate data, an understanding of markets, a lack of customer perception, etc. Similar to the costs, there are still many unknowns and hesitations due to many factors such as variations in gasoline prices, clogged roads, meteorological conditions, etc. In such cases, the decision-makers are unable to accurately predict the expense of transportation. As a result, Atanassov and Stoeva [8] presented the intuitionistic fuzzy collection (IFS), which is to be more reliable than the framework of fuzzy sets developed by Zadeh, for managing these ambiguous inputs. After that, a sizable number of effective solutions to TPs and IFTPs were reported in the research literature, and the scope of applications progressively expanded [9,10].

The neutrality degree is not one of the key concepts of IFS. The idea of neutrality grade is frequently observed under conditions where we are faced with human viewpoints containing more responses of the form: yes, abstain, no, or rejection [11]. For example, human voting, choosing features, and so forth. In this vein, Cuong and Kreinovich [12] created the picture fuzzy setting, which is an outgrowth of the IFS by including the ideas of the positive, neutral, and negative membership ratings of an aspect. Cuong and Kreinovich [13] examined a few picture fuzzy set (PFS) characteristics and proposed PFS distance measurements. Phong et al. [14] investigated a few combinations of picture fuzzy connections. In their study of the fundamental fuzzy reasoning operators, Cuong and Pham [15] examined denials, interjections, disjunctions, and their effects on picture sets that are fuzzy. They also developed the basic functions for fuzzy inference procedures in picture fuzzy structures. On picture fuzzy systems, Cuong et al. [16] demonstrated the features associated with an involutive picture negator and several related De Morgan uncertain triples. A picture uncertain inference framework created using a membership plot has been presented by Viet et al. [17]. PFS correlation factors were investigated by Singh [18]. For picture fuzzy sets, Cuong et al. [19] explored the categorization of attainable t-norms as well as t-conorms of picture operators. Son [20] suggested a novel distance metric between PFSs and implemented it in clustering with fuzzy data. Son [21] extended fundamental metrics for distance in PFSs and investigated a few of their characteristics. The fuzzy inference was suggested for PFSs by Son et al., [22]. By using a new separation metric as the basis for decision-making, Peng and Dai [23] established the algorithm for PFS. Wei [24] provided various methods for determining the similarities of PFS.

Garg [25] investigated several uses of picture-uncertain aggregating methods in multicriteria decision-making processes. The concept of complex PFS, resulting in a generalized version of complex IFS and pythagorean fuzzy set, was put forth by Akram et al. [26], who also created a decision-making paradigm. Harmonic operators involving TrPFNs were utilized by Shit et al. [27] to demonstrate their importance in multi-criteria decision-making issues. The extension technique was used by Dutta and Ganju [11] to conduct picture fuzzy arithmetic using illustrations. Employing trapezoidal picture fuzzy figures, Akram et al. [28] looked into the shortest path issues. Geetha and Selvakumari [29] found low-cost solutions to picture-fuzzy transport issues. Mehmood and Bashir [30] proposed a method for resolving the full-picture fuzzy transportation issue. An innovative hybrid framework built on PFS and linear assignment was proposed by Gündodu et al. [31] and used for the first time in a real-world setting to address a challenge related to the growth of public transit. By using a novel approach, Akram et al. [32] were able to tackle linear programming issues in the context of picture fuzzy sets. The concept of picture fuzzy entropy along with its utilization was created by Kumar et al. [33] using a combination of the picture fuzzy technique and partial value data.

PFSs were successfully employed in collaboration, administration, and other real-life decision-making and transportation problems that involve uncertainty. Kirişci [34] created an algorithm designed in generalized pythagorean fuzzy sets. This algorithm was provided to assist with solving multi-attribute issues related to decision-making. For a pythagorean fuzzy transit problem of three types, Hemalatha and Venkateswarlu [35] devised a novel mean square approach to determine the initial basic feasible solution.

As previously discussed, limited studies have been done on the picture fuzzy transportation problem. According to the literature review, there are no parallel fresh approaches for both ranking and initial basic feasible solution (IBFS) to resolve TP in a picture uncertain setting. This research gap led the authors to develop a novel ranking and IBFS technique that can optimize the transportation problem in a Picture uncertain context and its optimal value without any mathematical tools. This study aims to address transportation issues where supply, demand, and transportation prices are PFN. The primary goal of this research is to reduce total transport expenses in a picture-fuzzy context. The following is the paper's key contribution:

(i) Created a new ranking function to convert fuzzily-defined picture integers into precise values.

(ii) Developed an algorithm to handle the picture fuzzy transport problem's initial basic feasible answer. So, using the allocation of the suggested algorithm, we continue to the modified distribution (MODI) strategy for the ideal answer.

(iii) Investigated six numerical instances of random values for three different types of picture fuzzy transportation problem (PFTP) to demonstrate the validity and effectiveness of the suggested approach. With thorough comparisons to certain previous studies, its advantages and viability are also stated.

The paper is structured as follows: The preliminary material is presented in Section 2. The mathematical description of the picture-fuzzy transport issue is described in Section 3 in depth. Section 4 of the proposal contains a description of the algorithm. Numerical examples are provided in Section 5. Results and discussion are presented in Section 6, and the work is concluded in Section 7.

PRELIMINAIES

In this part, we define certain fundamental concepts related to the current studies.

Fuzzy Set [36]

Any of the fuzzy subsets of the universal collection $\tilde{z}'$ can be expressed as a collection of ordered pairs, as shown below:

$$A'' = \left\{ \left\{ (x\}'_0, \mu_{A''}(x'_0) \right) \middle| x'_0 \in \tilde{z}' \right\}$$

where $\mu_{A''}(x'_0)$ symbolizes an association functionality, which accepts values in the range [0,1].

Intutionistic Fuzzy Set [37]

Any IFS in the universal collection $\tilde{z}'$ can be described with the following syntax:

$$\bar{A}'' = \{\langle x'_0, \mu_{\bar{A}''}(x'_0), \nu_{\bar{A}''}(x'_0)\rangle | x'_0 \in \tilde{z}'\},$$

where $\mu_{\bar{A}''}, \nu_{\bar{A}''}$ clarifies the role of belonging and not belonging, these two functions accept inputs in the range [0,1] with the specified condition. $0 \le \mu_{\bar{A}''}(x'_0), \nu_{\bar{A}''}(x'_0) \le 1$.

Picture Fuzzy Set [38]

Any PFS in the Universal $\tilde{z}'$ collection can be defined as

$$\tilde{A}'' = \left\{ \{\langle x\}'_0, \mu_{\tilde{A}''}(x'_0), \eta_{\tilde{A}''}(x'_0), \nu_{\tilde{A}''}(x'_0)\rangle \middle| x'_0 \in \tilde{z}' \right\},$$

where $\mu_{\tilde{A}''}(x'_0)$, $\eta_{\tilde{A}''}(x'_0)$, $\nu_{\tilde{A}''}(x'_0) \epsilon [0,1]$; $\mu_{\tilde{A}''}, \eta_{\tilde{A}''}$, and $\nu_{\tilde{A}''}$ indicate the levels of belonging, neutral, and not belonging x'_0 in $\tilde{A}''$, respectively. The following requirements must be met: $0 \le \mu_{\tilde{A}''}(x'_0) + \eta_{\tilde{A}''}(x'_0) + \nu_{\tilde{A}''}(x'_0) \le 1$.

Proposed Ranking Function

Let $P_F = (\mu_{\tilde{A}''}(x'_0), \eta_{\tilde{A}''}(x'_0), \nu_{\tilde{A}''}(x'_0))$ be a picture fuzzy number. The ranking function is a defuzzification tool of picture fuzzy numbers to crisp numbers. It is used to compare fuzzy numbers. A novel ranking technique based on a collection of picture fuzzy numbers is outlined as follows:

$$R(P_F) = |\mu_{\tilde{A}''}(x'_0) - [\eta_{\tilde{A}''}(x'_0) + \nu_{\tilde{A}''}(x'_0)]| \quad (1)$$

Based on the new rank function we can analyze two picture fuzzy numbers. If $\sigma = \left(\mu_1^{P_F}, \eta_1^{P_F} \nu_1^{P_F}\right)$ and $\varphi = \left(\mu_2^{P_F}, \eta_2^{P_F}, \nu_2^{P_F}\right)$ are two picture fuzzy numbers, then the relation between those are given by,

Case (1) σ > φ iff R(σ) > R(φ)

Case (2) σ < φ iff R(σ) < R(φ)

Case (3) σ = φ iff R(σ) = R(φ)

MATHEMATICAL MODEL FOR PICTURE FUZZY TRANSPORTATON PROBLEM

Assume there are n destinations and m sources as shown in Table 1. A picture fuzzy TP can be mathematically expressed in the following equations (2-4):

$$\text{Minimize } \bar{z}^{P_F} = \sum_{i=1}^{m} \sum_{j=1}^{n} \bar{c}_{ij}^{P_F} . x_{ij} \quad (2)$$

Subject to constraints,

$$\sum_{j=1}^{n} x_{ij} = \bar{a}_i^{P_F}, i = 1 \ to \ m, \quad (3)$$

$$\sum_{i=1}^{m} x_{ij} = \bar{b}_j^{P_F}, j = 1 \ to \ n, \quad (4)$$

$x_{ij} \ge 0$ for each i, j

where,

Table 1. Picture fuzzy trnsportation problem

Sources	Destinations					
		$\mathcal{D}_1$	$\mathcal{D}_2$	….	$\mathcal{D}_n$	Supply
	s_1	$c_{11}^{P_F}$	$c_{12}^{P_F}$	….	$c_{1n}^{P_F}$	$a_1^{P_F}$
	s_2	$c_{21}^{P_F}$	$c_{22}^{P_F}$	….	$c_{2n}^{P_F}$	$a_2^{P_F}$
	……	……	…….	…….	…….	……
	s_m	$c_{m1}^{P_F}$	$c_{m2}^{P_F}$	….	$c_{mn}^{P_F}$	$a_m^{P_F}$
	Demand	$b_1^{P_F}$	$b_2^{P_F}$	….	$b_n^{P_F}$	

$\bar{c}_{ij}^{P_F}$- picture fuzzy expense of moving one unit of a given good supplier i to recipient j,

x_{ij}- transferred quantity from input i to terminal j,

$\bar{a}_i^{P_F}$- picture fuzzy units of supply to be carried between n places,

$\bar{b}_j^{P_F}$- picture fuzzy number of demand units needed at endpoints.

Proposed Alogrithm for Solving Picture Fuzzy Transportation Problem

The steps of the proposed algorithm are described below and the flowchart is shown in Figure 1.

Step 1: Select Transportation Problem under the Picture fuzzy setting.

Step 2: Refine picture fuzzy values into crisp quantities by applying the advised ranking function that has been created in equation (1).

Step 3: After turning them into crisp, determine whether the issue at hand is balanced or not.

(i) Go to step 5 if the given problem is balanced.

(ii) Go to step 4 if the given problem is unbalanced.

Step 4: To balance the aggregate demand and availability, add a cost-free dummy row or column.

Step 5: Divide each cost of a row by a number of columns, then add all of the divided values for each row.

Step 6: Divide each cost of a column by a number of rows, then add all of the divided values for each column.

Step 7: Select one penalty with the greatest value between the rows and columns. If the maximum value is the same for more than one option, pick either one.

Step 8: Choose the least cost value in the relevant row or column of the maximum penalty.

Step 9: For that specific cell, allocate the least value among the supply and need.

Step 10: When there is no longer any demand or supply for that specific row or column, remove the entire row or column.

Step 11: Repeat steps 5–10 until all allocations have been met.

Step 12: After determining IBFS, use the MODI approach to locate the ideal solution.

Numerical Illustrations

Example 5.1.[29] Consider the four places that require the delivery of four dairy-based goods. As shown in the matrix that appears below Table 2, the unit cost of shipping appears as picture-fuzzy values. We have to determine a transport strategy that will cost the least overall.

Step 1: Select Transportation Problem under the Picture fuzzy setting.

Step 2: Using equation (1) convert the picture fuzzy into crisp which is shown in Table 3.

Since the chosen problem is balanced. By using steps 5 and 6, divide each cost of a row by a number of columns,

Table 2. Transportation problem in picture fuzzy environment

Dairy products	L_1	L_2	L_3	L_4	Availability
Milk Powder	(0.8,0.1,0.1)	(0.4,0.3,0.3)	(0.5,0.3,0.2)	(0.7,0.1,0.1)	(0.6,0.3,0.1)
Ghee	(0.2,0.6,0.1)	(0.5,0.3,0.1)	(0.8,0.1,0)	(0.4,0.5,0.1)	(0.8,0.1,0.1)
Butter	(0.6,0.3,0.1)	(0.7,0.3,0)	(0.3,0.4,0.1)	(0.6,0.2,0.2)	(0.5,0.3,0.1)
Cheese	(0.4,0.4,0.2)	(0.8,0.2,0)	(0.4,0.6,0)	(0.7,0.1,0.1)	(0.4,0.4,0.1)
Requirement	(0.6,0.2,0.1)	(0.7,0.2,0.1)	(0.4,0.3,0.2)	(0.6,0.4,0)	

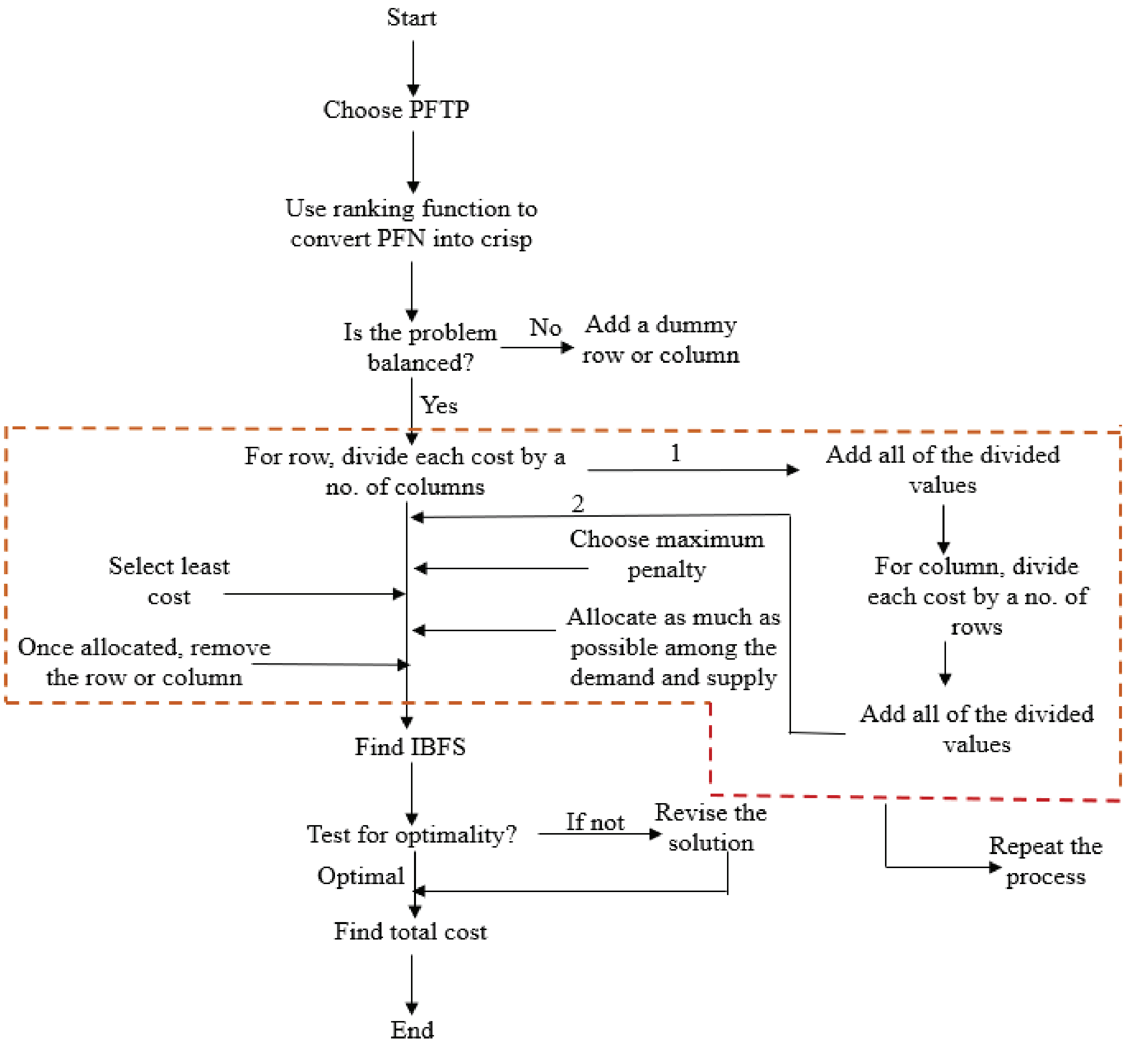

Figure 1. Flowchart.

Table 3. Defuzzified values

Dairy products	L_1	L_2	L_3	L_4	Availability
Milk Powder	0.6	0.2	0	0.6	0.2
Ghee	0.5	0.1	0.7	0.2	0.6
Butter	0.2	0.4	0.2	0.4	0.1
Cheese	0.2	0.6	0.2	0.6	0.1
Requirement	0.3	0.4	0.1	0.2	

Table 4. Row and column penalties

Dairy products	L_1	L_2	L_3	L_4	Availability	Row Penalty
Milk Powder	0.6	0.2	0	0.6	0.2	0.35
Ghee	0.5	0.1	0.7	0.2	0.6	0.375
Butter	0.2	0.4	0.2	0.4	0.1	0.3
Cheese	0.2	0.6	0.2	0.6	0.1	0.4
Requirement	0.3	0.4	0.1	0.2		
Column Penalty	0.375	0.325	0.275	0.45		

then add all of the divided values for each row. Similarly, divide each cost of a column by a number of rows, then add all of the divided values for each column which is shown in Table 4.

Step 7: Select one with the greatest value between the rows and columns. If the maximum value is the same for more than one option, pick either one.

Step 8: Choose the least cost value in the relevant row or column of the maximum penalty.

Step 9: For that specific cell, allocate the least value among supply and need which is shown in Table 5.

Step 10: When there is no longer any demand or supply for that specific row or column, remove the entire row or column. Table 6 shows the adjusted matrix with the second allocation.

Table 5. First allocation

Dairy products	L_1	L_2	L_3	L_4	Availability	Row penalty
Milk Powder	0.6	0.2	0	0.6	0.2	0.35
Ghee	0.5	0.1	0.7	0.2 $^{0.2}$	0.6	0.375
Butter	0.2	0.4	0.2	0.4	0.1	0.3
Cheese	0.2	0.6	0.2	0.6	0.1	0.4
Requirement	0.3	0.4	0.1	0.2		
Column Penalty	0.375	0.325	0.275	0.45		

Table 6. Second allocation

Dairy products	L_1	L_2	L_3	Availability	Row penalty
Milk Powder	0.6	0.2	0	0.2	0.267
Ghee	0.5	0.1 $^{0.4}$	0.7	0.4	0.427
Butter	0.2	0.4	0.2	0.1	0.267
Cheese	0.2	0.6	0.2	0.1	0.334
Requirement	0.3	0.4	0.1		
Column Penalty	0.375	0.325	0.275		

Table 7. Third allocation

Dairy products	L_1	L_3	Availability	Row penalty
Milk Powder	0.6	0	0.2	0.3
Butter	0.2 $^{0.1}$	0.2	0.1	0.2
Cheese	0.2	0.2	0.1	0.2
Requirement	0.3	0.1		
Column Penalty	0.334	0.134		

Table 8. Fourth allocation

Dairy products	L_1	L_3	Availability	Row penalty
Milk powder	0.6	0	0.2	0.3
Cheese	0.2 $^{0.1}$	0.2	0.1	0.2
Requirement	0.2	0.1		
Column penalty	0.4	0.1		

Table 9. Final allocations

Dairy products	L_1	L_3	Availability
Milk Powder	$0.6^{0.1}$	$0^{0.1}$	0.2
Requirement	0.1	0.1	

Step 11: Repeat steps 5–10 until all allocations have been met.

By step 12, utilizing the suggested algorithm, Table 3-9 displays the defuzzified quantities and full allocations of demand and availability. The suffix entries of each Table from 5-9 display allocations. We used the MODI approach after getting the IBFS, and the overall minimal transit cost was 0.18.

Example 5.2. With the capacity of production facilities S, T, and U must supply goods to three separate sites, P1, P2, and P3. Table 10 displays the mobility problem matrix together with demand and supply data as picture fuzzy numbers. The total least transportation expense must be determined.

For the complete transportation issue, which involves supply and demand, use the prescribed rank function to transform picture fuzziness into accurate numbers. Following that, applying the offered algorithm, we were able to determine the total minimal cost of transportation, which is 0.08.

Example 5.3. Three plants producing fertilizers have been established across the nation, and their products will be delivered to the states of J, K, and L, respectively. The cost of transportation must be kept to a minimum. Table 11 shows the cost of transportation for the items in picture-fuzzy settings while supply and demand information are presented in precise form.

For the complete transportation issue, which involves supply and demand, use the prescribed rank function

Table 10. Input data for PFTP

Production shops	P_1	P_2	P_3	Availability
S	(0.2,0.6,0.1)	(0.3,0.1,0.5)	(0.5,0.2,0.3)	(0.6,0.1,0.2)
T	(0.7,0.2,0.1)	(0.4,0.3,0.2)	(0.8,0,0.1)	(0.5,0.4,0)
U	(0.4,0.3,0)	(0.1,0.8,0.1)	(0.6,0.2,0.2)	(0.7,0.1,0.1)
Requirement	(0.5,0.1,0.1)	(0.3,0.6,0.1)	(0.9,0,0)	

Table 11. Input data for PFTP

Factories	J	K	L	Availability
X_1	(0.8,0.1,0.1)	(0.5,0.2,0.1)	(0.9,0,0)	26
X_2	(0.4,0.6,0)	(0.3,0.4,0.2)	(0.2,0.7,0)	42
X_3	(0.7,0,0.3)	(0.6,0.1,0.1)	(0.5,0.3,0)	33
Requirement	19	72	58	

Table 12. Input data for PFTP

Factories	*q*	*r*	*s*	*t*	Availability
F_1	(0.5,0.3,0)	(0.3,0.4,0.2)	(0.8,0.1,0.1)	(0.6,0.2,0.1)	82
F_2	(0.2,0.4,0.2)	(0.8,0.1,0)	(0.7,0.5,0.1)	(0.6,0,0)	58
F_3	(0.7,0.1,0.1)	(0.6,0.2,0.2)	(0.1,0.8,0.1)	(0.3,0.1,0.5)	30
F_4	(0.4,0.3,0.3)	(0.9,0.1,0)	(0.3,0.5,0)	(0.9,0,0)	36
Requirement	83	42	25	56	

to transform picture fuzziness into accurate numbers. Following that, applying the offered algorithm, we were able to determine the total minimal cost of transportation, which is 22.5.

Example 5.4. Four cement plants and four local distributors are owned by a corporation. From the following Table 12, we must determine the minimum price for transportation.

For the complete transportation issue, which involves supply and demand, use the prescribed rank function to transform picture fuzziness into accurate numbers. Following that, applying the offered algorithm, we were able to determine the total minimal cost of transportation, which is 59.6.

Example 5.5. Four plants are owned by a fan manufacturing company. The corporation has three separate warehouse locations. The next Table 13 provided picture-fuzzy values that represented the warehouse demand and the maximum capabilities of the plants. For it, we need to discover minimal transit costs.

For the complete transportation issue, which involves supply and demand, use the prescribed rank function to transform picture fuzziness into accurate numbers. Following that, applying the offered algorithm, we were able to determine the total minimal cost of transportation, which is 0.11.

Example 5.6. The issue of figuring out the minimal cost plan for supplying dealers with the appropriate quantity of cars is one that an automobile dealer must solve. The pertinent facts are shown in Table 14 below, where supply, as well as demand, were depicted as picture fuzzy numerals. The cost of transportation must be kept to a minimum.

For the complete transportation issue, which involves supply and demand, use the prescribed rank function to transform picture fuzziness into accurate numbers. Following that, applying the offered algorithm, we were able to determine the total minimal cost of transportation, which is 78.8.

Example 5.7. A petroleum business must deliver fuel to four distinct depots from its four refineries. The price of delivering one unit of fuel coming from each refinery to each depot is shown in Table 15. For it, we need to discover minimal transit costs.

Table 13. Input data for PFTP

Plants	W_1	W_2	W_3	Availability
U	(0.3,0.4,0.1)	(0.5,0.3,0.1)	(0.8,0.2,0)	(0.7,0.2,0.1)
V	(0.5,0.2,0.1)	(0.6,0.1,0.1)	(0.9,0,0)	(0.3,0.6,0.1)
W	(0.7,0.2,0.1)	(0.1,0.8,0.1)	(0.3,0.1,0.5)	(0.6,0.1,0.2)
X	(0.5,0.2,0.2)	(0.7,0.3,0)	(0.4,0.4,0.1)	(0.3,0.4,0.2)
Requirement	(0.6,0.1,0.3)	(0.8,0.3,0.1)	(0.5,0.3,0.1)	

Table 14. Input data for PFTP

Plant	*a*	*b*	*c*	*d*	Availability
A	25	28	40	34	(0.8,0.3,0)
B	66	54	43	52	(0.8,0.1,0.1)
C	36	30	56	48	(0.9,0,0)
Requirement	(0.5,0.2,0.2)	(0.6,0.1,0.1)	(0.9,0.1,0)	(0.9,0.1,0.1)	

Table 15. Input data for PFTP

Refinery	*p*	*q*	*r*	*s*	Availability
l	40	25	46	34	(0.5,0.2,0.1)
m	32	38	42	50	(0.5,0.3,0)
n	44	60	22	56	(0.7,0.1,0.1)
o	28	45	33	40	(0.8,0.1,0)
Requirement	(0.9,0.1,0)	(0.7,0.3,0.1)	(0.7,0.1,0.2)	(0.4,0.4,0.2)	

Table 16. Comparative analysis

	Numerical Examples						
	1	2	3	4	5	6	7
VAM	0.47	0.08	27.1	62.6	0.11	79.2	46.6
Existing [35]	0.41	0.08	27.1	59.6	0.13	78.2	46.3
Proposed	0.18	0.08	22.5	59.6	0.11	78.2	44.1
Optimum	0.18	0.08	22.5	52.1	0.11	78.2	44.1

For the complete transportation issue, which involves supply and demand, use the prescribed rank function to transform picture fuzziness into accurate numbers. Following that, applying the offered algorithm, we were able to determine the total minimal cost of transportation, which is 44.1.

RESULTS AND DISCUSSION

Data derived from transit issues are frequently ambiguous in many real-world circumstances. Fuzzy mathematics is a way to quantify such ambiguity to deal with issues like these. In this paper, we suggested a method for choosing the initial basic feasible answer to the transportation problem with a picture fuzzy. The capacity, consumer demand, and cost of the item's transport are all represented as picture numbers that are fuzzier in our algorithm. For capturing ambiguous, inconsistent, and imperfect information, picture fuzzy collections are preferable. In contrast to intuitionistic fuzzy sets, picture fuzzy sets take refusal membership grades into account. In Table 16 below, the disparity between the proposed method and the current one is displayed. The created PFTP framework, except for the first quantitative instance, produces results that are satisfactory and nearly identical to those of the comparing technique, based on comparison results. This indicates that the new algorithm and ranking function offer a better answer than the one that already exists. We took six mathematical instances representing random PFTP values into consideration and solved them using the proposed method as well as the existing approaches to demonstrate the efficacy of the proposed approach. On the other hand, the problems that we randomly selected incorporate three different forms of balanced and imbalanced PFTPs. Executives in the fields of transportation and supply chain management could potentially be guided in making judgments because the process is straightforward regarding the steps required for the computation. Figures 2 and 3 shows the comparison chart of proposed with existing and traditional approach.

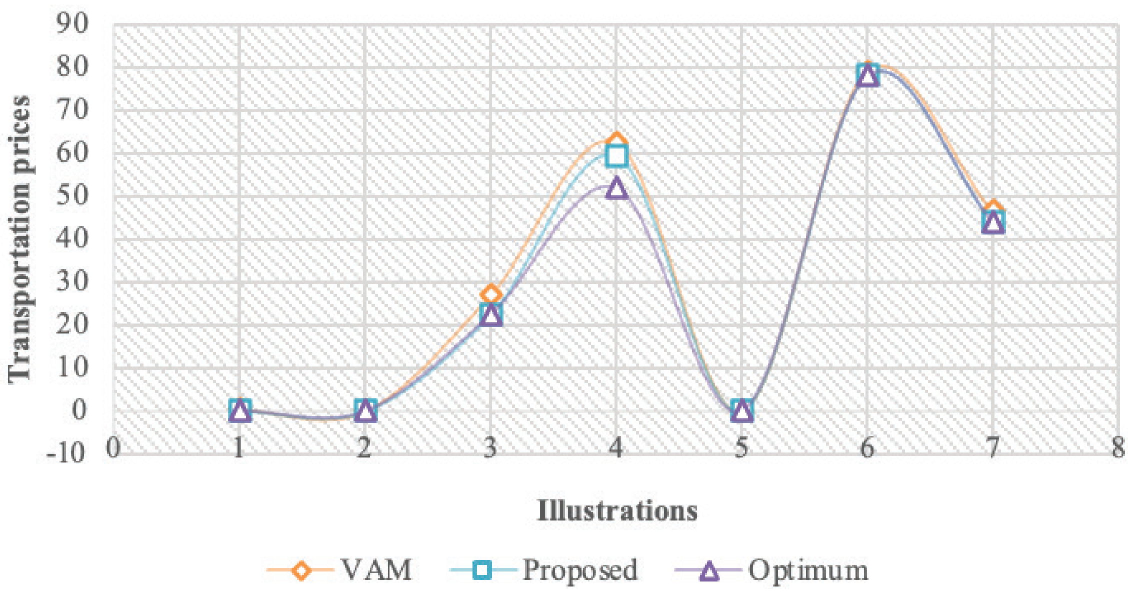

Figure 2. Comparison of proposed with traditional method.

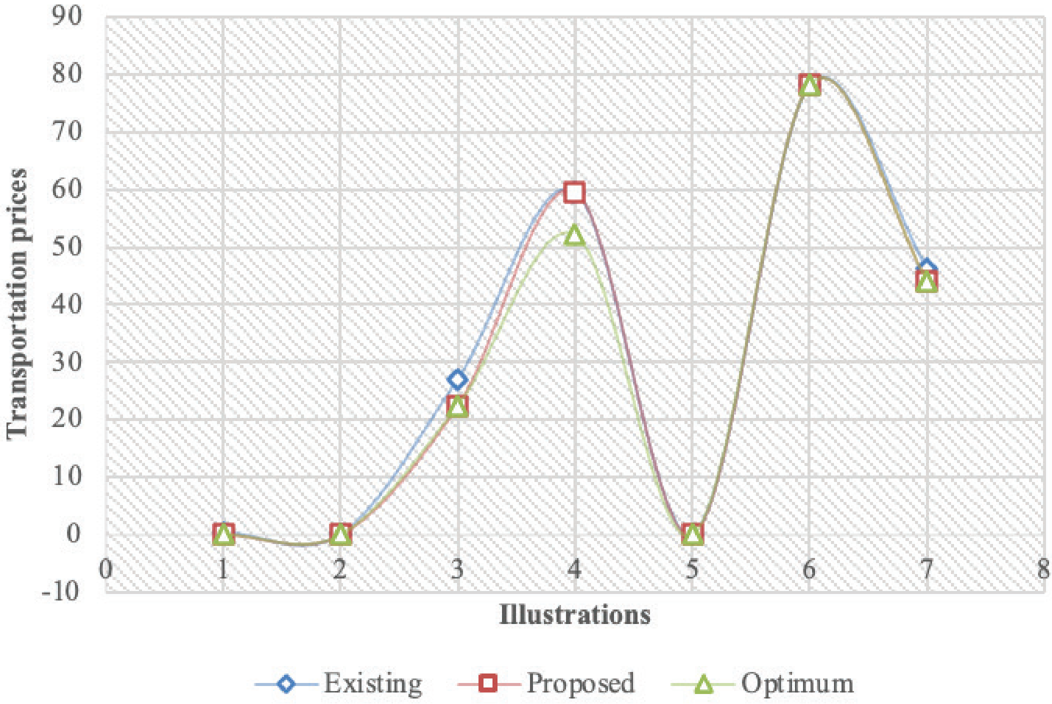

Figure 3. Comparison of proposed with existing method.

CONCLUSION

In this study, a specific family of uncertain transportation problems, the picture fuzzy transportation problem is optimized. Many published works have investigated a wide range of transport challenges of varying complexity. The characteristics of transportation can change over a particular period due to globalization in the current technology era as well as other inevitable factors. Instead of employing the traditional technique to resolve transit concerns, we investigated picture imprecise data and devised an easy alternating solution. In practical situations, a ranking approach is required to handle a transportation challenge in a fuzzy environment. In the current study, we first developed a rank function for transforming an uncertain picture figure into a crisp figure, followed by an algorithm for determining the first fundamental feasible solution to the picture fuzzy transportation problem. The effectiveness of the proposed approach has been supported by numerical evidence obtained through a thorough comparison of the proposed method to other existing approaches. Demonstrating the approach with numerical examples revealed no weaknesses. Thus, the suggested work's objective has been achieved. The suggested technique will be used to address the transshipment issue, in which sources may pass via intermediate locations before getting to their final destination. Among the applications of the transportation dilemma, the proposed strategy resolves issues with allocation and physical distribution. The proposed ranking approach cannot handle complex picture fuzzy sets. In the future, we plan to expand our inquiry into assignment and fractional transit concerns in a picture-fuzzy scenario.

AUTHORSHIP CONTRIBUTIONS

Authors equally contributed to this work.

DATA AVAILABILITY STATEMENT

The authors confirm that the data that supports the findings of this study are available within the article. Raw data that support the finding of this study are available from the corresponding author, upon reasonable request.

CONFLICT OF INTEREST

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ETHICS

There are no ethical issues with the publication of this manuscript.

STATEMENT ON THE USE OF ARTIFICIAL INTELLIGENCE

Artificial intelligence was not used in the preparation of the article.

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