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Multi-attribute group decision-making based on the Neutrosophic Bonferroni mean operator

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Abstract

In this study, a Neutrosophic technique and arithmetic ranking operations are employed to group decision-making problems with many qualities. The outcome is contrasted with the current approach. When compared to the current method, the proposed method is much more manageable and useful for solving group decision making problems involving several qualities. All of the information provided by the decision makers (DMs) in the Neutrosophic Multi-Attribute Group Decision Making (NMAGDM) problems.

Keywords: Neutrosophic possibility mean, Neutrosophic operator.

1.Introduction

Employed the TOPSIS method's expansion [1]. [2] and [3] created a method for choosing configuration items by using the software development. The aforesaid problem (FMAGDM), the aggregating function known as fuzzy weighted minkowski distance is utilised, as it was first developed by [4]. [6] employed a maximising deviation approach to tackle the aforesaid problem (FMAGDM) in a linguistic context. [7] approach of analysis is ad hoc. [8] have presented a computational coordination approach to resolve the above method (FMAGDM). [9] demonstrate how the multi-granularity linguistic method (FMAGDM) is employed to tackle the aforementioned issue. [10] Different distance values have been measured using non-homogeneous information, and a new method (FMAGDM) has been created to overcome the aforesaid problem. The above methods, however, all rely on type-1 fuzzy sets. [11] was the first to suggest that type-1 fuzzy sets may be extended to type-2 fuzzy sets. In [12] introduction, it is said that type-2 fuzzy sets were able to resolve more uncertainty than type-1 fuzzy sets by using type-1 fuzzy sets' clear membership values. [13] and utilised in many practical applications is presented in [14],[15] and [16]. This is due to the complexity of employing type-2 fuzzy sets. [17] work, a brand-new approach known as the FMAGDM—a linguistic weighted average method—is applied to interval type-2 fuzzy sets in order to tackle the aforementioned issue. According to [18] the FMAGDM is resolved utilising the ranking approach and arithmetic operations in interval type-2 fuzzy sets. [19] the TOPSIS approach is also employed to solve the FMAGDM using interval type-2 fuzzy sets. Even if the attribute weights are only partially known, [20] explanation of how the interval type-2 fuzzy set is utilised to characterise the attribute values is comprehensive. [21] presented a ranking approach that is used in an interval type-2 fuzzy set to resolve the FMAGDM method. [22],[23] and [24] developed a novel approach to solve the FMAGDM utilising a trapezoidal interval type-2 fuzzy set. [25] explanation of the possibility degree approach utilised to solve the FMAGDM problem. In our daily life the multiple criteria decision making problem achieved a vital role and it was elaborately researched by many scholars [26],[27] and [28] were used gained and lost dominance score method [29] and [30]. But the information they were given was incomplete while using the fuzzy set and it is necessary to investigate further to solve the group decision making problem well. The highlights of the paper is by improving the possibility degree, a better solution has been given compare to the existing method and the accuracy of the rank is increased in the proposed method compare to the existing method. Neutrosophic multicriteria is a decision-making technique that combines a number of criteria or elements, sometimes with sparse or ambiguous information, in order to arrive at a conclusion [31]. The expression of the students is assessed using real-time data obtained by taking pictures of the students in relation to various themes using a mathematical model built using a double bounded rough neutrosophic set [32]. The primary medical domains that NIP can produce for image segmentation from DICOM photos are mentioned in the suggested study. It has been discovered to be a better approach because of how it manages unclear information [33]. With the exception of placing more emphasis on Neutrosophic voice recognition, existing methods are utilised. the development of formulas that compute, classify, or distinguish between various stress conditions. The objectives of this research are to comprehend stress and develop methods to mitigate its impacts on voice recognition and human-computer interaction systems [34]. In this article, we offer an approach for estimating a system's anticipated expenses under various circumstances. The trapezoidal bipolar neutrosophic numbers are used to manage the uncertainties that are present in the various model parameters [35]. The dynamic programming method is used in this article to address complex group decision-making scenarios where the preference data is represented by linguistic variables. The complexity and ambiguity of reality make it challenging for decision-makers to draw judgements using precise data [36]. The advantage of the method is that it may be handled without a lower membership function for falsehood, which allows for significant calculation time savings [37]. In order to address the traffic issue, this paper attempted to give a general summary of each method. The suggested study is anticipated to be beneficial to numerous researchers studying traffic flow, traffic accident diagnostics, and its hybridization in the future [38]. This study demonstrates that, in contrast to standard regression models, neurosophic multiple regression is the most effective model for uncertainty [39]. The triangular interval type-2 fuzzy soft weighted arithmetic operator (TIT2FSWA) with the requisite mathematical features has been proposed in this research. Additionally, the proposed methodology has been applied to a decision-making problem for profit analysis [40]. For the purpose of demonstrating the originality of the suggested graphical representation, the proposed distance measure and several trapezoidal fuzzy neutrosophic number forms have been given out [41]. In this study, we will write the issue text suitably for such a situation before building the suitable mathematical model to achieve the lowest inspection cost possible [42]. The elements of Industry 5.0 are considered in this framework. By first examining the pertinent experts and body of published research, it is possible to discover the most crucial associated aspects and tactics [43]. For the region's economic and environmental wellbeing, it is crucial to reduce HCWT through suitable treatment. This research develops a novel multi-criteria decision-making strategy to address single-valued neutrosophic group decision-making problems with lacking weight data. [44].

2. **Preliminary:**

Definition 2.1:

The upper and lower trapezoidal Neutrosophic set is defined as

$$(TN_1, IN_1, FN_1) = \left((TN_1^U, IN_1^U, FN_1^U), (TN_1^L, IN_1^L, FN_1^L)\right)$$
$$= \Big(\big((Ta_{11}^U, Ia_{11}^U, Fa_{11}^U), (Ta_{12}^U, Ia_{12}^U, Fa_{12}^U), (Ta_{13}^U, Ia_{13}^U, Fa_{13}^U), (Ta_{14}^U, Ia_{14}^U, Fa_{14}^U), (Th_1^U, Ih_1^U, Fh_1^U)\big),$$
$$((Ta_{11}^L, Ia_{11}^L, Fa_{11}^L), (Ta_{12}^L, Ia_{12}^L, Fa_{12}^L), (Ta_{13}^L, Ia_{13}^L, Fa_{13}^L), (Ta_{14}^L, Ia_{14}^L, Fa_{14}^L), (Th_1^L, Ih_1^L, Fh_1^L)))$$

(1)

Definition 2.2:

The upper and lower triangular Neutrosophic set is defined as

$$(TN_1, IN_1, FN_1) = \left((TN_1^U, IN_1^U, FN_1^U), (TN_1^L, IN_1^L, FN_1^L)\right)$$
$$= \Big(\big((Ta_{11}^U, Ia_{11}^U, Fa_{11}^U), (Ta_{12}^U, Ia_{12}^U, Fa_{12}^U), (Ta_{12}^U, Ia_{12}^U, Fa_{12}^U), (Ta_{13}^U, Ia_{13}^U, Fa_{13}^U), (Th_1^U, Ih_1^U, Fh_1^U)\big),$$
$$((Ta_{11}^L, Ia_{11}^L, Fa_{11}^L), (Ta_{12}^L, Ia_{12}^L, Fa_{12}^L), (Ta_{12}^L, Ia_{12}^L, Fa_{12}^L), (Ta_{13}^L, Ia_{13}^L, Fa_{13}^L), (Th_1^L, Ih_1^L, Fh_1^L)))$$

(2)

Definition 2.3:

The additive operation of two upper and lower trapezoidal Neutrosophic set is defined as

$$(TN_1, IN_1, FN_1) \oplus (TN_2, IN_2, FN_2)$$
$$= \left((TN_1^U, IN_1^U, FN_1^U), (TN_1^L, IN_1^L, FN_1^L)\right) \oplus \left((TN_2^U, IN_2^U, FN_2^U), (TN_2^L, IN_2^L, FN_2^L)\right)$$
$$= \Big(\big((Ta_{11}^U, Ia_{11}^U, Fa_{11}^U), (Ta_{12}^U, Ia_{12}^U, Fa_{12}^U), (Ta_{13}^U, Ia_{13}^U, Fa_{13}^U), (Ta_{14}^U, Ia_{14}^U, Fa_{14}^U), (Th_1^U, Ih_1^U, Fh_1^U)\big),$$
$$((Ta_{11}^L, Ia_{11}^L, Fa_{11}^L), (Ta_{12}^L, Ia_{12}^L, Fa_{12}^L), (Ta_{13}^L, Ia_{13}^L, Fa_{13}^L), (Ta_{14}^L, Ia_{14}^L, Fa_{14}^L), (Th_1^L, Ih_1^L, Fh_1^L)))$$
$$\oplus \Big(\big((Ta_{21}^U, Ia_{21}^U, Fa_{21}^U), (Ta_{22}^U, Ia_{22}^U, Fa_{22}^U), (Ta_{23}^U, Ia_{23}^U, Fa_{23}^U), (Ta_{24}^U, Ia_{24}^U, Fa_{24}^U), (Th_2^U, Ih_2^U, Fh_2^U)\big),$$

$$((Ta_{21}^L, Ia_{21}^L, Fa_{21}^L), (Ta_{22}^L, Ia_{22}^L, Fa_{22}^L), (Ta_{23}^L, Ia_{23}^L, Fa_{23}^L), (Ta_{24}^L, Ia_{24}^L, Fa_{24}^L), (Th_2^L, Ih_2^L, Fh_2^L)))$$

$$= \Bigg(\Big(\big((Ta_{11}^U - Ta_{21}^U + Ta_{11}^U * Ta_{21}^U), (Ia_{11}^U * Ia_{21}^U), (Fa_{11}^U * Fa_{21}^U)\big), \big((Ta_{12}^U - Ta_{22}^U + Ta_{12}^U * Ta_{22}^U), (Ia_{12}^U * Ia_{22}^U), (Fa_{12}^U * Fa_{22}^U)\big), \big((Ta_{13}^U - Ta_{23}^U + Ta_{13}^U * Ta_{23}^U), (Ia_{13}^U * Ia_{23}^U), (Fa_{13}^U * Fa_{23}^U)\big), \big((Ta_{14}^U - Ta_{24}^U + Ta_{14}^U * Ta_{24}^U), (Ia_{14}^U * Ia_{24}^U), (Fa_{14}^U * Fa_{24}^U)\big), \big((Th_1^U - Th_2^U + Th_1^U * Th_2^U), (Ih_1^U * Ih_2^U), (Fh_1^U * Fh_2^U)\big)\Big), \Big(\big((Ta_{11}^L - Ta_{21}^L + Ta_{11}^L * Ta_{21}^L), (Ia_{11}^L * Ia_{21}^L), (Fa_{11}^L * Fa_{21}^L)\big), \big((Ta_{12}^L - Ta_{22}^L + Ta_{12}^L * Ta_{22}^L), (Ia_{12}^L * Ia_{22}^L), (Fa_{12}^L * Fa_{22}^L)\big), \big((Ta_{13}^L - Ta_{23}^L + Ta_{13}^L * Ta_{23}^L), (Ia_{13}^L * Ia_{23}^L), (Fa_{13}^L * Fa_{23}^L)\big), \big((Ta_{14}^L - Ta_{24}^L + Ta_{14}^L * Ta_{24}^L), (Ia_{14}^L * Ia_{24}^L), (Fa_{14}^L * Fa_{24}^L)\big), \big((Th_1^L - Th_2^L + Th_1^L * Th_2^L), (Ih_1^L * Ih_2^L), (Fh_1^L * Fh_2^L)\big)\Big)\Bigg) \quad (3)$$

Definition 2.4:

The multiplicative operation of two upper and lower trapezoidal Neutrosophic set is defined as

$$(TN_1, IN_1, FN_1) \otimes (TN_2, IN_2, FN_2)$$
$$= \big((TN_1^U, IN_1^U, FN_1^U), (TN_1^L, IN_1^L, FN_1^L)\big) \otimes \big((TN_2^U, IN_2^U, FN_2^U), (TN_2^L, IN_2^L, FN_2^L)\big)$$
$$= (\big((Ta_{11}^U, Ia_{11}^U, Fa_{11}^U), (Ta_{12}^U, Ia_{12}^U, Fa_{12}^U), (Ta_{13}^U, Ia_{13}^U, Fa_{13}^U), (Ta_{14}^U, Ia_{14}^U, Fa_{14}^U), (Th_1^U, Ih_1^U, Fh_1^U)\big),$$

$$((Ta_{11}^L, Ia_{11}^L, Fa_{11}^L), (Ta_{12}^L, Ia_{12}^L, Fa_{12}^L), (Ta_{13}^L, Ia_{13}^L, Fa_{13}^L), (Ta_{14}^L, Ia_{14}^L, Fa_{14}^L), (Th_1^L, Ih_1^L, Fh_1^L)))$$
$$\otimes (\big((Ta_{21}^U, Ia_{21}^U, Fa_{21}^U), (Ta_{22}^U, Ia_{22}^U, Fa_{22}^U), (Ta_{23}^U, Ia_{23}^U, Fa_{23}^U), (Ta_{24}^U, Ia_{24}^U, Fa_{24}^U), (Th_2^U, Ih_2^U, Fh_2^U)\big),$$

$$((Ta_{21}^L, Ia_{21}^L, Fa_{21}^L), (Ta_{22}^L, Ia_{22}^L, Fa_{22}^L), (Ta_{23}^L, Ia_{23}^L, Fa_{23}^L), (Ta_{24}^L, Ia_{24}^L, Fa_{24}^L), (Th_2^L, Ih_2^L, Fh_2^L)))$$

$$= \Bigg(\Big(\big((Ta_{11}^U * Ta_{21}^U), (Ia_{11}^U * Ia_{21}^U), (Fa_{11}^U * Fa_{21}^U)\big), \big((Ta_{12}^U * Ta_{22}^U), (Ia_{12}^U * Ia_{22}^U), (Fa_{12}^U * Fa_{22}^U)\big), \big((Ta_{13}^U * Ta_{23}^U), (Ia_{13}^U * Ia_{23}^U), (Fa_{13}^U * Fa_{23}^U)\big), \big((Ta_{14}^U * Ta_{24}^U), (Ia_{14}^U * Ia_{24}^U), (Fa_{14}^U * Fa_{24}^U)\big), \big((Th_1^U * Th_2^U), (Ih_1^U * Ih_2^U), (Fh_1^U * Fh_2^U)\big)\Big), \Big(\big((Ta_{11}^L * Ta_{21}^L), (Ia_{11}^L * Ia_{21}^L), (Fa_{11}^L * Fa_{21}^L)\big), \big((Ta_{12}^L * Ta_{22}^L), (Ia_{12}^L * Ia_{22}^L), (Fa_{12}^L *$$

$Fa_{22}^{L})\big),\big((Ta_{13}^{L}*Ta_{23}^{L}),(Ia_{13}^{L}*Ia_{23}^{L}),(Fa_{13}^{L}*Fa_{23}^{L})\big),\big((Ta_{14}^{L}*Ta_{24}^{L}),(Ia_{14}^{L}*Ia_{24}^{L}),(Fa_{14}^{L}*Fa_{24}^{L})\big),\big((Th_{1}^{L}* Th_{2}^{L}),(Ih_{1}^{L}*Ih_{2}^{L}),(Fh_{1}^{L}*Fh_{2}^{L})\big)\big)\Big)$ (4)

Definition 2.5:

The arithmetic operation of upper and lower trapezoidal Neutrosophic set is defined as

$$k(TN_1,IN_1,FN_1)=k\big((TN_1^U,IN_1^U,FN_1^U),(TN_1^L,IN_1^L,FN_1^L)\big)$$
$$=\left(\begin{pmatrix}((Ta_{11}^U)^k,(Ia_{11}^U)^k,(Fa_{11}^U)^k),((Ta_{12}^U)^k,(Ia_{12}^U)^k,(Fa_{12}^U)^k),((Ta_{13}^U)^k,(Ia_{13}^U)^k,(Fa_{13}^U)^k),\\ ((Ta_{14}^U)^k,(Ia_{14}^U)^k,(Fa_{14}^U)^k),((Th_1^U)^k,(Ih_1^U)^k,(Fh_1^U)^k)\end{pmatrix}, \atop \begin{pmatrix}((Ta_{11}^L)^k,(Ia_{11}^L)^k,(Fa_{11}^L)^k),((Ta_{12}^L)^k,(Ia_{12}^L)^k,(Fa_{12}^L)^k),((Ta_{13}^L)^k,(Ia_{13}^L)^k,(Fa_{13}^L)^k),\\ ((Ta_{14}^L)^k,(Ia_{14}^L)^k,(Fa_{14}^L)^k),((Th_1^L)^k,(Ih_1^L)^k,(Fh_1^L)^k)\end{pmatrix},\right)$$

(5)

Definition 2.6:

The score function for Neutrosophic triangular set is given by

$$\dot{S}^*\big(T_A(x),I_A(x),F_A(x)\big)=\frac{1}{2}\big(1+T_A(x)-2*I_A(x)+F_A(x)\big) \tag{6}$$

Definition 2.7:

The proposed score function for Neutrosophic trapezoidal set is given by

$$\dot{\dot{S}}^*\big(T_A(x),I_A(x),F_A(x)\big)=\frac{1}{2}\big(1+n*T_A(x)-I_A(x)+F_A(x)\big) \tag{7}$$

Where n represents number of terms in the matrices.

If a single value Neutrosophic number is $(TN,IN,FN)=\big((TN^U,IN^U,FN^U),(TN^L,IN^L,FN^L)\big)$, where$(TN^U,IN^U,FN^U)$ is the upper Neutrosophic member function and (TN^L,IN^L,FN^L) is the lower Neutrosophic member function having the level set as $(TN_\alpha^U,IN_\alpha^U,FN_\alpha^U)=\big[\big(TN_1^U(\alpha),IN_1^U(\alpha),FN_1^U(\alpha)\big),\big(TN_2^U(\alpha),IN_2^U(\alpha),FN_2^U(\alpha)\big)\big],\alpha\in[(0,0,0),(Th_U,Ih_U,Fh_U)]$ and $\big(TN_\beta^L,IN_\beta^L,FN_\beta^L\big)=\big[\big(TN_1^L(\beta),IN_1^L(\beta),FN_1^L(\beta)\big),\big(TN_2^L(\beta),IN_2^L(\beta),FN_2^L(\beta)\big)\big],\alpha\in[(0,0,0),(Th_L,Ih_L,Fh_L)]$ where (Th_U,Ih_U,Fh_U) is the highest membership Neutrosophic function of N^U and (Th_L,Ih_L,Fh_L) is the lower membership Neutrosophic function of N^L .

Definition 2.8:

The lower Neutrosophic possibility mean for $N = (N^U, N^L)$ is given by

$$\left(T\widetilde{M}_*(N), I\widetilde{M}_*(N), F\widetilde{M}_*(N)\right) = \left(\int_0^{Th_U}\left(TN_1^U(\alpha)\right)^\alpha d\alpha + \int_0^{Th_L}\left(TN_1^L(\beta)\right)^\beta d\beta, \int_0^{Ih_U}\left(IN_1^U(\alpha)\right)^\alpha d\alpha + \int_0^{Ih_L}\left(IN_1^L(\beta)\right)^\beta d\beta, \int_0^{Fh_U}\left(FN_1^U(\alpha)\right)^\alpha d\alpha + \int_0^{Fh_L}\left(FN_1^L(\beta)\right)^\beta d\beta\right) \quad (8)$$

Where $\left(T\widetilde{M}_*(N), I\widetilde{M}_*(N), F\widetilde{M}_*(N)\right)$ is the arithmetic mean of members of the Neutrosophic membership function.

Definition 2.9:

The upper Neutrosophic possibility mean for $(TN, IN, FN) = \left((TN^U, IN^U, FN^U), (TN^L, IN^L, FN^L)\right)$ is given by

$$\left(T\widetilde{M}^*(N), I\widetilde{M}^*(N), F\widetilde{M}^*(N)\right) = \left(\int_0^{Th_U}\left(TN_2^U(\alpha)\right)^\alpha d\alpha + \int_0^{Th_L}\left(TN_2^L(\beta)\right)^\beta d\beta, \int_0^{Ih_U}\left(IN_2^U(\alpha)\right)^\alpha d\alpha + \int_0^{Ih_L}\left(IN_2^L(\beta)\right)^\beta d\beta, \int_0^{Fh_U}\left(FN_2^U(\alpha)\right)^\alpha d\alpha + \int_0^{Fh_L}\left(FN_2^L(\beta)\right)^\beta d\beta\right) \quad (9)$$

Where $\left(T\widetilde{M}^*(N), I\widetilde{M}^*(N), F\widetilde{M}^*(N)\right)$ is the arithmetic mean of members of the Neutrosophic membership function.

Definition 2.100:

The closed bounded interval of Neutrosophic lower and upper mean value is given by the notation

$$\left(T\widetilde{M}(N), I\widetilde{M}(N), F\widetilde{M}(N)\right) = \left[\left(T\widetilde{M}_*(N), I\widetilde{M}_*(N), F\widetilde{M}_*(N)\right), \left(T\widetilde{M}^*(N), I\widetilde{M}^*(N), F\widetilde{M}^*(N)\right)\right].$$

Definition 2.11:

Similarly, the Neutrosophic mean value of (TN_1, IN_1, FN_1) and (TN_2, IN_2, FN_2) is given by $\left(T\widetilde{M}(N_1), I\widetilde{M}(N_1), F\widetilde{M}(N_1)\right) = \left[\left(T\widetilde{M}_*(N_1), I\widetilde{M}_*(N_1), F\widetilde{M}_*(N_1)\right), \left(T\widetilde{M}^*(N_1), I\widetilde{M}^*(N_1), F\widetilde{M}^*(N_1)\right)\right]$ and $\left(T\widetilde{M}(N_2), I\widetilde{M}(N_2), F\widetilde{M}(N_2)\right) = \left[\left(T\widetilde{M}_*(N_2), I\widetilde{M}_*(N_2), F\widetilde{M}_*(N_2)\right), \left(T\widetilde{M}^*(N_2), I\widetilde{M}^*(N_2), F\widetilde{M}^*(N_2)\right)\right]$

Definition 2.12:

The possibility Neutrosophic degree is given as

$$\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = \left(\begin{array}{c} min\left\{\max\left(\frac{T\widetilde{M}^*(N_1) - T\widetilde{M}_*(N_2)}{T\widetilde{M}^*(N_1) - T\widetilde{M}_*(N_1) + T\widetilde{M}^*(N_2) - T\widetilde{M}_*(N_2)}, 0\right), 1\right\}, min\left\{\max\left(\frac{I\widetilde{M}^*(N_1) - I\widetilde{M}_*(N_2)}{I\widetilde{M}^*(N_1) - I\widetilde{M}_*(N_1) + I\widetilde{M}^*(N_2) - I\widetilde{M}_*(N_2)}, 0\right), 1\right\}, \\ min\left\{\max\left(\frac{F\widetilde{M}^*(N_1) - F\widetilde{M}_*(N_2)}{F\widetilde{M}^*(N_1) - F\widetilde{M}_*(N_1) + F\widetilde{M}^*(N_2) - F\widetilde{M}_*(N_2)}, 0\right), 1\right\} \end{array} \right) \tag{10}$$

Definition 2.13:

The possibility Neutrosophic degree $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right)$ has to satisfy the following property

$(0,0,0) \leq \left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) \leq (1,1,1)$ and $(0,0,0) \leq \left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) \leq (1,1,1)$

If $\left(T\widetilde{M}_*(N_1), I\widetilde{M}_*(N_1), F\widetilde{M}_*(N_1)\right) = \left(T\widetilde{M}_*(N_2), I\widetilde{M}_*(N_2), F\widetilde{M}_*(N_2)\right)$ and $\left(T\widetilde{M}^*(N_1), I\widetilde{M}^*(N_1), F\widetilde{M}^*(N_1)\right) = \left(T\widetilde{M}^*(N_2), I\widetilde{M}^*(N_2), F\widetilde{M}^*(N_2)\right)$, then $\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (0.5,0.5,0.5)$

For a Neutrosophic member $(TN_1, IN_1, FN_1), (TN_2, IN_2, FN_2), (TN_3, IN_3, FN_3)$, If $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (0.5,0.5,0.5)$ and $\left(p(TN_2 \geqslant TN_3), p(IN_2 \geqslant IN_3), p(FN_2 \geqslant FN_3)\right) = (0.5,0.5,0.5)$ then $\left(p(TN_1 \geqslant TN_3), p(IN_1 \geqslant IN_3), p(FN_1 \geqslant FN_3)\right) = (0.5,0.5,0.5)$.

For a Neutrosophic member $(TN_1, IN_1, FN_1), (TN_2, IN_2, FN_2), (TN_3, IN_3, FN_3)$, If $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (0.5,0.5,0.5)$ and $\left(p(TN_2 \geqslant TN_3), p(IN_2 \geqslant IN_3), p(FN_2 \geqslant FN_3)\right) = (0.5,0.5,0.5)$ then $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) + \left(p(TN_2 \geqslant TN_3), p(IN_2 \geqslant IN_3), p(FN_2 \geqslant FN_3)\right) = 2\left(p(TN_1 \geqslant TN_3), p(IN_1 \geqslant IN_3), p(FN_1 \geqslant FN_3)\right)$.

Definition 2.14:

For the Neutrosophic trapezoidal number $(TN, IN, FN) = \left((TN^U, IN^U, FN^U), (TN^L, IN^L, FN^L)\right) = \left(\left((Ta_1^U, Ia_1^U, Fa_1^U), (Ta_2^U, Ia_2^U, Fa_2^U), (Ta_3^U, Ia_3^U, Fa_3^U), (Ta_4^U, Ia_4^U, Fa_4^U), (Th^U, Ih^U, Fh^U)\right),\right.$

$((Ta_1^L, Ia_1^L, Fa_1^L), (Ta_2^L, Ia_2^L, Fa_2^L), (Ta_3^L, Ia_3^L, Fa_3^L), (Ta_4^L, Ia_4^L, Fa_4^L), (Th^L, Ih^L, Fh^L)))$, the lower Neutrosophic possibility mean is calculated by,

$$\left(T\widetilde{M}_*(N), I\widetilde{M}_*(N), F\widetilde{M}_*(N)\right) = \begin{pmatrix} \int_0^{Th_U} \left(Ta_1^U + \frac{Ta_2^U - Ta_1^U}{Th_U}\right)^\alpha d\alpha + \int_0^{Th_L} \left(Ta_1^L + \frac{Ta_2^L - Ta_1^L}{Th_L}\right)^\beta d\beta\,, \\ \int_0^{Ih_U} \left(Ia_1^U + \frac{Ia_2^U - Ia_1^U}{Ih_U}\right)^\alpha d\alpha + \int_0^{Ih_L} \left(Ia_1^L + \frac{Ia_2^L - Ia_1^L}{Ih_L}\right)^\beta d\beta\,, \\ \int_0^{Fh_U} \left(Fa_1^U + \frac{Fa_2^U - Fa_1^U}{Fh_U}\right)^\alpha d\alpha + \int_0^{Fh_L} \left(Fa_1^L + \frac{Fa_2^L - Fa_1^L}{Fh_L}\right)^\beta d\beta\,, \end{pmatrix} \tag{11}$$

$$= \left(\left(\tfrac{1}{6}(Ta_1^U + 2Ta_2^U)Th_U^2 + \tfrac{1}{6}(Ta_1^L + 2Ta_2^L)Th_L^2\right), \left(\tfrac{1}{6}(Ia_1^U + 2Ia_2^U)Ih_U^2 + \tfrac{1}{6}(Ia_1^L + 2Ia_2^L)Ih_L^2\right), \left(\tfrac{1}{6}(Fa_1^U + 2Fa_2^U)Fh_U^2 + \tfrac{1}{6}(Fa_1^L + 2Fa_2^L)Fh_L^2\right)\right) \tag{12}$$

Definition 2.15:

For the Neutrosophic trapezoidal number $(TN, IN, FN) = \left((TN^U, IN^U, FN^U), (TN^L, IN^L, FN^L)\right) = \left(\left((Ta_1^U, Ia_1^U, Fa_1^U), (Ta_2^U, Ia_2^U, Fa_2^U), (Ta_3^U, Ia_3^U, Fa_3^U), (Ta_4^U, Ia_4^U, Fa_4^U), (Th^U, Ih^U, Fh^U)\right)\right.$,

$((Ta_1^L, Ia_1^L, Fa_1^L), (Ta_2^L, Ia_2^L, Fa_2^L), (Ta_3^L, Ia_3^L, Fa_3^L), (Ta_4^L, Ia_4^L, Fa_4^L), (Th^L, Ih^L, Fh^L)))$, the upper Neutrosophic possibility mean is calculated by,

$$\left(T\widetilde{M}^*(N), I\widetilde{M}^*(N), F\widetilde{M}^*(N)\right) = \begin{pmatrix} \int_0^{Th_U} \left(Ta_4^U + \frac{Ta_3^U - Ta_4^U}{Th_U}\right)^\alpha d\alpha + \int_0^{Th_L} \left(Ta_4^L + \frac{Ta_3^L - Ta_4^L}{Th_L}\right)^\beta d\beta\,, \\ \int_0^{Ih_U} \left(Ia_4^U + \frac{Ia_3^U - Ia_4^U}{Ih_U}\right)^\alpha d\alpha + \int_0^{Ih_L} \left(Ia_4^L + \frac{Ia_3^L - Ia_4^L}{Ih_L}\right)^\beta d\beta\,, \\ \int_0^{Fh_U} \left(Fa_4^U + \frac{Fa_3^U - Fa_4^U}{Fh_U}\right)^\alpha d\alpha + \int_0^{Fh_L} \left(Fa_4^L + \frac{Fa_3^L - Fa_4^L}{Fh_L}\right)^\beta d\beta\,, \end{pmatrix} \tag{13}$$

$$= \left(\left(\tfrac{1}{6}(Ta_4^U + 2Ta_3^U)Th_U^2 + \tfrac{1}{6}(Ta_4^L + 2Ta_3^L)Th_L^2\right), \left(\tfrac{1}{6}(Ia_4^U + 2Ia_3^U)Ih_U^2 + \tfrac{1}{6}(Ia_4^L + 2Ia_3^L)Ih_L^2\right), \left(\tfrac{1}{6}(Fa_4^U + 2Fa_3^U)Fh_U^2 + \tfrac{1}{6}(Fa_4^L + 2Fa_3^L)Fh_L^2\right)\right) \tag{14}$$

Definition 2.16:

The neutrosopic preference matrix (TP, IP, FP) is given as

$$(TP, IP, FP) = \begin{pmatrix} (p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)) & (p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)) & \dots & (p(TN_1 \geqslant TN_n), p(IN_1 \geqslant IN_n), p(FN_1 \geqslant FN_n)) \\ (p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)) & (p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)) & \dots & (p(TN_1 \geqslant TN_n), p(IN_1 \geqslant IN_n), p(FN_1 \geqslant FN_n)) \\ \vdots & \vdots & \vdots & \vdots \\ (p(TN_n \geqslant TN_1), p(IN_n \geqslant IN_1), p(FN_n \geqslant FN_1)) & (p(TN_n \geqslant TN_2), p(IN_n \geqslant IN_2), p(FN_n \geqslant FN_2)) & \dots & (p(TN_n \geqslant TN_n), p(IN_n \geqslant IN_n), p(FN_n \geqslant FN_n)) \end{pmatrix} \quad (15)$$

Definition 2.17:

The Neutrosophic ranking value $\mathcal{R}(TN, IN, FN)$ is given by

$$\mathcal{R}(TN, IN, FN) = \left(\frac{1}{n(n-1)}\left(\bigoplus_{k=1}^{n} p(TN_1 \geqslant TN_k) + \frac{n}{2} - 1\right), \frac{1}{n(n-1)}\left(\bigoplus_{k=1}^{n} p(IN_1 \geqslant IN_k) + \frac{n}{2} - 1\right), \frac{1}{n(n-1)}\left(\bigoplus_{k=1}^{n} p(FN_1 \geqslant FN_k) + \frac{n}{2} - 1\right)\right) \quad (16)$$

Step 1: Consider the problem in (27), and convert it into Neutrosophic trapezoidal number as

$$N_1 = \begin{pmatrix} ((0.7,0.2,0.1)(1.4,0.4,0.2)(2.8,0.8,0.4)(4.9,1.4,0.7)(0.7,0.2,0.1)), \\ ((1.05,0.3,0.15)(2.1,0.6,0.3)(2.1,0.6,0.3)(4.9,1.4,0.7)(0.56,0.16,0.08)) \end{pmatrix} \text{ and}$$

$$N_2 = \begin{pmatrix} ((1.05,0.3,0.15)(2.1,0.6,0.3)(4.2,1.2,0.6)(4.2,1.2,0.6)(0.7,0.2,0.1)) \\ , ((1.05,0.3,0.15)(2.31,0.66,0.33)(3.15,0.9,0.45)(3.5,1,0.5)(0.56,0.16,0.08)) \end{pmatrix}$$

Step 2:

Figure 1 represents the graphical representation of Neutrosophic trapezoidal number.

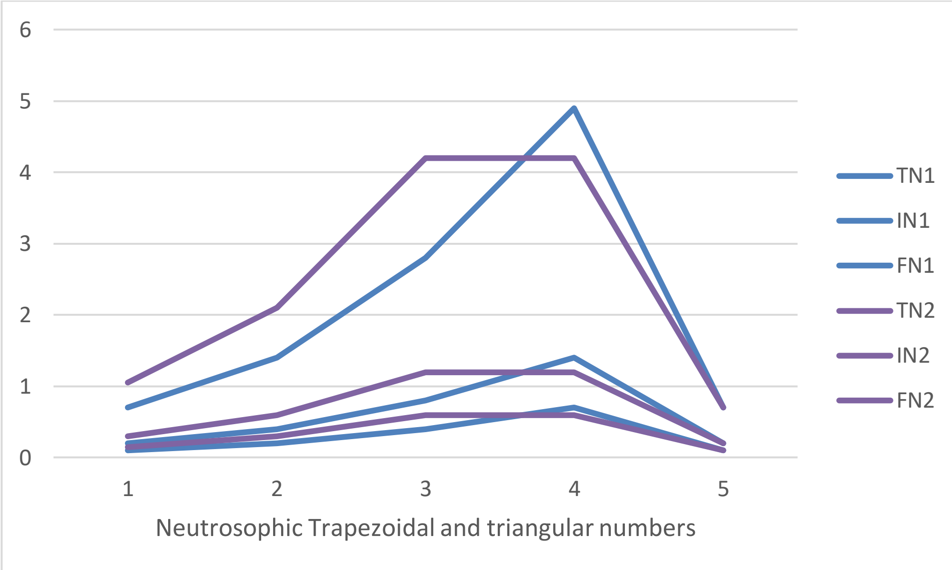

Figure 1: Neutrosophic Trapezoidal and triangular numbers

Step 3: For the above Neutrosophic member, the upper and lower possibility Neutrosophic mean value is given as

Case 1:

For $N_1 \& N_2$,

The closed bounded interval of Neutrosophic lower and upper mean value is given by

$$\left(T\widetilde{M}(N_1), I\widetilde{M}(N_1), F\widetilde{M}(N_1)\right) = \left[\left(T\widetilde{M}_*(N_1), I\widetilde{M}_*(N_1), F\widetilde{M}_*(N_1)\right), \left(T\widetilde{M}^*(N_1), I\widetilde{M}^*(N_1), F\widetilde{M}^*(N_1)\right)\right]$$

$$= [(-2.74, 0.01, 0.01), (0.78, 0.01, 0)]$$

$$\left(T\widetilde{M}(N_2), I\widetilde{M}(N_2), F\widetilde{M}(N_2)\right) = \left[\left(T\widetilde{M}_*(N_2), I\widetilde{M}_*(N_2), F\widetilde{M}_*(N_2)\right), \left(T\widetilde{M}^*(N_2), I\widetilde{M}^*(N_2), F\widetilde{M}^*(N_2)\right)\right]$$

$$= [(-5.39, 0.02, 0.01), (0.94, 0.01, 0)]$$

Case 2:

For $N_1 \& N_1$

The closed bounded interval of Neutrosophic lower and upper mean value is given by

$$\left(T\widetilde{M}(N_1), I\widetilde{M}(N_1), F\widetilde{M}(N_1)\right) = \left[\left(T\widetilde{M}_*(N_1), I\widetilde{M}_*(N_1), F\widetilde{M}_*(N_1)\right), \left(T\widetilde{M}^*(N_1), I\widetilde{M}^*(N_1), F\widetilde{M}^*(N_1)\right)\right]$$

$$= [(-2.74, 0.01, 0.01), (0.78, 0.01, 0)]$$

$$\left(T\widetilde{M}(N_1), I\widetilde{M}(N_1), F\widetilde{M}(N_1)\right) = \left[\left(T\widetilde{M}_*(N_1), I\widetilde{M}_*(N_1), F\widetilde{M}_*(N_1)\right), \left(T\widetilde{M}^*(N_1), I\widetilde{M}^*(N_1), F\widetilde{M}^*(N_1)\right)\right]$$

$$= [(-2.74, 0.01, 0.01), (0.78, 0.01, 0)]$$

Case 3:

For $N_2 \& N_2$

The closed bounded interval of Neutrosophic lower and upper mean value is given by

$$\left(T\widetilde{M}(N_2), I\widetilde{M}(N_2), F\widetilde{M}(N_2)\right) = \left[\left(T\widetilde{M}_*(N_2), I\widetilde{M}_*(N_2), F\widetilde{M}_*(N_2)\right), \left(T\widetilde{M}^*(N_2), I\widetilde{M}^*(N_2), F\widetilde{M}^*(N_2)\right)\right]$$

$$= [(-5.39, 0.02, 0.01), (0.94, 0.01, 0)]$$

$$\left(T\widetilde{M}(N_2), I\widetilde{M}(N_2), F\widetilde{M}(N_2)\right) = \left[\left(T\widetilde{M}_*(N_2), I\widetilde{M}_*(N_2), F\widetilde{M}_*(N_2)\right), \left(T\widetilde{M}^*(N_2), I\widetilde{M}^*(N_2), F\widetilde{M}^*(N_2)\right)\right]$$

$$= [(-5.39, 0.02, 0.01), (0.94, 0.01, 0)]$$

Case 4

For $N_2 \& N_1$

The closed bounded interval of Neutrosophic lower and upper mean value is given by

$$\left(T\widetilde{M}(N_2), I\widetilde{M}(N_2), F\widetilde{M}(N_2)\right) = \left[\left(T\widetilde{M}_*(N_2), I\widetilde{M}_*(N_2), F\widetilde{M}_*(N_2)\right), \left(T\widetilde{M}^*(N_2), I\widetilde{M}^*(N_2), F\widetilde{M}^*(N_2)\right)\right]$$

$$= [(-5.39, 0.02, 0.01), (0.94, 0.01, 0)]$$

$$\left(T\widetilde{M}(N_1), I\widetilde{M}(N_1), F\widetilde{M}(N_1)\right) = \left[\left(T\widetilde{M}_*(N_1), I\widetilde{M}_*(N_1), F\widetilde{M}_*(N_1)\right), \left(T\widetilde{M}^*(N_1), I\widetilde{M}^*(N_1), F\widetilde{M}^*(N_1)\right)\right]$$

$$= [(-2.74, 0.01, 0.01), (0.78, 0.01, 0)]$$

Step 4:

For the above cases, the Neutrosophic possibility degree is given by

For case 1, $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (0.38, 0.35, 0.36)$

For case 2, $\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (0.5, 0.5, 0.5)$

For case 3, $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (0.5, 0.5, 0.5)$

For case 4, $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (0.63, 0.66, 0.65)$

Step 5:

The Neutrosophic preference matrix is given by

$$(TP, IP, FP) = \begin{bmatrix} (0.5,0.5,0.5) & (0.38,0.35,0.36) \\ (0.63,0.66,0.65) & (0.5,0.5,0.5) \end{bmatrix}$$

Step 6:

The Neutrosophic ranking value is given as

$\mathcal{R}(TN_1, IN_1, FN_1) = (0.25, 0.42, 0.42)$ and $\mathcal{R}(TN_2, IN_2, FN_2) = (0.91, 0.58, 0.57)$

Step 7:

The rank of the alternatives $\mathcal{R}(N_1) = 0.9938$ and $\mathcal{R}(N_2) = 2.3027$

Step 8:

The rank is given in descending order

$$\mathcal{R}(N_2) > R(N_1)$$

Step 9:

The above result is compared with thirteen sets of trapezoidal and triangular Neutrosophic number in (20) is discussed in the next section.

4. Comparison result of trapezoidal and triangular Neutrosophic number:

A trapezoidal Neutrosophic member becomes the triangular Neutrosophic number, when the middle value is equal. Here we are taking the example of thirteen different sets in (20) to compare the result with the proposed method. Algorithm for this is same as the previous section but only in step 6, the scorefunction for deneutrosophic the triangular Neutrosophic is different. We use (6) for triangular Neutrosophic member.Also we give the graphical representation of each set also.

Table 1 represents the Neutrosophic member of thirteen set

S.No	Set	Neutrosophic values
1	I	$N_1 = ((0.245,0.07,0.035)(0.28,0.08,0.04)(0.28,0.08,0.04)(0.7,0.2,0.1)(0.7,0.2,0.1))$ $N_2 = ((0.105,0.03,0.015)(0.49,0.14,0.07)(0.49,0.14,0.07)(0.56,0.16,0.08)(0.7,0.2,0.1))$
2	II	$N_1 = ((0,0,0)(0.07,0.02,0.01)(0.35,0.1,0.05)(0.7,0.2,0.1)(0.7,0.2,0.1))$ $N_2 = ((0.05,0.42,0.12)(0.06,0.42,0.12)(0.06,0.49,0.14)(0.07,0.7,0.2)(0.1,0.7,0.2))$
3	III	$N_1 = ((0,0,0)(0.07,0.02,0.01)(0.35,0.1,0.05)(0.7,0.2,0.1)(0.7,0.2,0.1))$ $N_2 = ((0.42,0.12,0.06)(0.49,0.14,0.07)(0.49,0.14,0.07)(0.56,0.16,0.08)(0.7,0.2,0.1))$
4	IV	$N_1 = ((0.28,0.08,0.04)(0.63,0.18,0.09)(0.63,0.18,0.09)(0.7,0.2,0.1)(0.7,0.2,0.1))$ $N_2 = ((0.28,0.08,0.04)(0.49,0.14,0.07)(0.49,0.14,0.07)(0.7,0.2,0.1)(0.7,0.2,0.1))$ $N_3 = ((0.28,0.08,0.04)(0.35,0.1,0.05)(0.35,0.1,0.05)(0.7,0.2,0.1)(0.7,0.2,0.1))$
5	V	$N_1 = ((0.35,0.1,0.05)(0.49,0.14,0.07)(0.49,0.14,0.07)(0.63,0.18,0.09)(0.7,0.2,0.1))$ $N_2 = ((0.21,0.06,0.03)(0.49,0.14,0.07)(0.49,0.14,0.07)(0.63,0.18,0.09)(0.7,0.2,0.1))$ $N_3 = ((0.21,0.06,0.03)(0.28,0.08,0.04)(0.49,0.14,0.07)(0.63,0.18,0.09)(0.7,0.2,0.1))$
6	VI	$N_1 = ((0.21,0.06,0.03)(0.35,0.1,0.05)(0.56,0.16,0.08)(0.63,0.18,0.09)(0.7,0.2,0.1))$ $N_2 = ((0.21,0.06,0.03)(0.35,0.1,0.05)(0.35,0.1,0.05)(0.63,0.18,0.09)(0.7,0.2,0.1))$ $N_3 = ((0.21,0.06,0.03)(0.35,0.1,0.05)(0.35,0.1,0.05)(0.49,0.14,0.07)(0.7,0.2,0.1))$
7	VII	$N_1 = ((0.14,0.04,0.02)(0.35,0.1,0.05)(0.35,0.1,0.05)(0.56,0.16,0.08)(0.7,0.2,0.1))$ $N_2 = ((0.28,0.08,0.04)(0.35,0.1,0.05)(0.35,0.1,0.05)(0.42,0.12,0.06)(0.7,0.2,0.1))$

8	VIII	$N_1 = ((0,0,0)(0.28,0.08,0.04)(0.42,0.12,0.06)(0.56,0.16,0.08)(0.7,0.2,0.1))$ $N_2 = ((0.14,0.04,0.02)(0.35,0.1,0.05)(0.35,0.1,0.05)(0.63,0.18,0.09)(0.7,0.2,0.1))$ $N_3 = ((0.14,0.04,0.02)(0.42,0.12,0.06)(0.49,0.14,0.07)(0.56,0.16,0.08)(0.7,0.2,0.1))$
9	IX	$N_1 = ((0,0,0)(0.14,0.04,0.02)(0.14,0.04,0.02)(0.28,0.08,0.04)(0.7,0.2,0.1))$ $N_2 = ((0.42,0.12,0.06)(0.56,0.16,0.08)(0.56,0.16,0.08)(0.7,0.2,0.1)(0.7,0.2,0.1))$
10	X	$N_1 = ((0.28,0.08,0.04)(0.42,0.12,0.06)(0.42,0.12,0.06)(0.56,0.16,0.08)(0.7,0.2,0.1))$ $N_2 = ((1.26,0.36,0.18)(1.33,0.38,0.19)(1.33,0.38,0.19)(1.4,0.4,0.2)(0.7,0.2,0.1))$
11	XI	$N_1 = ((0,0,0)(0.14,0.04,0.02)(0.14,0.04,0.02)(0.28,0.08,0.04)(0.7,0.2,0.1))$ $N_2 = ((0.42,0.12,0.06)(0.56,0.16,0.08)(0.56,0.16,0.08)(0.7,0.2,0.1)(0.7,0.2,0.1))$
12	XII	$N_1 = ((0.14,0.04,0.02)(0.42,0.12,0.06)(0.42,0.12,0.06)(0.7,0.2,0.1)(0.7,0.2,0.1))$ $N_2 = ((0.14,0.04,0.02)(0.42,0.12,0.06)(0.42,0.12,0.06)(0.7,0.2,0.1)(0.14,0.04,0.02))$
13	XIII	$N_1 = ((0.42,0.12,0.06)(0.7,0.2,0.1)(0.7,0.2,0.1)(0.7,0.2,0.1)(0.7,0.2,0.1))$ $N_2 = ((0.56,0.16,0.08)(0.7,0.2,0.1)(0.7,0.2,0.1)(0.7,0.2,0.1)(0.14,0.04,0.02))$

Table 1: Neutrosophic member of thirteen set

The Neutrosophic possibility degree of thirteen set is given in below table 2

S.No	Set	Neutrosophic possibility degree
1	I	$(p(TN_1 \succcurlyeq TN_2), p(IN_1 \succcurlyeq IN_2), p(FN_1 \succcurlyeq FN_2)) = (0,0,0.94)$ $(p(TN_1 \succcurlyeq TN_1), p(IN_1 \succcurlyeq IN_1), p(FN_1 \succcurlyeq FN_1)) = (1,1,1)$ $(p(TN_2 \succcurlyeq TN_2), p(IN_2 \succcurlyeq IN_2), p(FN_2 \succcurlyeq FN_2)) = (1,1,1)$ $(p(TN_2 \succcurlyeq TN_1), p(IN_2 \succcurlyeq IN_1), p(FN_2 \succcurlyeq FN_1)) = (0.77,0,0.98)$

2	II	$\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (0,0.72,0.95)$ $\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (0.67,0,0.98)$
3	III	$\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (0,1.29,0.95)$ $\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (0.78,0,0.99)$
4	IV	$\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (1,0,1)$ $\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_1 \geqslant TN_3), p(IN_1 \geqslant IN_3), p(FN_1 \geqslant FN_3)\right) = (1,0,1)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (0.2,0,0.95)$ $\left(p(TN_2 \geqslant TN_3), p(IN_2 \geqslant IN_3), p(FN_2 \geqslant FN_3)\right) = (1,0,1)$ $\left(p(TN_3 \geqslant TN_2), p(IN_3 \geqslant IN_2), p(FN_3 \geqslant FN_2)\right) = (0,0,0.92)$ $\left(p(TN_3 \geqslant TN_1), p(IN_3 \geqslant IN_1), p(FN_3 \geqslant FN_1)\right) = (0,0,0.91)$ $\left(p(TN_3 \geqslant TN_3), p(IN_3 \geqslant IN_3), p(FN_3 \geqslant FN_3)\right) = (1,1,1)$
5	V	$\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (1,0,1)$ $\left(p(TN_1 \geqslant TN_3), p(IN_1 \geqslant IN_3), p(FN_1 \geqslant FN_3)\right) = (1,0,1)$

		$\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (1,0,1)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$ $\left(p(TN_2 \geqslant TN_3), p(IN_2 \geqslant IN_3), p(FN_2 \geqslant FN_3)\right) = (1,0,1)$ $\left(p(TN_3 \geqslant TN_1), p(IN_3 \geqslant IN_1), p(FN_3 \geqslant FN_1)\right) = (0,0,0.96)$ $\left(p(TN_3 \geqslant TN_2), p(IN_3 \geqslant IN_2), p(FN_3 \geqslant FN_2)\right) = (0.25,0,0.96)$ $\left(p(TN_3 \geqslant TN_3), p(IN_3 \geqslant IN_3), p(FN_3 \geqslant FN_3)\right) = (1,1,1)$
6	VI	$\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (1,0,1)$ $\left(p(TN_1 \geqslant TN_3), p(IN_1 \geqslant IN_3), p(FN_1 \geqslant FN_3)\right) = (1,0,1)$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (0,0,0.9)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$ $\left(p(TN_2 \geqslant TN_3), p(IN_2 \geqslant IN_3), p(FN_2 \geqslant FN_3)\right) = (1,0,1)$ $\left(p(TN_3 \geqslant TN_1), p(IN_3 \geqslant IN_1), p(FN_3 \geqslant FN_1)\right) = (0,0,0.84)$ $\left(p(TN_3 \geqslant TN_2), p(IN_3 \geqslant IN_2), p(FN_3 \geqslant FN_2)\right) = (0.5,0,0.94)$ $\left(p(TN_3 \geqslant TN_3), p(IN_3 \geqslant IN_3), p(FN_3 \geqslant FN_3)\right) = (1,1,1)$
7	VII	$\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (1,0,1)$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (0.34,0,0.96)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$
8	VIII	$\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$

		$\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (0.5,0,0.98)$ $\left(p(TN_1 \geqslant TN_3), p(IN_1 \geqslant IN_3), p(FN_1 \geqslant FN_3)\right) = (0.25,0,0.97)$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (0.75,0,0.99)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$ $\left(p(TN_2 \geqslant TN_3), p(IN_2 \geqslant IN_3), p(FN_2 \geqslant FN_3)\right) = (0.25,0,0.95)$ $\left(p(TN_3 \geqslant TN_1), p(IN_3 \geqslant IN_1), p(FN_3 \geqslant FN_1)\right) = (1,0,1)$ $\left(p(TN_3 \geqslant TN_2), p(IN_3 \geqslant IN_2), p(FN_3 \geqslant FN_2)\right) = (0.84,0,0.99)$ $\left(p(TN_3 \geqslant TN_3), p(IN_3 \geqslant IN_3), p(FN_3 \geqslant FN_3)\right) = (1,1,1)$
9	IX	$\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (0,0.39,0.89)$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (1,0,1)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$
10	X	$\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (0,1.63,0.88)$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (1,0,1)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$
11	XI	$\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (0,0.39,0.89)$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (1,0,1)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$

12	XII	$\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (1,0,1))$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (0,0.15,0.72)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$
13	XIII	$\left(p(TN_1 \geqslant TN_1), p(IN_1 \geqslant IN_1), p(FN_1 \geqslant FN_1)\right) = (1,1,1)$ $\left(p(TN_1 \geqslant TN_2), p(IN_1 \geqslant IN_2), p(FN_1 \geqslant FN_2)\right) = (1,0,1))$ $\left(p(TN_2 \geqslant TN_1), p(IN_2 \geqslant IN_1), p(FN_2 \geqslant FN_1)\right) = (0,0.15,0.75)$ $\left(p(TN_2 \geqslant TN_2), p(IN_2 \geqslant IN_2), p(FN_2 \geqslant FN_2)\right) = (1,1,1)$

Table 2: Neutrosophic possibility degree of thirteen set

Table 3 represents the Neutrosophic preference matrix of 13 sets

S.No	Set	Neutrosophic preference matrix
1	I	$(TP, IP, FP) = \begin{pmatrix} (1,1,1) & (0,0,0.94) \\ (0.77,0,0.98) & (1,1,1) \end{pmatrix}$
2	II	$(TP, IP, FP) = \begin{pmatrix} (1,1,1) & (0,0.72,0.95) \\ (0.67,0,0.98) & (1,1,1) \end{pmatrix}$
3	III	$(TP, IP, FP) = \begin{pmatrix} (1,1,1) & (0,1.29,0.95) \\ (0.78,0,0.99) & (1,1,1) \end{pmatrix}$
4	IV	$(TP, IP, FP) = \begin{pmatrix} (1,1,1) & (1,0,1) & (1,0,1) \\ (0.2,0,0.95) & (1,1,1) & (1,0,1) \\ (0,0,0.91) & (0,0,0.92) & (1,1,1) \end{pmatrix}$
5	V	$(TP, IP, FP) = \begin{pmatrix} (1,1,1) & (1,0,1) & (1,0,1) \\ (1,0,1) & (1,1,1) & (1,0,1) \\ (0,0,0.96) & (0.25,0,0.96) & (1,1,1) \end{pmatrix}$
6	VI	$(TP, IP, FP) = \begin{pmatrix} (1,1,1) & (1,0,1) & (1,0,1) \\ (0,0,0.9) & (1,1,1) & (1,0,1) \\ (0,0,0.84) & (0.5,0,0.94) & (1,1,1) \end{pmatrix}$

7	VII	$(TP,IP,FP)=\begin{pmatrix}(1,1,1) & (1,0,1)\\(0.34,0,0.96) & (1,1,1)\end{pmatrix}$
8	VIII	$(TP,IP,FP)=\begin{pmatrix}(1,1,1) & (0.5,0,0.98) & (0.25,0,0.97)\\(0.75,0,0.99) & (1,1,1) & (0.25,0,0.95)\\(1,0,1) & (0.84,0,0.99) & (1,1,1)\end{pmatrix}$
9	IX	$(TP,IP,FP)=\begin{pmatrix}(1,1,1) & (0,0.39,0.89)\\(1,0,1) & (1,1,1)\end{pmatrix}$
10	X	$(TP,IP,FP)=\begin{pmatrix}(1,1,1) & (0,1.63,0.88)\\(1,0,1) & (1,1,1)\end{pmatrix}$
11	XI	$(TP,IP,FP)=\begin{pmatrix}(1,1,1) & (0,0.39,0.89)\\(1,0,1) & (1,1,1)\end{pmatrix}$
12	XII	$(TP,IP,FP)=\begin{pmatrix}(1,1,1) & 1,0,1)\\(0,0.15,0.72) & (1,1,1)\end{pmatrix}$
13	XIII	$(TP,IP,FP)=\begin{pmatrix}(1,1,1) & 1,0,1)\\(0,0.15,0.75) & (1,1,1)\end{pmatrix}$

Table 4: Neutrosophic preference matrix of thirteen set

Table 4: represents the Neutrosophic ranking value of thirteen sets

S.No	Set	Neutrosophic ranking value
1	I	$\mathcal{R}(TN_1,IN_1,FN_1)=(1,0,0.97),\mathcal{R}(TN_2,IN_2,FN_2)=(1,0,0.99)$
2	II	$\mathcal{R}(TN_1,IN_1,FN_1)=(1,0.85,0.98),\mathcal{R}(TN_2,IN_2,FN_2)=(1,0,0.99)$
3	III	$\mathcal{R}(TN_1,IN_1,FN_1)=(1,1.14,0.97),\mathcal{R}(TN_2,IN_2,FN_2)=(1,0,1)$
4	IV	$\mathcal{R}(TN_1,IN_1,FN_1)=(1,0,1),\mathcal{R}(TN_2,IN_2,FN_2)=(1,0,0.99),\mathcal{R}(TN_3,IN_3,FN_3)=(1,0,0.96)$
5	V	$\mathcal{R}(TN_1,IN_1,FN_1)=(1,0,1),\mathcal{R}(TN_2,IN_2,FN_2)=(1,0,1),\mathcal{R}(TN_3,IN_3,FN_3)=(1,0,0.98)$
6	VI	$\mathcal{R}(TN_1,IN_1,FN_1)=(1,0,1),\mathcal{R}(TN_2,IN_2,FN_2)=(1,0,1),\mathcal{R}(TN_3,IN_3,FN_3)=(1,0,0.98)$
7	VII	$\mathcal{R}(TN_1,IN_1,FN_1)=(1,0,1),\mathcal{R}(TN_2,IN_2,FN_2)=(1,0,0.98)$
8	VIII	$\mathcal{R}(TN_1,IN_1,FN_1)=(1,0,0.98),\mathcal{R}(TN_2,IN_2,FN_2)=(1,0,0.98),\mathcal{R}(TN_3,IN_3,FN_3)=(1,0,1)$

9	IX	$\mathcal{R}(TN_1, IN_1, FN_1) = (1,0.63,0.94), \mathcal{R}(TN_2, IN_2, FN_2) = (1,0,1)$
10	X	$\mathcal{R}(TN_1, IN_1, FN_1) = (1,1.28,0.94), \mathcal{R}(TN_2, IN_2, FN_2) = (1,0,1)$
11	XI	$\mathcal{R}(TN_1, IN_1, FN_1) = (1,0.63,0.94), \mathcal{R}(TN_2, IN_2, FN_2) = (1,0,1)$
12	XII	$\mathcal{R}(TN_1, IN_1, FN_1) = (1,0,1), \mathcal{R}(TN_2, IN_2, FN_2) = (1,0.38,0.85)$
13	III	$\mathcal{R}(TN_1, IN_1, FN_1) = (1,0,1), \mathcal{R}(TN_2, IN_2, FN_2) = (1,0.38,0.87)$

Table 5: Neutrosophic ranking value of thirteen sets

Table 6 represents the rank of the alternatives of thirteen sets

The rank of the alternatives $\mathcal{R}(N_1) = 0.9938$ and $\mathcal{R}(N_2) = 2.3027$

S.No	Set	rank of the alternatives
1	I	$\mathcal{R}(N_1) = 1.484$, $\mathcal{R}(N_2) = 1.495$
2	II	$\mathcal{R}(N_1) = 0.642$, $\mathcal{R}(N_2) = 1.494$
3	III	$\mathcal{R}(N_1) = 0.351$, $\mathcal{R}(N_2) = 1.497$
4	IV	$\mathcal{R}(N_1) = 1.5$, $\mathcal{R}(N_2) = 1.494, \mathcal{R}(N_3) = 1.478$
5	V	$\mathcal{R}(N_1) = 1.5$, $\mathcal{R}(N_2) = 1.5, \mathcal{R}(N_3) = 1.489$
6	VI	$\mathcal{R}(N_1) = 1.5$, $\mathcal{R}(N_2) = 1.486, \mathcal{R}(N_3) = 1.470$
7	VII	$\mathcal{R}(N_1) = 1.5$, $\mathcal{R}(N_2) = 1.5$
8	VIII	$\mathcal{R}(N_1) = 1.49$, $\mathcal{R}(N_2) = 1.49, \mathcal{R}(N_3) = 1.5$
9	IX	$\mathcal{R}(N_1) = 0.8$, $\mathcal{R}(N_2) = 1.5$
10	X	$\mathcal{R}(N_1) = 0.2, \mathcal{R}(N_2) = 1.5$
11	XI	$\mathcal{R}(N_1) = 0.8$, $\mathcal{R}(N_2) = 1.5$
12	XII	$\mathcal{R}(N_1) = 1.5$, $\mathcal{R}(N_2) = 1$

13	XIII	$\mathcal{R}(N_1) = 1.5$, $\mathcal{R}(N_2) = 1.1$

Table 6: Rank of the alternatives of thirteen sets

Table 7 represents the comparison results with the previous methods

S.No	Set	Alternatives	Kerre (30)	Lee (31) Uniform	Lee (31) Proportional	Bass (32)	Chang (33) $\alpha = 0.1,$ $\beta = 0.9$	Chang (33) $\alpha = 0.5,$ $\beta = 0.5$	Chan (20)	The Proposed Method
1	I	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$	0.96 0.89	0.58 0.55	0.54 0.59	0.84 1	0.417 0.462	0.519 0.544	0.52 0.48	1.484 , 1.495
2	II	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$	0.51 0.89	0.41 0.60	0.38 0.60	0.82 1	0.158 0.554	0.45 0.55	0.4 0.6	0.642 , 1.494
3	III	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$	0.42 0.95	0.41 0.70	0.38 0.70	0.66 1	0.158 0.644	0.45 0.6	0.36 0.64	0.351 , 1.497
4	IV	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$, $\mathcal{R}(N_3)$	1 0.86 0.76	0.77 0.70 0.63	0.80 0.70 0.60	1 0.74 0.6	0.878 0.788 0.698	0.65 0.6 0.55	0.39 0.33 0.28	1.5 , 1.494, 1.478
5	V	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$, $\mathcal{R}(N_3)$	1 0.91 0.75	0.70 0.63 0.58	0.70 0.65 0.57	1 1 1	0.752 0.743 0.73	0.6 0.575 0.538	0.4 0.32 0.28	1.5 , 1.5, 1.489
6	VI	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$, $\mathcal{R}(N_3)$	1 0.85 0.75	0.62 0.57 0.50	0.63 0.55 0.50	1 1 1	0.775 0.653 0.572	0.563 0.525 0.5	0.39 0.34 0.27	1.5 , 1.486, 1.470
7	VII	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$	0.91 0.91	0.50 0.50	0.50 0.50	1 1	0.608 0.536	0.5 0.5	0.5 0.5	1.5 , 1.5
8	VIII	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$, $\mathcal{R}(N_3)$	0.76 0.92 0.96	0.44 0.53 0.56	0.46 0.53 0.58	1 0.88 1	0.635 0.649 0.694	0.475 0.513 0.538	0.28 0.35 0.37	1.49 , 1.49, 1.5

9	IX	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$	0.64 1	0.20 0.80	0.20 0.80	0 0.8	0.158 0.688	0.35 0.6	0.28 0.72	0.8 , 1.5
10	X	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$	0.78 1	0.60 0.90	0.60 0.90	0 0.2	0.518 0.784	0.55 0.5	0.49 0.51	0.2, 1.5
11	XI	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$	0.89 0.88	0.20 0.80	0.20 0.80	0 0.2	0.118 0.698	0.15 0.65	0.25 0.75	0.8 , 1.5
12	XII	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$	0.72 0.97	0.60 0.60	0.60 0.60	0.2 0.2	0.446 0.406	0.55 0.35	0.63 0.37	1.5 , 1
13	XIII	$\mathcal{R}(N_1)$, $\mathcal{R}(N_2)$	0.82 1	0.87 0.95	0.90 0.95	0.2 0.2	0.932 0.901	0.7 0.525	0.63 0.37	1.5 , 1.1

Table 7: comparison results with the previous methods

From the above table7, the proposed method is comparatively better than the previous methods because it is giving the accurate result then the previous methods.

5. Conclusion:

Neutrosophic environments are more suited to portray the decision-makers uncertainty, indeterminacy, and ambiguity than trapezoidal and triangular ones. In comparison to the current way, the proposed method will provide the decision maker with the optimal attribute with greater accuracy. To demonstrate the NMAGDM process of the proposed technique, we additionally provide numerical examples. The result shows that the offered strategy provides us with a workable way to address NMAGDM problems based on trapezoidal and triangular Neutrosophic settings. Future research will involve using the suggested methods to address various other plithogenic environment-related decision-making problems.

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