



A neutrosophic approach to the transportation problem using single-valued trapezoidal neutrosophic numbers

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Abstract

In general, a fuzzy set can't handle situations of inconsistencies and inexact data, however, the Neutrosophic Set (NS) has been used to address such types of issues in all realworld problems. The neutrosophic set is an extension of the fuzzy set and the intuitionistic fuzzy set, that can deal with imperfect, inconsistent, and indeterminate data in all the related problems. This article proposed a conventional neutrosophic approach using a ranking function for the transportation problem. This approach has considered a single-valued neutrosophic set for the entire transportation problem with the numerical illustration. Single valued trapezoidal neutrosophic numbers are well-known and used in solving the transportation problem and its extension. Besides, a novel ranking function is proposed with the help of membership functions, which gives the best optimal solution. Moreover, the obtained optimal solution has been compared with recent new approaches. This research will help to get the best optimal solution for the transportation problem under uncertainty.

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1. Introduction

Fuzzy set theory was presented to treat indefinite, incorrect, and imprecise data by [25], a fuzzy number was developed to deal with inaccurate numerical quantities. The lack of understanding about degrees of membership was not addressed by fuzzy set theory. Atanassov [2] proposed an intuitionistic fuzzy set that can deal with non-membership degrees and imprecise information. Smarandache [20] developed an NS, which investigates the neutralities of philosophical issues, as a valuable mathematical tool for dealing with inadequate, incompatible, and indeterminate facts. The three membership functions Truth, Indeterminate, and Falsity have formed the NS. To effect this Wang and et.al [23] presented a set of theoretic operators on an occurrence of NS called Single valued Neutrosophic-set(SVNS). Deli and et.al [7] developed anSVNS a generalization of fuzzy numbers, whose precise meaning is somewhat ambiguous from a philosophical standpoint. A ranking method was proposed by Ye [24] to solve the MADM problems by introducing reduced NS. A TOPSIS approached a new paradigm for handling MGDM problems employing SVNS by Biswas et al. [3]. Thamaraiselvi [21] has proposed a conventional transportation problem in a neutrosophic context. A technique for solving the MCDM problem with Single- valued Trapezoidal neutrosophic numbers (SVTNNs) was developed by Li and Zhang [15]. Abdel-Basset et al. [1] devised a technique to deal with the trapezoidal neutrosophic numbers (TNNs) and highlighted group decision-making issues. Said Broumi and colleagues [4] have presented a procedure for measuring the shortest path length from a source node to a destination node using a rating function. Umamageswari and Uthraas [22] work was motivated us to propose a new ranking function with the aid of membership functions to defuzzify the SVTNNs and solve an SVTN Transportation problem. Lin Lu and Xiaochun Luo [16] used SVNs to modify an uncertain environment's transshipment problem into a MADM problem. Moreover, many researchers also have proposed different forms of ranking techniques for SVTNNs [7, 8, 13, 9, ?, 6]. Multi-Objective Linear Programming Problems(MOLPP) and Multi-level Muliti-objective Linear programming problem(MLMOLPP) are addressed and solved by Neutrosophic Goal Programming (NGP) in [17],[19]. Palanivel Kaliyaperumal and Amrit Das [12] proposed new fuzzy optimization model to address the Nonlinear programming Problem(NLP) with help of membership functions.

This paper is organized into five sections: In section 2, starting with the preliminary information that will assist you in understanding the basic concepts and definitions and also presented the proposed ranking function, as well as the mathematical formulation of the NTP and the procedure for solving it. In section 3, describes the proposed approach with numerical illustration, which gives the best optimal solution to the NTP. Lastly, section 4 started with a comparison table that justified the optimal solution by comparing different ranking functions with a discussion, and also the paper is ended with the conclusion in section 5.

1.1. Research Gap and Motivation:

Fuzzy Optimization Techniques (FOT) were used to identify and solve the uncertainty in linear programming problems (LPP'S). Generally, Fuzzy transposition problems (FTP) are special cases in which many researchers have developed various algorithms and ranking functions [9, 10, 18] to convert fuzzy data into crisp data in order to address the FTP. In recent times, Neutrosophic Transportation Problems (NTP) have been suggested to employ uncertain and indeterminate values using optimization techniques. Moreover, many researchers have proposed to address the NTP with numerous ranking techniques, such as score function, accuracy function, and so on. Also, it inspired us to create a new ranking function for single-valued trapezoidal neutrosophic numbers based on membership functions. Besides, this paper proposed the Single-valued Trapezoidal Neutrosophic Transportation Problem (SVTNTP) with an optimal ranking function and the obtained results have been compared with different ranking functions, which shows that the optimality and proposed ranking technique provides the minimum optimal result to the considered SVTNTP.

2. Preliminary Concepts

Definition 2.1. [22]

Fuzzy sets \tilde{A} maps the elements from the universe of discourse X to the unit interval interval $[0, 1]$, $\tilde{A} = \{(x, \mu_{\tilde{A}(x)})/x \in X\}$ here $\mu_{\tilde{A}}: X \rightarrow [0, 1]$, $\mu_{\tilde{A}}$ called the membership function value of $x \in X$ the fuzzy set, and it is represented by real numbers ranging from $[0, 1]$.

Definition 2.2. [22]

A fuzzy set \tilde{A} defined on the universal set of real numbers R is said to be a fuzzy number if its membership function has the following characteristics.

- $\mu_{\tilde{A}(x)} : R \rightarrow [0, 1]$ is continuous.
- $\mu_{\tilde{A}(x)} = 0$ for all $(-\infty, a] \cup [d, \infty)$
- $\mu_{\tilde{A}(x)}$ is strictly increasing on interval $[a, b]$, and strictly decreasing on $[c, d]$.
- $\mu_{\tilde{A}(x)} = 1$ for all $x \in [b, c]$ where $a < b < c < d$.

Definition 2.3. [11]

Let X be a non-empty set. Then an NS \tilde{A}^N on X defined as

$$\tilde{A}^N = \left\{ \langle x, T_{\tilde{A}^N}(x), I_{\tilde{A}^N}(x), F_{\tilde{A}^N}(x) \rangle / x \in X \mid x, T_{\tilde{A}^N}(x), I_{\tilde{A}^N}(x), F_{\tilde{A}^N}(x) \in [-0, 1^+[\right\}.$$

Where $T_{\tilde{A}^N}(x)$, $I_{\tilde{A}^N}(x)$ and $F_{\tilde{A}^N}(x)$ are the truth membership function, an indeterminacy membership function, and a falsity function and there is no restriction on the sum of $-0 \leq T_{\tilde{A}^N}(x) + I_{\tilde{A}^N}(x) + F_{\tilde{A}^N}(x) \leq 3^+$ nonstandard unit interval.

Definition 2.4. [15]

Let X be a non-empty set. Then an SVNS \tilde{A}_{SN} on X defined as

$$\tilde{A}_{SN} = \langle x, T_{\tilde{A}_{SN}}(x), I_{\tilde{A}_{SN}}(x), F_{\tilde{A}_{SN}}(x) \rangle / x \in X \text{ where}$$

$$T_{\tilde{A}_{SN}}(x), I_{\tilde{A}_{SN}}(x) \text{ and } F_{\tilde{A}_{SN}}(x) \in [0, 1] \text{ for each}$$

$$x \in X \quad 0 \leq T_{\tilde{A}_{SN}}(x), I_{\tilde{A}_{SN}}(x), F_{\tilde{A}_{SN}}(x) \leq 3.$$

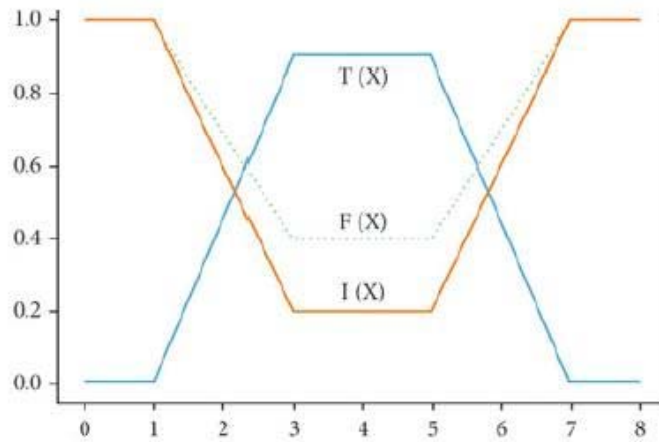


Figure 1. Pictorial representation of Single-valued Trapezoidal Neutrosophic number

Definition 2.5. [9]

Let m_1, m_2, m_3, m_4 such that $m_1 \leq m_2 \leq m_3 \leq m_4$ and $T_{\tilde{m}}, I_{\tilde{m}}, F_{\tilde{m}} \in [0, 1]$. Then an SVTNNs is defined as $m_{\tilde{m}} = (m_1, m_2, m_3, m_4); T_{\tilde{m}}, I_{\tilde{m}}, F_{\tilde{m}}$ is a special neutrosophic set on the real line set R , whose truth membership, indeterminacy membership, and falsity membership functions are given as follows:

$$\mu_{T_{\tilde{m}}} = \begin{cases} T_{\tilde{m}} \left(\frac{x-m_1}{m_2-m_1} \right), & m_1 \leq x \leq m_2 \\ T_{\tilde{m}}, & m_2 \leq x \leq m_3 \\ T_{\tilde{m}} \left(\frac{m_4-x}{m_4-m_3} \right), & m_3 \leq x \leq m_4 \\ 0, & \text{otherwise} \end{cases}$$

$$v_{I_{\tilde{m}}}(x) = \begin{cases} \frac{m_2-x+I_{\tilde{m}}(x-m_1)}{m_2-m_1}, & m_1 \leq x \leq m_2 \\ I_{\tilde{m}}, & m_2 \leq x \leq m_3 \\ \frac{x-m_2+I_{\tilde{m}}(m_4-x)}{m_4-m_3}, & m_3 \leq x \leq m_4 \\ 1, & \text{otherwise} \end{cases}$$

$$w_{F_{\tilde{m}}}(x) = \begin{cases} \frac{m_2-x+F_{\tilde{m}}(x-m_1)}{m_2-m_1}, & m_1 \leq x \leq m_2 \\ F_{\tilde{m}}, & m_2 \leq x \leq m_3 \\ \frac{x-m_2+F_{\tilde{m}}(m_4-x)}{m_4-m_3}, & m_3 \leq x \leq m_4 \\ 1, & \text{otherwise} \end{cases}$$

Definition 2.6. Arithmetic operations of SVTNNs[12]

Let $m_{\tilde{m}} = ((m_1, m_2, m_3, m_4); T_{\tilde{m}}, I_{\tilde{m}}, F_{\tilde{m}})$ and $m_{\tilde{n}} = ((n_1, n_2, n_3, n_4); T_{\tilde{n}}, I_{\tilde{n}}, F_{\tilde{n}})$ be two SVTNNs and $k \neq 0$, then

Addition:

$$\tilde{m} + \tilde{n} = \langle (\tilde{m}_1 + \tilde{n}_1, \tilde{m}_2 + \tilde{n}_2, \tilde{m}_3 + \tilde{n}_3, \tilde{m}_4 + \tilde{n}_4); T_{\tilde{m}} \wedge T_{\tilde{n}}, T_{\tilde{m}} \vee T_{\tilde{n}}, T_{\tilde{m}} \vee T_{\tilde{n}} \rangle$$

Subtraction:

$$\tilde{m} - \tilde{n} = \langle (\tilde{m}_1 - \tilde{n}_1, \tilde{m}_2 - \tilde{n}_2, \tilde{m}_3 - \tilde{n}_3, \tilde{m}_4 - \tilde{n}_4); T_{\tilde{m}} \vee T_{\tilde{n}}, T_{\tilde{m}} \wedge T_{\tilde{n}}, T_{\tilde{m}} \wedge T_{\tilde{n}} \rangle$$

Product:

$$\widetilde{mn} = \left\{ \begin{array}{l} \langle (\widetilde{m_1n_1}, \widetilde{m_2n_2}, \widetilde{m_3n_3}, \widetilde{m_4n_4}); T_{\widetilde{m}}^{\sim} \wedge T_{\widetilde{n}}^{\sim}, I_{\widetilde{m}}^{\sim} \vee I_{\widetilde{n}}^{\sim}, F_{\widetilde{m}}^{\sim} \vee F_{\widetilde{n}}^{\sim} \rangle (m_4 > 0, n_4 > 0) \\ \langle (\widetilde{m_1n_4}, \widetilde{m_2n_3}, \widetilde{m_3n_2}, \widetilde{m_4n_1}); T_{\widetilde{m}}^{\sim} \wedge T_{\widetilde{n}}^{\sim}, I_{\widetilde{m}}^{\sim} \vee I_{\widetilde{n}}^{\sim}, F_{\widetilde{m}}^{\sim} \vee F_{\widetilde{n}}^{\sim} \rangle (m_4 < 0, n_4 > 0) \\ \langle (\widetilde{m_4n_1}, \widetilde{m_3n_2}, \widetilde{m_2n_3}, \widetilde{m_1n_4}); T_{\widetilde{m}}^{\sim} \wedge T_{\widetilde{n}}^{\sim}, I_{\widetilde{m}}^{\sim} \vee I_{\widetilde{n}}^{\sim}, F_{\widetilde{m}}^{\sim} \vee F_{\widetilde{n}}^{\sim} \rangle (m_4 < 0, n_4 < 0) \end{array} \right\}$$

Division:

$$\widetilde{m/n} = \left\{ \begin{array}{l} \langle (\widetilde{m_1/n_4}, \widetilde{m_2/n_3}, \widetilde{m_3/n_2}, \widetilde{m_4/n_1}); T_{\widetilde{m}}^{\sim} \wedge T_{\widetilde{n}}^{\sim}, I_{\widetilde{m}}^{\sim} \vee I_{\widetilde{n}}^{\sim}, F_{\widetilde{m}}^{\sim} \vee F_{\widetilde{n}}^{\sim} \rangle (m_4 > 0, n_4 > 0) \\ \langle (\widetilde{m_4/n_4}, \widetilde{m_3/n_3}, \widetilde{m_2/n_2}, \widetilde{m_1/n_1}); T_{\widetilde{m}}^{\sim} \wedge T_{\widetilde{n}}^{\sim}, I_{\widetilde{m}}^{\sim} \vee I_{\widetilde{n}}^{\sim}, F_{\widetilde{m}}^{\sim} \vee F_{\widetilde{n}}^{\sim} \rangle (m_4 < 0, n_4 > 0) \\ \langle (\widetilde{m_4/n_1}, \widetilde{m_3/n_2}, \widetilde{m_2/n_3}, \widetilde{m_1/n_4}); T_{\widetilde{m}}^{\sim} \wedge T_{\widetilde{n}}^{\sim}, I_{\widetilde{m}}^{\sim} \vee I_{\widetilde{n}}^{\sim}, F_{\widetilde{m}}^{\sim} \vee F_{\widetilde{n}}^{\sim} \rangle (m_4 < 0, n_4 < 0) \end{array} \right\}$$

Scalar product:

$$k\widetilde{m} = \left\{ \begin{array}{l} \langle (km_1, km_2, km_3, km_4); T_{\widetilde{m}}^{\sim}, I_{\widetilde{m}}^{\sim}, F_{\widetilde{m}}^{\sim} \rangle (k > 0) \\ \langle (km_4, km_3, km_2, km_1); T_{\widetilde{m}}^{\sim}, I_{\widetilde{m}}^{\sim}, F_{\widetilde{m}}^{\sim} \rangle (k < 0) \end{array} \right\}$$

Definition 2.7. [14]

Let \widetilde{ASN} and \widetilde{BSN} be two SVNNS. Then ranking of \widetilde{ASN} and \widetilde{BSN} by the $R(\cdot)$ SVNNS is defined as follows.

1. [I]. $R(\widetilde{ASN}) > R(\widetilde{BSN})$ iff $\widetilde{ASN} > \widetilde{BSN}$
2. [II]. $R(\widetilde{ASN}) < R(\widetilde{BSN})$ iff $\widetilde{ASN} > \widetilde{BSN}$
3. [III]. $R(\widetilde{ASN}) = R(\widetilde{BSN})$ iff $\widetilde{ASN} = \widetilde{BSN}$

Definition 2.8. [22] The ordering \geq and \leq between any two SVNNS \widetilde{ASN} and \widetilde{BSN} are defined as follows.

- I. $R(\widetilde{ASN}) \geq R(\widetilde{BSN})$ iff $\widetilde{ASN} > \widetilde{BSN}$ or $\widetilde{ASN} = \widetilde{BSN}$.
- II. $R(\widetilde{ASN}) \leq R(\widetilde{BSN})$ iff $\widetilde{ASN} < \widetilde{BSN}$ or $\widetilde{ASN} = \widetilde{BSN}$.

Definition 2.9. [4] Let $\{\widetilde{ASN}_i, i = 1, 2, \dots, n\}$ be a set of SVNNS. If $R(\widetilde{ASN}) \leq R(\widetilde{BSN})$ for all i , then the SVNNS \widetilde{ASN}_i is the minimum of $\{\widetilde{ASN}_i, i = 1, 2, \dots, n\}$.

Definition 2.10. [22]

Let $\{\tilde{A}_{SN_i}, i = 1, 2, \dots, n\}$ be a set of SVNNS. If $R(\tilde{A}_{SN}) \geq R(\tilde{B}_{SN})$ for all i , then the SVNNS \tilde{A}_{SN_i} is the minimum of $\{\tilde{A}_{SN_i}, i = 1, 2, \dots, n\}$.

Definition 2.11. Said Broumi et.al Ranking Function[11]

Let $\tilde{A} = \langle (a_1, a_2, a_3, a_4); T, I, F \rangle$ be the SVTNNs. Then the score function $S(\tilde{A})$ is given as,

$$S(\tilde{A}) = \frac{1}{12}(a_1 + a_2 + a_3 + a_4) * [2 + T - I - F]$$

The accuracy function $A(\tilde{A})$

$$A(\tilde{A}) = \frac{1}{12}(a_1 + a_2 + a_3 + a_4) * [2 + T - I + F]$$

Definition 2.12. Umamageswari and Uthra's Ranking function

[22]

Let $\tilde{A}^N = \langle (a, b, c, d); w_{\tilde{A}}, u_{\tilde{A}}, y_{\tilde{A}} \rangle$ be as an SVTNNs. Then the $R(\cdot)$ of \tilde{A}^N on the set of SVTNNs is defined as follows.

$$R(\tilde{A}^N) = \left(\frac{w_{\tilde{A}} + 1 - u_{\tilde{A}} + 1 - y_{\tilde{A}}}{3} \right) * \left(\frac{a + b + c + d}{4} \right)$$

Definition 2.13. Proposed Ranking function

Let $\tilde{A}_{SN} = \langle (m_1, m_2, m_3, m_4); T_{\tilde{m}}, I_{\tilde{m}}, F_{\tilde{m}} \rangle$ be an SVTNNs. The ranking $R(\cdot)$ of \tilde{A}_{SN} set of SVTNNs is defined as follows.

$$R(\tilde{A}_{SN}) = \frac{((m_3 + m_4) - (m_1, m_2))}{2} * (T_{\tilde{m}} - I_{\tilde{m}} - F_{\tilde{m}})$$

3. Mathematical Formulation of SVTN Transportation problem

The transportation problem has been given in the form of $m \times n$ SVTN cost table $[C_{ij}]$ is tabulated below (Table 3.1):

Table 3.1: Transportation cost Matrix

	D₁	D₂	⋮	D_j	⋮	D_n	Quantities
O₁	\tilde{C}_{11}	\tilde{C}_{12}		\tilde{C}_{1j}		\tilde{C}_{1n}	\tilde{q}_1
⋮	⋮	⋮		⋮		⋮	⋮
O_i	\tilde{C}_{i1}	\tilde{C}_{i2}		\tilde{C}_{ij}		\tilde{C}_{in}	\tilde{q}_i
⋮	⋮	⋮		⋮		⋮	⋮
O_m	\tilde{C}_{m1}	\tilde{C}_{m2}		\tilde{C}_{mj}		\tilde{C}_{mn}	\tilde{q}_m
Requirements	\tilde{r}_1	\tilde{r}_2		\tilde{r}_j		\tilde{r}_n	

The cost C_{ij} are taken as SVTNNs.

$$\tilde{C}_{ij}^{SN} = ((\tilde{C}_{ij}^{SN}, \tilde{C}_{ij}^{SN}, \tilde{C}_{ij}^{SN}, \tilde{C}_{ij}^{SN})\mu_{ij}, v_{ij}, w_{ij})$$

The target is to minimize the SVTN cost induced transportation successfully. Let us presume that there are m quantities at the sources and n requirements at the destination. Let \tilde{q}_i^{SN} the SVTN quantities at i and \tilde{r}_j^{SN} SVTN requirement at j be the unit cost SVTN transportation cost from source i to destination j and \tilde{X}_{ij} be the number of units shifted from source i to destination j . The SVTN transportation problem can be mathematically expressed as

$$\min \tilde{z} = \sum_{i=1}^m \sum_{j=1}^n \tilde{C}_{ij}^{SN} \tilde{X}_{ij}$$

subject to the constraints, $\sum_{j=1}^n \tilde{X}_{ij} = \tilde{q}_i, i = 1 \quad \text{to} \quad m$ and $\sum_{i=1}^m \tilde{X}_{ij} = \tilde{r}_j, j = 1 \quad \text{to} \quad n$

The SVTNN problem is said to be balanced

$$\sum_{i=1}^m \tilde{q}_i = \sum_{j=1}^n \tilde{r}_j$$

(i.e., if the total supply from all the sources is equal to the demand of the requirement).

3.1. A conventional approach for SVTNN:

This section provides step by step procedure for a conventional approach to the SVTN transportation problem which leads as:

Step 1: Test the generalized SVTN transportation problem is balanced, if it is balanced, Proceed to step 3, otherwise move on to step 2.

Step 2: Use zero generalized single-valued dummy rows of dummy columns. To construct a balanced one, trapezoidal neutrosophic expenses must be added.

Step 3: Using the ranking function described, obtain the rank for each cell of the chosen generalized SVTN cost matrix.

Step 4: Find the initial basic feasible solution by following the VAM approach and if it is degeneracy check the optimality test by following a modified distribution approach to obtain the optimal solution.

Step 5: Using generalized SVTN cost by adding the optimal generalized SVTN cost which minimizes the transportation cost.

4. Numerical Illustration

The above conventional approach is illustrated in the following transportation problem, to obtain the best optimal solution. Here the problem is considered as a small-scale domestic industry requirement to get the best optimal solution as well as the optimal decision to the stakeholders. The problem is continued as below:

A company has three plants P1, P2, P3 from which it supplies to three markets M1, M2, M3. Calculating the optimal plan depending on the appropriate. data giving the plant to market shifting cost, quantities available at each plant, and quantities required at each market. Due to the uncertain situations, all the costs of the problem as SVTNNs.

Using the proposed ranking function the transportation cost from plants to the markets has defuzzified as a crisp number and applied the conventional approach to the problem to get the best optimal solution as well as optimal plan. The optimal plan for the transportation is given in the following table with detailed cost and quantity has driven for the crisp problem. The conventional approach provides the optimal solution or the total cost of the transportation problem is 576.

Table 4.1: Transportation cost from Plants to the Markets

Plant/ Market	M1	M2	M3
P1	$((60, 70, 90, 100);$ $0.8, 0.5, 0.2)$	$((50, 60, 80, 90);$ $0.9, 0.4, 0.2)$	$((35, 40, 65, 80);$ $0.6, 0.4, 0.1)$
P2	$((30, 50, 70, 90);$ $0.6, 0.3, 0.2)$	$((50, 75, 100, 115);$ $0.9, 0.3, 0.1)$	$((60, 75, 105, 120);$ $0.5, 0.2, 0.1)$
P3	$((65, 85, 105, 125);$ $0.7, 0.3, 0.2)$	$((35, 55, 70, 100);$ $0.8, 0.4, 0.2)$	$((25, 25, 65, 75);$ $0.5, 0.2, 0.1)$

Table 4.2: The optimal plan for the transportation from Plants to the Markets.

Plant	Market	Cost	Quantity
1	2	9	15.5
1	3	3.5	0
2	1	4	15
2	3	9	20.5
3	2	8	24

4.1. A comparison study for different ranking functions

The optimal results are compared with various other ranking functions for the proposed approach. The proposed ranking function for the SVTN problem has attained the minimum cost for the transportation problem, which is very minimal compared to other approaches. The comparison of results is illustrated in the below table and also the pictorial representation (Fig.2) for the different ranking functions with discussion:

Table 4.3: Comparison of results using different ranking functions.

Ranking Methods	Ranking Function	Ranking results (optimal solution using MODI method)	Results using Modified VAM Method [14]
Said Broumi et.al [11] (Score function)	$\frac{1}{12} \left[\frac{(a_1 + a_2 + a_3 + a_4) *}{(2 + T - I - F)} \right]$	21193	21761
Said Broumi et.al [11] (Accuracy function)	$\frac{1}{12} (a_1 + a_2 + a_3 + a_4) * [2 + T - I + F]$	27520	28290
Uthra and Umamageswari [12]	$\left(\frac{w_{\bar{a}} + 1 - u_{\bar{a}} + 1 - y_{\bar{a}}}{3} \right) * \left(\frac{a + b + c + d}{4} \right)$	21193	23611
Proposed method	$\frac{((m_3 + m_4) - (m_1 + m_2)) *}{2} (T_{\bar{m}} - I_{\bar{m}} - F_{\bar{m}})$	576	767

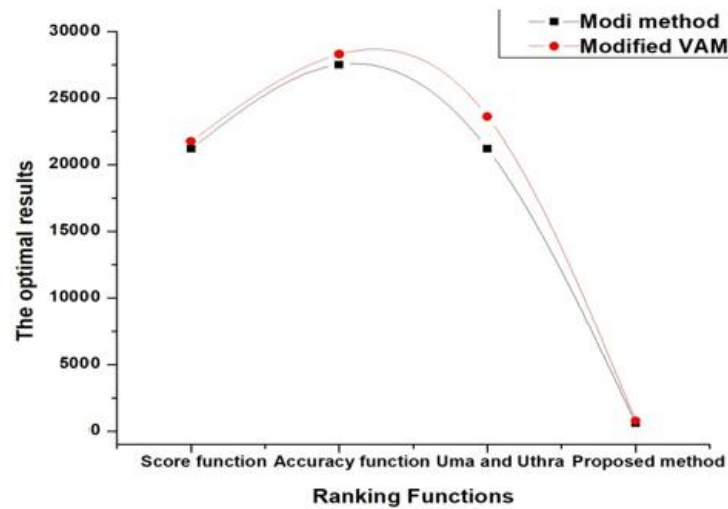


Figure 2. The optimal results for different ranking functions.

4.2. Discussion

The above table and figure show the results obtained from different ranking functions. It justified the newness of the approach which attains very minimum when compare with other ranking functions. Figure 2. represents the results of the problem for both Modi and modified VAM methods. Modi method gives a better solution than the Modified VAM method for all the ranking functions. Hence as a concluding remark, the conventional way also gives the best optimal solution for the problem with the uncertain situation using a neutrosophic approach to the transportation problem.

5. Conclusion

The neutrosophic set is the useful one to address the situations of inconsistencies and inexact data in all real-world problems. So this article proposed a conventional neutrosophic approach using a ranking function for the transportation problem. SVTNNs are well-known and used in the transportation problem with a numerical illustration. The obtained result was compared with a comparison study for different ranking functions and also discussed for the newness. Besides, a novel ranking function is justified in the comparison study which attains very minimum for the transportation cost. Hence the proposed ranking function provides the optimal solution this will attract more to the stack holder in situations of uncertainty to take the decision. Lastly, these kinds of new findings will help to get the best optimal decision for the transportation problem using the neutrosophic approach under uncertainty.

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