University of New Mexico

Linguistic Neutrosophic Sets with Application to Group Decision-Making to Enhance the Work Effectiveness Evaluation of University Counselors

Li Wang*

Jiangsu Maritime Institute, Nanjing, 21170, Jiangsu, China

*Corresponding author, E-mail: 20060549@jmi.edu.cn

Abstract: The evaluation of university counselors' work effectiveness in the new era aims to assess their performance in areas such as ideological and political education (IPE), psychological counseling, academic support, and daily management. The evaluation typically includes counselors' performance in guiding students' thoughts, promoting mental health, crisis intervention, and career planning. A scientific and comprehensive evaluation system can improve the quality of counselors' work and promote students' holistic development. The work effectiveness evaluation of university counselors is multiple-attribute group decision-making (MAGDM). Recently, Exponential TODIM (ExpTODIM) and TOPSIS approaches have been introduced to address MAGDM. The 2-tuple linguistic neutrosophic sets (2TLNSs) have emerged as a powerful tool for representing uncertain data, particularly in the evaluation of university counselors' work effectiveness. In this paper, we propose a 2-tuple linguistic neutrosophic Exponential TODIM-TOPSIS (2TLNN-ExpTODIM-TOPSIS) approach to solve MAGDM problems with 2TLNSs. A numerical study on the work effectiveness evaluation of university counselors is presented to validate the 2TLNN-ExpTODIM-TOPSIS approach. The major contributions of this research are outlined: (1) Information entropy based on score and accuracy functions is developed using 2TLNSs to determine weight information; (2) The 2TLNN-ExpTODIM-TOPSIS approach is integrated to handle MAGDM; (3) An illustrative example of university counselors' work effectiveness evaluation is provided to demonstrate the 2TLNN-ExpTODIM-TOPSIS method; (4) Comparative analyses are conducted to verify the effectiveness of the 2TLNN-ExpTODIM-TOPSIS approach.

Keywords: MAGDM; 2TLNSs; TODIM approach; TOPSIS approach; Work effectiveness evaluation of university counselors

---

1. Introduction

The purpose of evaluating the effectiveness of university counselors' work in the new era is to scientifically and comprehensively assess their performance in areas such as IPE, student management, and support services. As key figures in university educational efforts, counselors not only bear the responsibility of guiding students' ideological development but also provide comprehensive support throughout their academic journey. Therefore, evaluating their effectiveness ensures that counselors can fully contribute to fulfilling the fundamental task of "fostering virtue through education." The significance of such evaluations is reflected in several aspects. First, a scientific evaluation system helps universities identify strengths and weaknesses in counselors' work, providing a basis for improving work methods and enhancing professional skills. Second, effectiveness evaluations can motivate counselors to continually improve their competencies, encouraging innovation and progress in areas such as IPE, psychological support, and online education. Additionally, the evaluation results offer decision-making support for universities to formulate policies related to counselor team development, further promoting the professionalization and specialization of the counselor role. Finally, improving the effectiveness of counselors' work contributes to enhancing students' ideological and political qualities, thereby cultivating individuals with strong values and comprehensive abilities, ultimately advancing the overall quality of higher education. The evaluation of university counselors' work effectiveness is a complex MAGDM problem. Recently, the Exponential TODIM [1, 2] and TOPSIS [3] methods have been utilized to address such MAGDM challenges. In this context, 2TLNSs [4] have been employed as a powerful tool for capturing and representing uncertain and imprecise information, particularly during the evaluation process of university counselors' work performance. However, until now, there has been little to no research integrating information entropy and the ExpTODIM-TOPSIS approach under the framework of 2TLNSs. To bridge this gap, this paper proposes an integrated 2TLNN-ExpTODIM-TOPSIS approach to effectively manage MAGDM problems.

To validate the proposed 2TLNN-ExpTODIM-TOPSIS approach, numerical example of evaluating the work effectiveness of university counselors is presented. This example serves to demonstrate the practical application and utility of the 2TLNN-ExpTODIM-TOPSIS approach in real-world decision-making scenarios. The 2TLNN-ExpTODIM-TOPSIS approach not only addresses the inherent uncertainty in the decision-making process but also ensures a more comprehensive and balanced evaluation by considering multiple conflicting attributes.

The main motivations and objectives of this study are outlined:

- ✓ **Development of Information Entropy Technique Based on Score and Accuracy Functions**: This paper constructs the entropy model based on the score and accuracy functions derived from 2TLNSs. This allows for the extraction of weight information, which plays a crucial role in the MAGDM process by determining the relative importance of various attributes in the evaluation.
- ✓ **Establishment of the 2TLNN-ExpTODIM-TOPSIS Approach**: An integrated 2TLNN-ExpTODIM-TOPSIS approach is developed to handle MAGDM problems. This integrated model combines the strengths of ExpTODIM method, which accounts for decision-makers' risk preferences, with TOPSIS method, which evaluates alternatives based on their distance from an ideal solution. The fusion of these two methods provides

a more robust and reliable decision-making framework.

- ✓ **Illustrative Example for Work Effectiveness Evaluation**: To showcase the practicality of the proposed model, an illustrative example involving the work effectiveness evaluation of university counselors is provided. This example demonstrates how the 2TLNN-ExpTODIM-TOPSIS approach can be applied to rank and evaluate counselors' performance based on multiple attributes.
- ✓ **Comparative Analysis to Verify the Approach**: To further validate the effectiveness of 2TLNN-ExpTODIM-TOPSIS approach, comparative analyses with other existing methods are conducted. These comparisons highlight the advantages of 2TLNN-ExpTODIM-TOPSIS approach, particularly in handling uncertainty and delivering more precise decision-making outcomes.

In conclusion, the proposed 2TLNN-ExpTODIM-TOPSIS approach offers a novel and effective solution for addressing MAGDM problems under uncertain conditions, making it an invaluable tool for evaluating complex scenarios such as the work effectiveness of university counselors.

The structure of this paper is outlined. Section 2 introduces the literature review. Section 3 introduces 2TLNSs. In Section 4, the 2TLNN-ExpTODIM-TOPSIS approach is presented with 2TLNSs with entropy. Section 5 provides the numerical example for the work effectiveness evaluation of university counselors, along with some comparative analyses. Finally, Section 6 concludes with remarks.

2. Literature review

The evaluation of university counselors' work effectiveness in the new era aims to scientifically assess their performance in areas such as IPE, student management, and psychological support. As key figures in guiding students' values and supporting their development, counselors play a crucial role in fulfilling the core task of "fostering virtue through education." Through effectiveness evaluations, universities can gain a comprehensive understanding of the strengths and weaknesses of counselors' work, thereby optimizing their work models and enhancing their professional skills. This evaluation not only supports the professional development of counselors but also encourages innovation in areas such as online ideological education and psychological support. It provides important insights for universities in formulating policies for counselor team development, promoting the professionalization and specialization of the role. Furthermore, improving counselors' effectiveness is crucial for cultivating students with correct values and comprehensive abilities, ultimately contributing to the overall improvement of higher education quality. In 2007, Wang [5] discussed the impact of university counselors’ personal charisma on the effectiveness of IPE for students. He argued that the combination of counselors' moral cultivation, knowledge accumulation, and aesthetic taste could earn students' respect, thus enhancing the educational impact. In 2012, Li and Guo [6] further explored the influence of role positioning on counselors’ effectiveness, emphasizing that the coordination of their dual roles as educators and managers was crucial for improving work efficiency. By 2013, Zheng [7] highlighted the need for continuous improvement and innovation in university counselors' work. She proposed that counselors should innovate in guiding, educating, and serving students to keep pace with evolving societal demands. The following year, Tu [8] analyzed the role of counselors in IPE, identifying existing problems and suggesting strategies to improve their effectiveness. In 2015, Zhou and Zeng [9] addressed the challenges counselors faced in the new context of rapidly changing information and individualism among students and proposed a dual system of external and internal incentives to enhance counselors' work performance. In 2016, Zhao [10] explored how to ensure the effectiveness of counselors' work under the "Three Realities" principle, stressing the importance of counselor professionalization in light of policy reforms. In 2017, Xu [11] conducted empirical research that examined how counselors' personal charisma influenced students' IPE, emphasizing the critical role that personal charm plays in guiding student thoughts. In 2019, Liu and Cui [12] expanded on this by studying the skills counselors needed in their heart-to-heart conversations with students and asserted that counselors should deeply engage with students, listen empathetically, and persistently address their concerns to improve communication effectiveness. In 2021, based on the "Overall Plan for Deepening Education Evaluation Reform," Guo [13] proposed a "Five-in-One" evaluation system. This framework considered multiple dimensions, such as professional ethics and student work, to comprehensively enhance the effectiveness of IPE by counselors. In 2022, Yan [14] explored ways to improve counselors' effectiveness in psychological education, suggesting that enhancing team structure, professional abilities, and work mechanisms was essential in addressing the challenges of the new era. That same year, Jin and Wang [15] proposed a novel approach to improving the effectiveness of counselors in Sino-foreign cooperative universities by leveraging the popularity of campus history dramas, integrating cultural heritage with ideological education. In 2023, Liao [16] examined how counselors at regional institutions could improve the effectiveness of IPE through online platforms, proposing five pathways for enhancing digital education. Finally, in 2024, Peng and Ge [17] explored the role of data analytics in enhancing the effectiveness of counselors' ideological and political work, particularly in heart-to-heart dialogues and emphasized the importance of data-driven approaches in making the work of university counselors more precise and effective in the digital era.

The first significant attempt to mathematically model the imprecision or ambiguity inherent in human reasoning was made by Zadeh [18] who introduced the concept of fuzzy theory, which quantitatively represents the linguistic and vague knowledge typical of human cognition and observations. Fuzzy sets allow for the modeling of uncertainty by assigning a membership degree between 0 and 1 to each element in a set, indicating partial belonging. This system provides a way to represent ambiguity, but it only offers a single-valued interpretation of such uncertainty. Building on Zadeh's foundational work, Atanassov [19] extended fuzzy set through introducing the intuitionistic fuzzy sets (IFSs). In this model, an element of the universal set is characterized by both membership non-membership, with the sum of these values being less than or equal to 1. This difference accounts for hesitation or uncertainty. This two-tuple representation provides a more refined approach to handling vagueness compared to the standard fuzzy set. However, in many complex real-world situations, this model may still be insufficient for capturing the full range of uncertainty, especially when dealing with indeterminate or inconsistent information. To address these challenges, Smarandache [20] introduced the neutrosophic sets (NSs). This model extends fuzzy and IFSs by explicitly incorporating three components: truth (belongingness), falsity (non-belongingness), and indeterminacy. The neutrosophic set allows for a more nuanced representation of uncertainty, recognizing that elements can simultaneously belong, not belong, and be indeterminate to varying degrees. This flexibility makes NSs highly effective in handling complex real-life situations, especially those involving incomplete, ambiguous, or contradictory information. As such, NSs represent a significant advancement over fuzzy and IFSs, particularly in decision-making scenarios where linguistic variables are involved. Wang et al. [21] introduced the single-valued NSs (SVNSs). In this model, each element is assigned a single value for truth, falsity, and indeterminacy, making it easier to perform operations such as union, intersection, and complement. Since its introduction, NSs—especially single-valued NSs—have gained prominence in fields like

MADM and pattern recognition. These areas benefit greatly from the ability of NSs to handle uncertainty and imprecision in decision attributes. Ma and Yang [22] explored the use of Archimedean t-norms and t-conorms within intuitionistic fuzzy aggregation operators for MADM. This approach allows for more nuanced aggregation of decision attributes in situations where multiple criteria must be evaluated. Similarly, Wu, Yuan, Wei and Pei [23] studied entropy, similarity measures, and cross-entropy for information in single-valued NSs, demonstrating how these tools can be used to address MADM and assess the effectiveness of decision-making approaches. Other researchers have focused on refining these mathematical tools for NSs. Qin and Wang [24] proposed new similarity measures and entropy functions for single-valued NSs, further enhancing the ability to quantify uncertainty in decision attributes. Smarandache [25] introduced neutrosophic hedge algebra, which includes operations for aggregating neutrosophic linguistic values, and Hanafy, Salama and Mahfouz [26] developed a correlation coefficient formula for neutrosophic data, applicable in decision-making scenarios to measure relationships between neutrosophic variables. Singh, Sharma and Lalotra [27] extended correlation coefficients to IFSs and applied these measures to MADM problems. Biswas, Pramanik and Giri [28] proposed TOPSIS method within SVNSs environment, enabling ranking and selection of alternatives when dealing with uncertain or imprecise information. Further advancements include Jin et al. [29], who developed the entropy and similarity in single-valued NSs using sine and cosine functions. Their comparative analysis highlighted the effectiveness and rationality of their method. Singh, Lalotra and Sharma [30] developed a knowledge measure for fuzzy sets, and Lalotra and Singh [31] computed knowledge measures for hesitant fuzzy sets. Wang et al. [4] commenced the 2TLNSs. 2TLNSs are a combination of NSs and the 2-tuple linguistic approach, designed to handle linguistic information with uncertainty, inconsistency, and vagueness. Neutrosophic sets represent fuzzy information through three parameters—truth, falsity, and indeterminacy—while the 2-tuple model is used to express deviations in linguistic variables, avoiding information loss common in traditional linguistic models. By integrating these two concepts, 2TLNSs can more accurately manage the vagueness and uncertainty of linguistic variables in MADM and other complex problems. The introduction of the 2-tuple representation allows for more flexible linguistic evaluations, especially in scenarios involving human cognition marked by ambiguity, hesitation, and multiple interpretations.

In summary, neutrosophic theory offers a powerful framework for managing the uncertainty and ambiguity often encountered in real-world decision-making processes. Neutrosophic entropy, in particular, provides a way to evaluate uncertainty in a given neutrosophic set, which is especially valuable in MADM problems for determining the objective weights of decision attributes. However, existing entropy measures sometimes fail in counterintuitive situations, where they cannot distinguish between different 2TLNSs. This issue, along with the challenge of assigning weights to decision attributes when the expertise of decision-makers is unknown, drives the development of alternative entropy-like measures and mechanisms for assigning weights to decision attributes.

2. Preliminaries

Wang et al. [4] commenced the 2TLNSs.

Definition 1[28-29]**.** Let $\pi s_1, \pi s_2, \dots, \pi s_\pi$ be linguistic terms. The ws_i shows possible linguistic information, and ws is commenced:

$$\pi s = \begin{Bmatrix} ws_0 = extremely\ poor, ws_1 = very\ poor, ws_2 = poor, ws_3 = medium, \\ ws_4 = good, ws_5 = very\ good, ws_6 = extremely\ good. \end{Bmatrix}$$

The SVNSs $\pi\eta$ is [6-7]:

$$\pi\eta = \left\{\left(\pi, \phi_\eta(\pi), \varphi_\eta(\pi), \gamma_\eta(\pi)\right) \middle| \pi \in \Theta\right\} \tag{1}$$

The $\phi_\eta(\pi), \varphi_\eta(\pi), \gamma_\eta(\pi) \in [0,1]$ is truth-membership (TM), indeterminacy-membership (IM) and falsity-membership (FM), $0 \le \phi_\eta(\pi) + \varphi_\eta(\pi) + \gamma_\eta(\pi) \le 3$.

Definition 2[4]**.** Let $\pi\delta_j (j = 1,2, \dots, k)$ be 2TLSs. If $\pi\delta = \langle(\pi s_t, \pi\xi), (\pi s_i, \pi\psi), (\pi s_f, \pi\zeta)\rangle$ is commenced for $\pi s_t, \pi s_i, \pi s_f \in \pi s$, $\pi\xi, \pi\psi, \pi\zeta \in [0, 0.5)$, where $(\pi s_t, \pi\xi), (\pi s_i, \pi\psi), (\pi s_f, \pi\zeta)$ is TM, IM and FM through employing 2TLSs, the 2TLNSs are commenced:

$$\pi\delta_j = \left\langle\left(\pi s_{t_j}, \pi\xi_j\right), \left(\pi s_{i_j}, \pi\psi_j\right), \left(\pi s_{f_j}, \pi\zeta_j\right)\right\rangle \tag{2}$$

where $0 \le \Delta^{-1}\left(\pi s_{t_j}, \pi\xi_j\right) \le \pi, 0 \le \Delta^{-1}\left(\pi s_{i_j}, \pi\psi_j\right) \le \pi, 0 \le \Delta^{-1}\left(\pi s_{f_j}, \pi\zeta_j\right) \le \pi$, and $0 \le \Delta^{-1}\left(\pi s_{t_j}, \pi\xi_j\right) + \Delta^{-1}\left(\pi s_{i_j}, \pi\psi_j\right) + \Delta^{-1}\left(\pi s_{f_j}, \pi\zeta_j\right) \le 3\pi$.

Definition 3[27]. Let $\pi\delta = \langle(\pi s_t, \pi\xi), (\pi s_i, \pi\psi), (\pi s_f, \pi\zeta)\rangle$. The score function $SF(\pi\delta)$ and accuracy function $AF(\pi\delta)$ are commenced:

$$\boldsymbol{SF(\pi\delta)} = \frac{\left(\boldsymbol{2\pi + \Delta^{-1}(\pi s_t, \pi\xi) - \Delta^{-1}(\pi s_i, \pi\psi) - \Delta^{-1}(\pi s_f, \pi\zeta)}\right)}{\boldsymbol{3\pi}}, \boldsymbol{SF(\pi\delta) \in [0, 1]} \tag{3}$$

$$AF(\pi\delta) = \frac{\Delta^{-1}(\pi s_t, \pi\xi) - \Delta^{-1}(\pi s_f, \pi\zeta) + \pi}{2\pi}, AF(\pi\delta) \in [0,1]. \tag{4}$$

Definition 4[27]. Let $\pi\delta_1 = \langle(\pi s_{t_1}, \pi\xi_1), (\pi s_{i_1}, \pi\psi_1), (\pi s_{f_1}, \pi\zeta_1)\rangle$ and $\pi\delta_2 = \langle(\pi s_{t_2}, \pi\xi_2), (\pi s_{i_2}, \pi\psi_2), (\pi s_{f_2}, \pi\zeta_2)\rangle$, then

(1)$\boldsymbol{if\ \ SF(\pi\delta_1) \prec SF(\pi\delta_2), \pi\delta_1 \prec \pi\delta_2}$;

(2)$\boldsymbol{if\ \ SF(\pi\delta_1) = SF(\pi\delta_2), AH(\pi\delta_1) \prec AH(\pi\delta_2),\ \pi\delta_1 \prec \pi\delta_2}$;

(3) $\boldsymbol{if\ \ SF(\pi\delta_1) = SF(\pi\delta_2), AH(\pi\delta_1) = AH(\pi\delta_2),\ \pi\delta_1 = \pi\delta_2}$;

Definition 5[27]. Let $\pi\delta_1 = \langle(\pi s_{t_1}, \pi\xi_1), (\pi s_{i_1}, \pi\psi_1), (\pi s_{f_1}, \pi\zeta_1)\rangle$ and $\pi\delta_2 = \langle(\pi s_{t_2}, \pi\xi_2), (\pi s_{i_2}, \pi\psi_2), (\pi s_{f_2}, \pi\zeta_2)\rangle$and$\pi\delta = \langle(\pi s_t, \pi\xi), (\pi s_i, \pi\psi), (\pi s_f, \pi\zeta)\rangle$ be three 2TLNNs, then

(1) $$\pi\delta_1 \oplus \pi\delta_2 = \left\{\begin{array}{l} \Delta\left(\pi\left(\frac{\Delta^{-1}(\pi s_{t_1},\pi\xi_1)}{\pi} + \frac{\Delta^{-1}(\pi s_{t_2},\pi\xi_2)}{\pi} - \frac{\Delta^{-1}(\pi s_{t_1},\pi\xi_1)}{\pi}\cdot\frac{\Delta^{-1}(\pi s_{t_2},\pi\xi_2)}{\pi}\right)\right), \\ \Delta\left(\pi\left(\frac{\Delta^{-1}(\pi s_{i_1},\pi\psi_1)}{\pi}\cdot\frac{\Delta^{-1}(\pi s_{i_2},\pi\psi_2)}{\pi}\right)\right), \\ \Delta\left(\pi\left(\frac{\Delta^{-1}(\pi s_{f_1},\pi\zeta_1)}{\pi}\cdot\frac{\Delta^{-1}(\pi s_{f_2},\pi\zeta_2)}{\pi}\right)\right) \end{array}\right\};$$

(2) $$\pi\delta_1 \otimes \pi\delta_2 = \left\{\begin{array}{l} \Delta\left(\pi\left(\frac{\Delta^{-1}(\pi s_{t_1},\pi\xi_1)}{\pi}\cdot\frac{\Delta^{-1}(\pi s_{t_2},\pi\xi_2)}{\pi}\right)\right), \\ \Delta\left(\pi\left(\frac{\Delta^{-1}(\pi s_{i_1},\pi\psi_1)}{\pi} + \frac{\Delta^{-1}(\pi s_{i_2},\pi\psi_2)}{\pi} - \frac{\Delta^{-1}(\pi s_{i_1},\pi\psi_1)}{\pi}\cdot\frac{\Delta^{-1}(\pi s_{i_2},\pi\psi_2)}{\pi}\right)\right), \\ \Delta\left(\pi\left(\frac{\Delta^{-1}(\pi s_{f_1},\pi\zeta_1)}{\pi} + \frac{\Delta^{-1}(\pi s_{f_2},\pi\zeta_2)}{\pi} - \frac{\Delta^{-1}(\pi s_{f_1},\pi\zeta_1)}{\pi}\cdot\frac{\Delta^{-1}(\pi s_{f_2},\pi\zeta_2)}{\pi}\right)\right) \end{array}\right\};$$

(3) $$\alpha\pi\delta = \left\{\begin{array}{l} \Delta\left(\pi\left(1-\left(1-\frac{\Delta^{-1}(\pi s_t,\pi\xi)}{\pi}\right)^{\alpha}\right)\right), \\ \Delta\left(\pi\left(\frac{\Delta^{-1}(\pi s_i,\pi\psi)}{\pi}\right)^{\alpha}\right), \Delta\left(\pi\left(\frac{\Delta^{-1}(\pi s_f,\pi\zeta)}{\pi}\right)^{\alpha}\right) \end{array}\right\}, \alpha > 0;$$

(4) $$\pi\delta^{\alpha} = \left\{\begin{array}{l} \Delta\left(\pi\left(\frac{\Delta^{-1}(\pi s_t,\pi\xi)}{\pi}\right)^{\alpha}\right), \Delta\left(\pi\left(1-\left(1-\frac{\Delta^{-1}(\pi s_i,\pi\psi)}{\pi}\right)^{\alpha}\right)\right), \\ \Delta\left(\pi\left(1-\left(1-\frac{\Delta^{-1}(\pi s_f,\pi\zeta)}{\pi}\right)^{\alpha}\right)\right) \end{array}\right\}, \alpha > 0.$$

Definition 6[32]. Let $\pi\delta_1 = \langle(\pi s_{t_1}, \pi\xi_1), (\pi s_{i_1}, \pi\psi_1), (\pi s_{f_1}, \pi\zeta_1)\rangle$ and $\pi\delta_2 = \langle(\pi s_{t_2}, \pi\xi_2), (\pi s_{i_2}, \pi\psi_2), (\pi s_{f_2}, \pi\zeta_2)\rangle$, the Hamming distance is commenced:

$$HD(\pi\delta_1, \pi\delta_2) = \frac{1}{3}\left(\begin{array}{l} \left|\frac{\Delta^{-1}(\pi s_{t_1},\pi\xi_1) - \Delta^{-1}(\pi s_{t_2},\pi\xi_2)}{\pi}\right| \\ + \left|\frac{\Delta^{-1}(\pi s_{i_1},\pi\psi_1) - \Delta^{-1}(\pi s_{i_2},\pi\psi_2)}{\pi}\right| \\ + \left|\frac{\Delta^{-1}(\pi s_{f_1},\pi\zeta_1) - \Delta^{-1}(\pi s_{f_2},\pi\zeta_2)}{\pi}\right| \end{array}\right) \tag{5}$$

The 2TLNNDA is commenced:

Definition 7[4]. Let $\pi\delta_j = \left\{\left(\pi s_{t_j}, \pi\alpha_j\right), \left(\pi s_{i_j}, \pi\beta_j\right), \left(\pi s_{f_j}, \pi\chi_j\right)\right\}$, the 2TLNNDA is presented:

$$\begin{aligned} &\text{2TLNNWA}(\pi\delta_1, \pi\delta_2, \dots, \pi\delta_n) \\ &= \pi_1 w_1 \pi\delta_1 \oplus \pi w_2 \pi\delta_2 \dots \oplus \pi w_n \pi\delta_n = \overset{j=1}{\underset{n}{\oplus}} \pi w_j \pi\delta_j \end{aligned}$$

$$= \left\{ \begin{array}{l} \Delta\left(\pi\left(1-\prod_{j=1}^{n}\left(1-\frac{\Delta^{-1}\left(\pi s_{t_j},\pi\alpha_j\right)}{\pi}\right)^{\pi w_j}\right)\right), \\ \Delta\left(\pi\prod_{j=1}^{n}\left(\frac{\Delta^{-1}\left(\pi s_{i_j},\pi\beta_j\right)}{\pi}\right)^{\pi w_j}\right), \Delta\left(\pi\prod_{j=1}^{n}\left(\frac{\Delta^{-1}\left(\pi s_{f_j},\pi\chi_j\right)}{\pi}\right)^{\pi w_j}\right) \end{array} \right\} \quad (6)$$

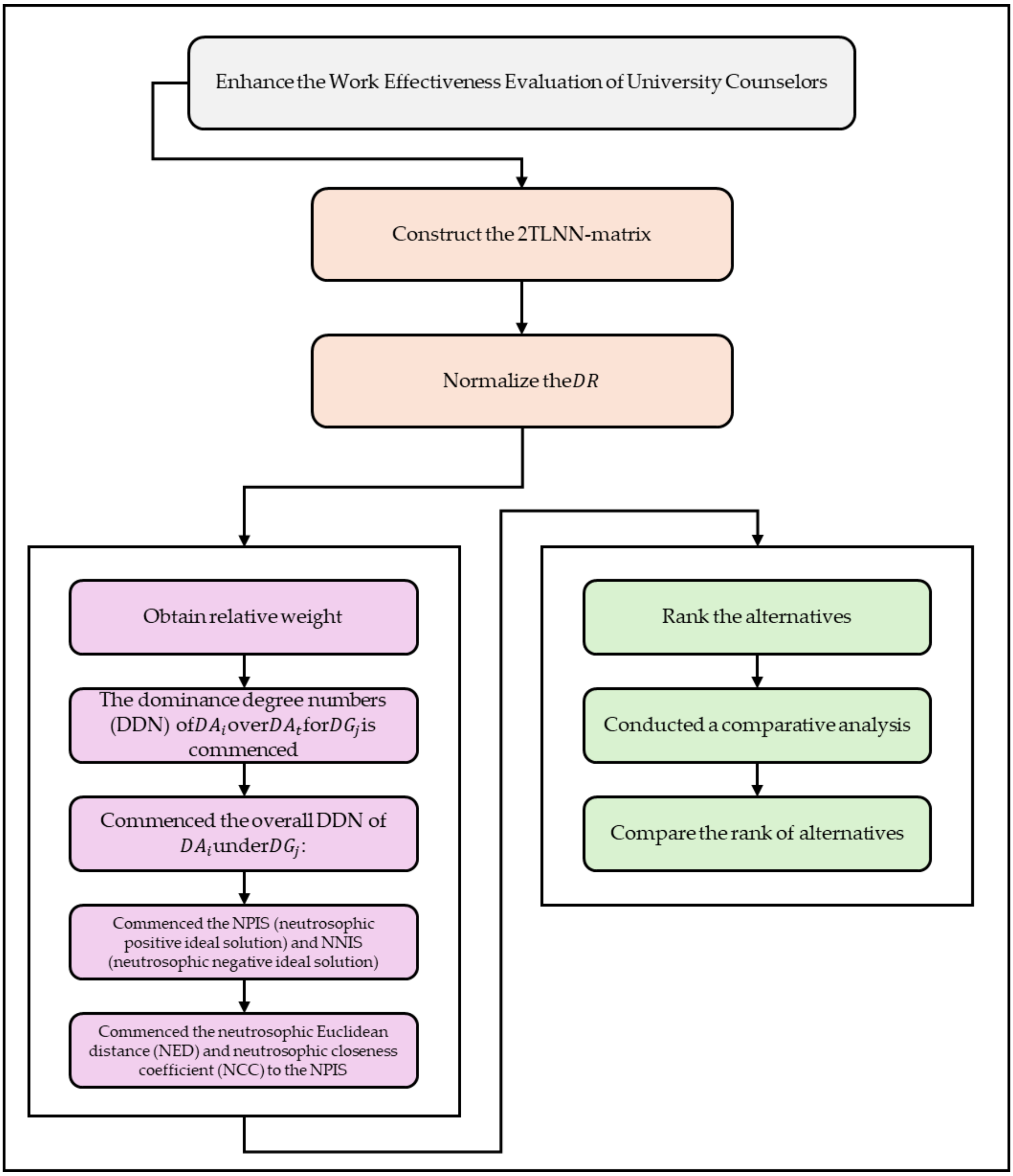

Figure 1. The 2TLNN-ExpTODIM-TOPSIS approach steps.

3. 2TLNN-ExpTODIM-TOPSIS approach

3.1. 2TLNN-MAGDM issues description

The 2TLNN-ExpTODIM-TOPSIS approach is commenced for MAGDM as shown in Figure 1. Let $DA = \{DA_1, DA_2, \cdots, DA_m\}$ be alternatives, and the attributes set $DG = \{DG_1, DG_2, \cdots, DG_n\}$with weight$\pi w$, where$\pi w_j \in [0,1]$,$\sum_{j=1}^{n} \pi w_j = 1$and a set of invited experts $DE = \{DE_1, DE_2, \cdots, DE_q\}$with weight $\pi\xi = \{\pi\xi_1, \pi\xi_2, \cdots, \pi\xi_t\}$.

The 2TLNN-ExpTODIM-TOPSIS approach is commenced for MAGDM.

Step 1. Construct the 2TLNN-matrix $DR = [DR_{ij}^t]_{m\times n} = \left\{\left(\pi s_{t_{ij}}^t, \pi\alpha_{ij}^t\right), \left(\pi s_{i_{ij}}^t, \pi\beta_{ij}^t\right), \left(\pi s_{f_{ij}}^t, \pi\chi_{ij}^t\right)\right\}_{m\times n}$ and average matrix $DR = [DR_{ij}]_{m\times n}$:

$$DR = [DR_{ij}^t]_{m\times n} = \begin{matrix} & DG_1 & DG_2 & \dots & DG_n \\ DA_1 & DR_{11}^t & DR_{12}^t & \dots & DR_{1n}^t \\ DA_2 & DR_{21}^t & DR_{22}^t & \dots & DR_{2n}^t \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ DA_m & DR_{m1}^t & DR_{m2}^t & \dots & DR_{mn}^t \end{matrix} \tag{7}$$

$$DR = [DR_{ij}]_{m\times n} = \begin{matrix} & DG_1 & DG_2 & \dots & DG_n \\ DA_1 & DR_{11} & DR_{12} & \dots & DR_{1n} \\ DA_2 & DR_{21} & DR_{22} & \dots & DR_{2n} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ DA_m & DR_{m1} & DR_{m2} & \dots & DR_{mn} \end{matrix} \tag{8}$$

Based on 2TLNNDA, the$DR = [DR_{ij}]_{m\times n} = \left\{\left(\pi s_{t_{ij}}, \pi\alpha_{ij}\right), \left(\pi s_{i_{ij}}, \pi\beta_{ij}\right), \left(\pi s_{f_{ij}}, \pi\chi_{ij}\right)\right\}_{m\times n}$ is:

$$DR_{ij} = \pi\xi_1 DR_{ij}^1 \oplus \pi\xi_2 DR_{ij}^2 \oplus \cdots \oplus \pi\xi_t DR_{ij}^t$$

$$= \left\{\begin{matrix} \Delta\left(\pi\left(1 - \prod_{d=1}^{t}\left(1 - \frac{\Delta^{-1}\left(\pi s_{t_{ij}}, \pi\alpha_{ij}\right)^t}{\pi}\right)^{\pi\xi_t}\right)\right), \\ \Delta\left(\pi\prod_{d=1}^{t}\left(\frac{\Delta^{-1}\left(\pi s_{i_{ij}}, \pi\beta_{ij}\right)^t}{\pi}\right)^{\pi\xi_t}\right), \Delta\left(\pi\prod_{d=1}^{t}\left(\frac{\Delta^{-1}\left(\pi s_{f_{ij}}, \pi\chi_{ij}\right)^t}{\pi}\right)^{\pi\xi_t}\right) \end{matrix}\right\} \tag{9}$$

Step 2. Normalize the$DR = [DR_{ij}]_{m\times n}$into $NDR = [NDR_{ij}]_{m\times n}$.

For benefit attributes:

$$NDR_{ij} = DR_{ij} = \left\{\left(\pi s_{t_{ij}}, \pi\alpha_{ij}\right), \left(\pi s_{i_{ij}}, \pi\beta_{ij}\right), \left(\pi s_{f_{ij}}, \pi\chi_{ij}\right)\right\} \tag{10}$$

For cost attributes:

$$NDR_{ij} = \left\{\left(\pi s_{t_{ij}}, \pi\alpha_{ij}\right), \left(\pi s_{i_{ij}}, \pi\beta_{ij}\right), \left(\pi s_{f_{ij}}, \pi\chi_{ij}\right)\right\}$$

$$= \left\{\Delta\left(\pi - \Delta^{-1}\left(\pi s_{t_{ij}}, \pi\alpha_{ij}\right)\right), \Delta\left(\pi - \Delta^{-1}\left(\pi s_{i_{ij}}, \pi\beta_{ij}\right)\right), \Delta\left(\pi - \Delta^{-1}\left(\pi s_{f_{ij}}, \pi\chi_{ij}\right)\right)\right\} \tag{11}$$

3.2. Commenced the attributes weight.

Entropy [33] is utilized to obtain weight. The matrix$DD_{ij}$is commenced:

$$DD_{ij} = \frac{\begin{pmatrix} SF\left\{\left(\pi s_{t_{ij}}, \pi\alpha_{ij}\right), \left(\pi s_{i_{ij}}, \pi\beta_{ij}\right), \left(\pi s_{f_{ij}}, \pi\chi_{ij}\right)\right\} \\ +AF\left\{\left(\pi s_{t_{ij}}, \pi\alpha_{ij}\right), \left(\pi s_{i_{ij}}, \pi\beta_{ij}\right), \left(\pi s_{f_{ij}}, \pi\chi_{ij}\right)\right\}+1 \end{pmatrix}}{\sum_{i=1}^{m}\begin{pmatrix} SF\left\{\left(\pi s_{t_{ij}}, \pi\alpha_{ij}\right), \left(\pi s_{i_{ij}}, \pi\beta_{ij}\right), \left(\pi s_{f_{ij}}, \pi\chi_{ij}\right)\right\} \\ +AF\left\{\left(\pi s_{t_{ij}}, \pi\alpha_{ij}\right), \left(\pi s_{i_{ij}}, \pi\beta_{ij}\right), \left(\pi s_{f_{ij}}, \pi\chi_{ij}\right)\right\}+1 \end{pmatrix}}, \tag{12}$$

The decision Shannon entropy $DSE = (DSE_1, DSE_2, \cdots, DSE_n)$is commenced:

$$2TLNNSE_j = -\frac{1}{\ln m}\sum_{i=1}^{m} WW_{ij} \ln W\, W_{ij} \tag{13}$$

and $DD_{ij} \ln D\, D_{ij} = 0$ if $DD_{ij} = 0$.

Then, the weights$\pi w = (\pi w_1, \pi w_2, \cdots, \pi w_n)$is commenced:

$$\pi w_j = \frac{1-DSE_j}{\sum_{j=1}^{n}(1-DSE_j)}, \quad j = 1,2,\cdots,n. \tag{14}$$

3.3. 2TLNN-ExpTODIM-TOPSIS approach for MAGDM

The 2TLNN-ExpTODIM-TOPSIS approach is commenced for MAGDM.

(1) Obtain relative weight:

$$r\pi w_j = \frac{\pi w_j}{\max_j}(\pi w_j), \tag{15}$$

(2) The dominance degree numbers (DDN) ofDA_iover$DA_t$for$DG_j$is commenced in light with ExpTODIM technique.

$$DDN_j(DA_i, DA_t) = \begin{cases} \dfrac{r\pi w_j \times \left(1-10^{-\rho HD\left(NDR_{ij}, NDR_{tj}\right)}\right)}{\sum_{j=1}^{n} r\pi w_j} & \text{if } SF\left(NDR_{ij}\right) > SF\left(NDR_{tj}\right) \\ 0 & \text{if } SF\left(NDR_{ij}\right) = SF\left(NDR_{tj}\right) \\ -\dfrac{1}{\theta}\dfrac{\sum_{j=1}^{n} r\pi w_j \times \left(1-10^{-\rho HD\left(NDR_{ij}, NDR_{tj}\right)}\right)}{r\pi w_j} & \text{if } SF\left(NDR_{ij}\right) < SF\left(NDR_{tj}\right) \end{cases} \tag{16}$$

where$\theta$is from the Tversky and Kahneman [34] and $\rho \in [1,5]$ [1].

The $DDN_j(DA_i)(j = 1,2,\cdots,n)$ is commenced:

$$DDN_j(DA_i) = \left[DDN_j(DA_i, DA_t)\right]_{m\times m}$$

$$= \begin{array}{c} \\ DA_1 \\ DA_2 \\ \vdots \\ DA_m \end{array} \begin{array}{c} \begin{array}{cccc} DA_1 & DA_2 & \cdots & DA_m \end{array} \\ \begin{bmatrix} 0 & DDN_j(DA_1, DA_2) & \cdots & DDN_j(DA_1, DA_m) \\ DDN_j(DA_2, DA_1) & 0 & \cdots & DDN_j(DA_2, DA_m) \\ \vdots & \vdots & \cdots & \vdots \\ DDN_j(DA_m, DA_1) & DDN_j(DA_m, DA_2) & \cdots & 0 \end{bmatrix} \end{array}$$

(3) Commenced the overall DDN of DA_iunderDG_j:

$$DDN_j(DA_i) = \sum_{t=1}^{m} DDN_j(DA_i, DA_t) \tag{17}$$

The overall DDN is commenced:

$$DG_1 \qquad DG_2 \qquad \cdots \qquad DG_n$$

$$DDN = \left(DDN_{ij}\right)_{m\times n} = \begin{matrix} DA_1 \\ DA_2 \\ \vdots \\ DA_m \end{matrix} \begin{bmatrix} \sum_{t=1}^{m} DDN_1(DA_1, DA_t) & \sum_{t=1}^{m} DDN_2(DA_1, DA_t) & \dots & \sum_{t=1}^{m} DDN_n(DA_1, DA_t) \\ \sum_{t=1}^{m} DDN_1(DA_2, DA_t) & \sum_{t=1}^{m} DDN_2(DA_2, DA_t) & \dots & \sum_{t=1}^{m} DDN_n(DA_2, DA_t) \\ \vdots & \vdots & \vdots & \vdots \\ \sum_{t=1}^{m} DDN_1(DA_m, DA_t) & \sum_{t=1}^{m} DDN_2(DA_m, DA_t) & \dots & \sum_{t=1}^{m} DDN_n(DA_m, DA_t) \end{bmatrix}$$

(4) Commenced the NPIS (neutrosophic positive ideal solution) and NNIS (neutrosophic negative ideal solution):

$$NPIS = (NPIS_1, NPIS_1, \cdots, NPIS_n) \tag{18}$$

$$NNIS = (NNIS_1, NNIS_1, \cdots, NNIS_n) \tag{19}$$

$$NPIS_j = \overset{j=1}{\underset{n}{max}} DDN_{ij}, NNIS_j = \overset{j=1}{\underset{n}{min}} DDN_{ij} \tag{20}$$

(5) Commenced the neutrosophic Euclidean distance (NED) and neutrosophic closeness coefficient (NCC) to the NPIS. The larger NCC is better alternative.

$$NED(DA_i, NPIS) = \sqrt{\sum_{j=1}^{n}\left(DDN_{ij} - NPIS_j\right)^2} \tag{21}$$

$$NED(DA_i, NNIS) = \sqrt{\sum_{j=1}^{n}\left(DDN_{ij} - NNIS_j\right)^2} \tag{22}$$

$$NCC(DA_i, NPIS) = \frac{NED(DA_i, NNIS)}{NED(DA_i, NNIS) + 2TLNNED(DA_i, NPIS)} \tag{23}$$

4. Numerical Example and comparative analysis

4.1. Numerical Example

The evaluation of university counselors' work effectiveness in the new era is an important tool for assessing the impact and efficiency of counselors in areas such as IPE, mental health counseling, academic support, and career planning. With the ongoing development of society and reforms in higher education, the role of counselors has expanded beyond traditional student management to include responsibilities such as ideological guidance, psychological counseling, cultural transmission, and the cultivation of innovative abilities. Therefore, constructing a scientific and systematic evaluation framework is essential for improving the overall quality and competencies of the counselor workforce. Firstly, the evaluation of counselors' work effectiveness allows university administrators to comprehensively understand counselors' performance in various fields, especially in their role in student IPE. By quantifying and qualitatively assessing counselors' contributions in areas such as ideological guidance, value shaping, and psychological well-being, the evaluation can help maximize the counselors' core role in students' growth and development. Secondly, the evaluation also promotes counselors' professional development. Clear evaluation criteria enable counselors to identify their strengths and weaknesses, allowing them to enhance their professional skills and management abilities in a targeted manner. This not only increases counselors' sense of self-worth and job satisfaction but also provides universities with effective talent development and incentive mechanisms. Moreover, the establishment of an evaluation system provides a scientific basis for the continuous improvement of student management. With regular evaluation and feedback, universities can adjust the focus and methods of counselors' work to address the challenges students face in the new era, ensuring a higher level of overall student management. Finally, the work effectiveness evaluation of counselors plays a crucial role in promoting educational equity and enhancing the quality of education. An objective and fair evaluation system can regulate counselors' work behavior, encourage the rational allocation of educational resources, and ensure that every student receives effective guidance and support. In summary, the evaluation of university counselors' work effectiveness in the new era is not only an important tool for counselors' professional development but also a key component in improving the level of student management and education quality. It provides clear direction and improvement paths for both university administrators and counselors, driving reforms and advancements in the entire higher education system. The evaluation of university counselors' work effectiveness in the new era requires a multi-dimensional approach, comprehensively assessing their performance in areas such as IPE, psychological counseling, academic support, and student management. Thus, the work effectiveness evaluation of university counselors is MAGDM issue.

The following are four key evaluation criteria:

DG_1 is **Effectiveness in Ideological and Political Education:** This criterion evaluates how well counselors guide students in fostering a correct worldview, values, and outlook on life. Counselors should be able to help students correctly understand social phenomena through ideological and political theory education, daily discussions, and organizing themed activities, thereby enhancing students' political awareness and actively promoting campus culture.

DG_2 is **Psychological Counseling Ability:** Counselors' performance in mental health education is crucial, especially in the early identification of psychological issues, crisis intervention, and routine psychological counseling. This criterion assesses whether counselors can effectively help students cope with psychological stress, organize mental health education activities, and provide timely support during psychological crises.

DG_3 is **Academic Support and Career Guidance:** This criterion focuses on the effectiveness of counselors in helping students develop academic and career plans. It examines whether counselors can offer individualized academic support, assist students in choosing suitable career paths, provide job market information, and enhance students' career competitiveness through targeted resources and guidance.

DG_4 is **Student Management and Service Quality:** This criterion evaluates the efficiency of counselors in daily student management, including dormitory oversight, class development, and organizing student activities. Counselors should be student-centered, addressing students' daily needs, solving their problems promptly, and ensuring they grow in a healthy, safe, and positive environment.

Five regional comprehensive universities $DA_i(i = 1,2,3,4,5)$ are evaluated with linguistic scales (See **Table 1**) by three experts $DE_t(t = 1,2,3)$ with equal weight information.

Table 1. Linguistic scales and 2TLNNs

Linguistic Scales	2TLNNs
Exceedingly Terrible-DET	$\{(\pi s_0,0), (\pi s_5,0), (\pi s_6,0)\}$
Very Terrible-DVT	$\{(\pi s_1,0), (\pi s_4,0), (\pi s_5,0)\}$
Terrible-DT	$\{(\pi s_2,0), (\pi s_3,0), (\pi s_4,0)\}$
Medium-DM	$\{(\pi s_3,0), (\pi s_3,0), (\pi s_3,0)\}$
Well-DW	$\{(\pi s_4,0), (\pi s_3,0), (\pi s_2,0)\}$
Very Well-DVW	$\{(\pi s_5,0), (\pi s_2,0), (\pi s_1,0)\}$
Exceedingly Well-DEW	$\{(\pi s_6,0), (\pi s_1,0), (\pi s_0,0)\}$

The 2TLNN-ExpTODIM-TOPSIS approach is commenced to solve the work effectiveness evaluation of university counselors.

Step 1. Commenced the 2TLNN matrix $DR = [DR_{ij}^t]_{5\times4}$ (Table 2).

Table 2. Evaluation for DE_1

	C_1	C_2	C_3	C_4
A_1	DM	DVW	DT	DW
A_2	DVT	DM	DVW	DM
A_3	DVT	DVW	DM	DM
A_4	DVT	DM	DW	DVW
A_5	DM	DVT	DVT	DVW
	C_1	C_2	C_3	C_4
A_1	DT	DVW	DVT	DM
A_2	DVW	DW	DM	DVT

A_3	DW	DM	DT	DVW
A_4	DW	DM	DT	DVW
A_5	DT	DVT	DM	DVW
	C_1	C_2	C_3	C_4
A_1	DW	DVW	DT	DM
A_2	DVT	DVT	DM	DW
A_3	DM	DT	DVW	DW
A_4	DW	DVW	DVT	DT
A_5	DM	DW	DT	DM

Then according to 2TLNNDA approach, the $DR = \left[DR_{ij}\right]_{5\times4}$ is commenced (See Table 3).

Table 3. The $DR = \left[DR_{ij}\right]_{5\times4}$

	C_1	C_2	C_3	C_4
A_1	$\{(\pi s_2, -0.27), (\pi s_3, 0.24), (\pi s_4, 0.29)\}$	$\{(\pi s_3, -0.43), (\pi s_3, 0.24), (\pi s_3, 0.45)\}$	$\{(\pi s_3, -0.23), (\pi s_3, 0.25), (\pi s_3, 0.13)\}$	$\{(\pi s_3, -0.23), (\pi s_3, 0.25), (\pi s_3, 0.16)\}$
A_2	$\{(\pi s_4, 0.12), (\pi s_3, 0.14), (\pi s_2, 0.18)\}$	$\{(\pi s_5, -0.27), (\pi s_2, 0.26), (\pi s_1, 0.42)\}$	$\{(\pi s_2, -0.17), (\pi s_3, 0.42), (\pi s_4, 0.26)\}$	$\{(\pi s_2, -0.23), (\pi s_3, 0.17), (\pi s_4, 0.19)\}$
A_3	$\{(\pi s_4, -0.17), (\pi s_3, -0.29), (\pi s_2, 0.36)\}$	$\{(\pi s_3, -0.28), (\pi s_3, 0.31), (\pi s_3, 0.24)\}$	$\{(\pi s_1, 0.32), (\pi s_4, -0.36), (\pi s_5, -0.18)\}$	$\{(\pi s_1, 0.37), (\pi s_4, -0.32), (\pi s_5, -0.18)\}$
A_4	$\{(\pi s_5, -0.34), (\pi s_2, 0.29), (\pi s_1, 0.32)\}$	$\{(\pi s_3, -0.43), (\pi s_3, 0.23), (\pi s_3, 0.49)\}$	$\{(\pi s_4, -0.16), (\pi s_3, -0.24), (\pi s_2, 0.12)\}$	$\{(\pi s_4, -0.14), (\pi s_3, -0.29), (\pi s_2, 0.18)\}$
A_5	$\{(\pi s_4, 0.15), (\pi s_3, -0.39), (\pi s_2, -0.17)\}$	$\{(\pi s_4, 0.35), (\pi s_3, -0.43), (\pi s_2, -0.16)\}$	$\{(\pi s_4, 0.18), (\pi s_2, 0.42), (\pi s_2, -0.32)\}$	$\{(\pi s_4, 0.27), (\pi s_2, 0.42), (\pi s_2, -0.34)\}$

Step 2. Normalize the $DR = \left[DR_{ij}\right]_{5\times4}$ into $NDR = \left[NDR_{ij}\right]_{5\times4}$ (See Table 4).

Table 4. The $NDR = \left[NDR_{ij}\right]_{5\times4}$

	C_1	C_2	C_3	C_4
A_1	$\{(ws_5, -0.38), (ws_2, 0.32), (ws_1, 0.34)\}$	$\{(ws_3, -0.42), (ws_3, 0.26), (ws_3, 0.43)\}$	$\{(ws_3, 0.32), (ws_3, 0.26), (ws_3, -0.35)\}$	$\{(ws_4, 0.32), (ws_2, 0.45), (ws_2, -0.36)\}$
A_2	$\{(ws_4, 0.14), (ws_3, -0.38), (ws_2, -0.16)\}$	$\{(ws_4, 0.42), (ws_3, -0.49), (ws_2, -0.06)\}$	$\{(ws_3, 0.05), (ws_3, 0.18), (ws_3, -0.02)\}$	$\{(ws_3, -0.27), (ws_3, 0.29), (ws_3, 0.12)\}$
A_3	$\{(ws_2, -0.26), (ws_3, 0.23), (ws_4, 0.28)\}$	$\{(ws_3, -0.42), (ws_3, 0.21), (ws_3, 0.43)\}$	$\{(ws_4, -0.43), (ws_3, -0.23), (ws_2, 0.45)\}$	$\{(ws_2, -0.27), (ws_3, 0.32), (ws_4, 0.09)\}$
A_4	$\{(ws_4, 0.03), (ws_3, 0.12), (ws_2, 0.16)\}$	$\{(ws_5, -0.26), (ws_2, 0.23), (ws_1, 0.39)\}$	$\{(ws_4, -0.13), (ws_3, -0.43), (ws_2, 0.15)\}$	$\{(ws_1, 0.39), (ws_4, -0.34), (ws_5, -0.17)\}$
A_5	$\{(ws_4, -0.19), (ws_3, -0.26), (ws_2, 0.34)\}$	$\{(ws_3, -0.27), (ws_3, 0.37), (ws_3, 0.23)\}$	$\{(ws_4, -0.16), (ws_3, -0.26), (ws_2, 0.19)\}$	$\{(ws_4, 0.32), (ws_2, 0.45), (ws_2, -0.36)\}$

Step 3. Inaugurate the weight: $\pi w_1 = 0.2952, \pi w_2 = 0.3151, \pi w_3 = 0.2424, \pi w_4 = 0.1473$.

Step 4. Inaugurate the relative weight: $r\pi w = \{0.9368, 1.0000, 0.7693, 0.4675\}$

Step 5. Inaugurate the $DDN = (DDN_{ij})_{5\times4}$ (See table 5):

Table 5. The $DDN = (DDN_{ij})_{5\times4}$

	C_1	C_2	C_3	C_4
A_1	-0.2591	1.0270	-1.1610	-0.8581
A_2	0.2489	0.3437	0.7876	-0.4818
A_3	0.3175	-0.5611	-1.0536	-1.3626
A_4	-1.7747	0.4298	-0.4727	0.9585
A_5	0.7930	-1.2082	-0.5635	-0.0589

Step 7. Construct the NPIS and NNIS Figure 2.

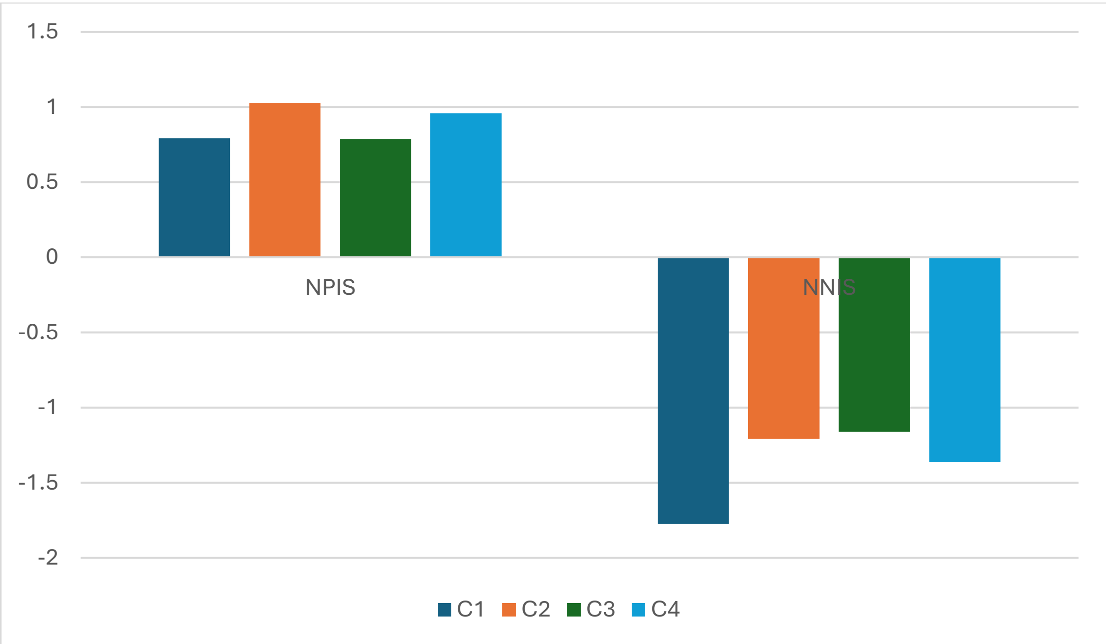

Figure 2. Values of NPIS and NNIS.

Step 8. Construct the $(DDN_{ij} - NPIS_j)^2$ and $(DDN_{ij} - NNIS_j)^2$ (See table 6).

Table 6. The $(DDN_{ij} - NPIS_j)^2$ and $(DDN_{ij} - NNIS_j)^2$

	C_1	C_2	C_3	C_4	C_1	C_2	C_3	C_4
A_1	1.1070	0.0000	3.7971	3.2999	2.2971	4.9958	0.0000	0.2546
A_2	0.2961	0.4668	0.0000	2.0743	4.0949	2.4084	3.7971	0.7759

A_3	0.2261	2.5219	3.3900	5.3875	4.3773	0.4187	0.0115	0.0000
A_4	6.5933	0.3566	1.5885	0.0000	0.0000	2.6830	0.4737	5.3875
A_5	0.0000	4.9958	1.8254	1.0352	6.5933	0.0000	0.3570	1.6996

Step 17. Calculate the $NED(DA_i, NPIS)$, $NED(DA_i, NNIS)$ and $NCC(DA_i, NPIS)$. We ordered the alternatives as shown in Figure 3.

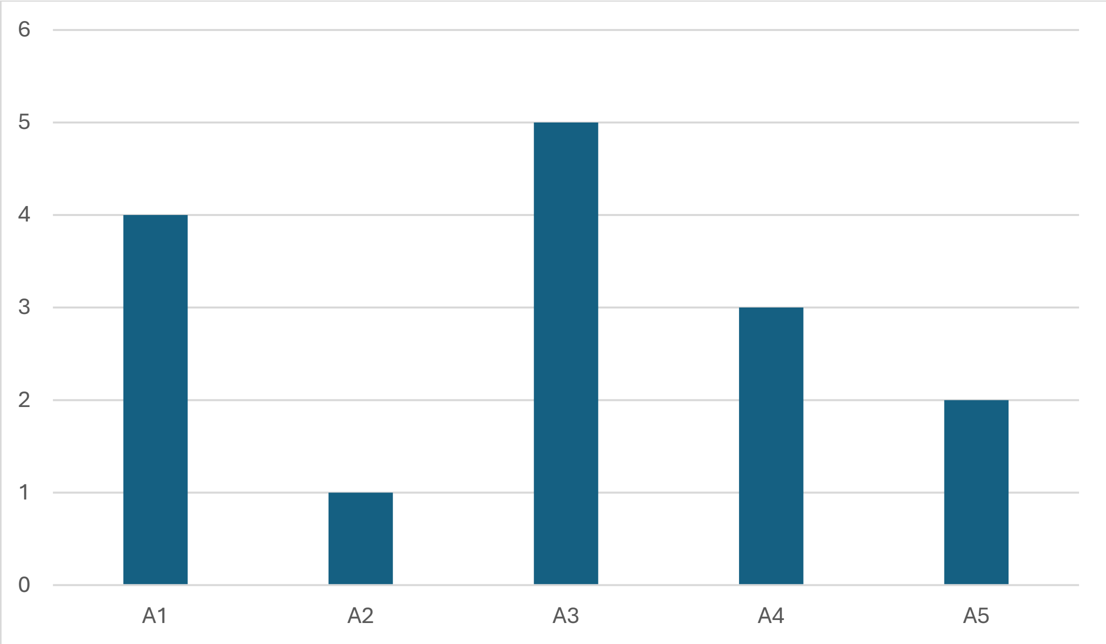

Figure 3. The order of alternatives.

Thus, the optimal regional comprehensive university isDA_2.

4.2. Comparative analysis

The 2TLNN-ExpTODIM-TOPSIS approach is compared with 2TLNNDA approach and 2TLNNDG approach[4], 2TLNWHM approach[35], 2TLNWDHM approach[35], 2TLNN-GRA approach [36], 2TLNN-CODAS approach [37], and 2TLNN-TODIM approach [32]. The comparative decision results are constructed in Table 7.

Table 7. Order of different approaches

Method	Order
2TLNNDA approach [4]	$DA_2 > DA_5 > DA_4 > DA_1 > DA_3$
2TLNNDG approach [4]	$DA_2 > DA_5 > DA_1 > DA_4 > DA_3$
2TLNWHM approach[35]	$DA_2 > DA_5 > DA_4 > DA_1 > DA_3$
2TLNWDHM approach[35]	$DA_2 > DA_5 > DA_4 > DA_1 > DA_3$

2TLNN-GRA approach [36]	$DA_2 > DA_5 > DA_4 > DA_1 > DA_3$
2TLNN-CODAS approach [37]	$DA_2 > DA_5 > DA_4 > DA_1 > DA_3$
2TLNN-TODIM approach [32]	$DA_2 > DA_5 > DA_1 > DA_4 > DA_3$
2TLNN-ExpTODIM-TOPSIS approach	$DA_2 > DA_5 > DA_4 > DA_1 > DA_3$

From the comparative analysis presented above, it is clear that while the ranking order of the models may vary slightly, they all consistently identify the same optimal and worst regional comprehensive universities. This consistency demonstrates that the 2TLNN-ExpTODIM-TOPSIS approach is both reasonable and effective in solving the problem at hand. The 2TLNN-ExpTODIM-TOPSIS model not only delivers reliable results but also provides more accurate and precise techniques compared to other decision-making approaches.

One of main advantages of the 2TLNN-ExpTODIM-TOPSIS approach is its ability to account for the bounded rationality of DMs. In real-world decision-making scenarios, individuals often make decisions based on limited information and cognitive constraints, leading to decisions that are not fully rational. The 2TLNN-ExpTODIM-TOPSIS model incorporates this reality by considering decision-makers' subjective preferences and allowing for the presence of uncertainty and imprecision in the linguistic data they provide. This makes the approach more aligned with actual decision-making processes, where perfect information is rarely available.

Additionally, a key strength of the 2TLNN-ExpTODIM-TOPSIS approach is its ability to handle MAGDM problems that involve conflicting or non-commensurable attributes. In many decision-making situations, attributes may have different units of measurement or may conflict with one another. For example, one university may excel in academic reputation but lag in infrastructure, while another may have strong research capabilities but weaker student satisfaction. The 2TLNN-ExpTODIM-TOPSIS approach effectively addresses such complexities by integrating the ExpTODIM approach, which is based on prospect theory and accounts for decision-makers' risk preferences, with the TOPSIS approach, which identifies the best and worst alternatives in light with their distance from ideal solution. This combination allows for a more comprehensive and balanced evaluation that can accommodate diverse and conflicting attributes.

In conclusion, the 2TLNN-ExpTODIM-TOPSIS approach offers a powerful and flexible solution for solving MAGDM problems. By accounting for bounded rationality and addressing conflicting attributes, the model delivers more reliable and precise decision-making outcomes. This makes it an invaluable tool for evaluating complex scenarios, such as the ranking of regional comprehensive universities, and ensures that decision-makers can make informed and balanced choices.

4.3 Managerial Implications

The managerial implications of enhancing the work effectiveness evaluation of university counselors focus on improving counseling outcomes, resource allocation, support mechanisms, and the development of a structured evaluation framework that contributes to a positive institutional environment. Here are some key managerial implications:

1. Improved Counselor Performance and Accountability

Setting Performance Benchmarks: Developing clear performance benchmarks helps counselors understand their goals and enables managers to track progress. This can create a performance-driven culture, ensuring counselors remain accountable and motivated.

Data-Driven Feedback: Managers can use quantitative and qualitative data to provide constructive feedback to counselors. This fosters a culture of continuous improvement and helps counselors refine their approaches.

2. Enhanced Student Support Services

Targeted Resource Allocation: An effective evaluation system identifies counselors who may need additional support or training. Managers can then allocate resources more effectively, ensuring counselors receive the necessary tools and training to support student needs.

Personalized Student-Counselor Matching: By evaluating the strengths and specialization areas of each counselor, managers can optimize student-counselor assignments, matching students with counselors best suited to address their specific issues, thus enhancing student satisfaction.

3. Professional Development and Training Programs

Skill Gap Identification: Regular evaluations reveal skill gaps, allowing managers to tailor professional development programs that address specific counselor needs, such as communication skills, cultural competence, or mental health training.

Encouraging Specializations: Through performance evaluations, counselors with a natural aptitude for certain counseling areas can be encouraged to specialize, such as in crisis counseling, career counseling, or academic advising, ultimately improving the overall service quality.

4. Improved Counseling Program Design

Customizing Intervention Strategies: Evaluations can shed light on what counseling approaches work best in certain scenarios. Managers can then revise program design based on real outcomes, developing interventions that are more relevant to the needs of the student body.

Identifying Effective Counseling Techniques: Regular assessments can identify counseling techniques or methodologies that yield better results, guiding counselors to adopt best practices and improve service effectiveness.

5. Strengthened Institutional Reputation and Student Retention

Enhanced Student Satisfaction: A transparent, effective counseling evaluation system assures students and parents that counselors are held to high standards, increasing overall student satisfaction and engagement.

Increased Retention and Success Rates: Effective counseling services can lead to higher student retention by providing support systems that help students navigate challenges, ultimately leading to higher graduation and success rates for the institution.

6. Facilitating a Supportive Work Environment

Reducing Counselor Burnout: Understanding counselor workloads and performance challenges can help managers distribute caseloads more effectively and address any issues leading to counselor burnout.

Providing Emotional and Peer Support Systems: By monitoring counselor well-being and work-life balance, managers can create programs that support counselors' mental health, leading to better productivity and effectiveness in their roles.

7. Informed Decision-Making for Policy Development

Implementing Evidence-Based Policies: Using data from counselor evaluations helps university management make informed decisions about policies related to counseling services, student mental health, and wellness programs.

Dynamic Policy Adaptation: Evaluation data provides insights into emerging trends and challenges in student needs, enabling management to adapt policies proactively to address these changes effectively.

8. Building a Culture of Transparency and Improvement

Developing Transparent Evaluation Criteria: Managers can enhance trust and morale by establishing clear, objective criteria for evaluating effectiveness, helping counselors understand expectations and encouraging self-improvement.

Encouraging Self-Assessment and Peer Reviews: Regular self-assessment and peer review sessions help foster a collaborative environment where counselors support each other's growth, contributing to a more cohesive counseling team.

9. Financial and Operational Efficiency

Optimizing Counseling Resource Use: Evaluations can identify where resources are being effectively used and where adjustments are needed, helping institutions manage budgets more effectively and make data-driven investments.

Reducing Turnover Costs: By addressing workload issues, providing professional development, and improving counselor satisfaction, institutions can reduce counselor turnover, minimizing the costs associated with hiring and training new staff.

10. Supporting Diversity, Equity, and Inclusion (DEI) Initiatives

Inclusive Counseling Practices: Evaluations can reveal gaps in cultural competency and inclusivity, allowing managers to provide training that aligns counselors with DEI values, fostering a supportive environment for all students.

Addressing Systemic Barriers: Regularly assessing counselor effectiveness can reveal systemic issues affecting diverse student populations, allowing management to refine processes and offer more equitable support.

These managerial implications emphasize the importance of a structured, data-driven approach to evaluating and enhancing the effectiveness of university counselors, ultimately leading to improved student outcomes and a positive campus environment.

5. Conclusion

The evaluation of university counselors' work effectiveness in the new era holds significant importance, as it helps comprehensively assess their performance in areas such as IPE, student management, psychological counseling, and career planning. Through a scientific and systematic evaluation system, it becomes possible to identify counselors' strengths and weaknesses, facilitating the improvement of their professional abilities and enhancing overall student management. Furthermore, this evaluation provides data support for school administrators, aiding in the optimization of the counselor workforce, improving education quality, and increasing management efficiency, ultimately ensuring students' holistic development. In summary, the evaluation of counselors' work effectiveness is a crucial component in building a high-quality, high-standard university education system. The evaluation of university counselors' work effectiveness is MAGDM problem. Recently, the ExpTODIM-TOPSIS approach has been introduced to effectively address such challenges. In parallel, 2TLNSs have emerged as useful approach for representing uncertain and imprecise information, especially in the context of evaluating counselors' work performance. In this study, we propose the 2TLNN-ExpTODIM-TOPSIS model to handle MAGDM with 2TLNSs. This model enhances decision-making by accounting for both subjective preferences and the inherent uncertainty in linguistic data. To demonstrate the practicality of the proposed model, a numerical case study is conducted, focusing on the work effectiveness evaluation of university counselors. This case study showcases how the 2TLNN-ExpTODIM-TOPSIS model can be applied in real-world scenarios, providing the robust solution for managing complex decision-making problems involving uncertain and qualitative information.

The major contributions of this paper are outlined:

(1) Information Entropy for Weight Calculation: We introduce an information entropy method derived from 2TLNSs, to determine the weight. This method provides a more accurate depiction of the importance of attributes in evaluating counselors' work effectiveness.

(2) Integration of the 2TLNN-ExpTODIM-TOPSIS Model: We establish an integrated 2TLNN-ExpTODIM-TOPSIS approach to handle MAGDM problems. This approach combines the strengths of ExpTODIM, which incorporates risk preferences into decision-making, and TOPSIS, which ranks alternatives in light with their proximity to the ideal solution. The integration allows for a more comprehensive and balanced decision-making process.

(3) Illustrative Example: An illustrative example of counselors' work effectiveness evaluation is provided to show the practical application of the 2TLNN-ExpTODIM-TOPSIS model. This example shows how the model can rank and evaluate multiple counselors based on various criteria, considering both quantitative and qualitative factors.

(4) Comparative Analysis: To validate the effectiveness of 2TLNN-ExpTODIM-TOPSIS approach, we conduct comparative analyses with other existing methods. These comparisons highlight the advantages of the 2TLNN-ExpTODIM-TOPSIS model, especially its ability to handle uncertainty and deliver more reliable decision-making outcomes in complex evaluation scenarios.

In conclusion, the 2TLNN-ExpTODIM-TOPSIS model offers a powerful and flexible solution for evaluating the work effectiveness of university counselors. By integrating advanced decision-making techniques with robust tools for managing uncertainty, this approach proves valuable for solving MAGDM problems in diverse real-world contexts.

References

[1] A.B. Leoneti, L. Gomes, A novel version of the TODIM method based on the exponential model of prospect theory: The ExpTODIM method, European Journal of Operational Research, 295 (2021) 1042-1055.

[2] H. Sun, Z. Yang, Q. Cai, G.W. Wei, Z.W. Mo, An extended Exp-TODIM method for multiple attribute decision making based on the Z-Wasserstein distance, Expert Systems with Applications, 214 (2023) 14.

[3] Y.-J. Lai, T.-Y. Liu, C.-L. Hwang, TOPSIS for MODM, European journal of operational research, 76 (1994) 486-500.

[4] J. Wang, G.W. Wei, Y. Wei, Models for Green Supplier Selection with Some 2-Tuple Linguistic Neutrosophic Number Bonferroni Mean Operators, Symmetry-Basel, 10 (2018) 36.

[5] X. Wang, On the Influence of University Counselors' Personal Charisma on the Effectiveness of Ideological and Political Education for College Students, Wenjiao Ziliao, 2007 (2007) 8-9.

[6] P. Li, W. Guo, A Discussion on the Impact of Role Positioning on the Effectiveness of University Counselors' Work, Xuelilun, 2012 (2012) 217-218.

[7] Y. Zheng, Enhancing the Effectiveness of University Counselors' Work through Continuous Improvement and Innovation, Journal of Jiangsu Provincial Socialist College, 2013 (2013) 69-72.

[8] X. Tu, An Analysis of Improving the Effectiveness of University Counselors' Ideological and Political Education Work, New Curriculum (Middle Edition), 2014 (2014) 101.

[9] Y. Zhou, T. Zeng, A Brief Analysis of the Incentive Mechanism for the Effectiveness of University Counselors' Work under New Circumstances, Science & Technology Innovation Herald, 12 (2015) 252-253.

[10] Y. Zhao, Achieving the 'Three Realities' to Ensure the Effectiveness of University Counselors' Work, Asia-Pacific Education, 2016 (2016) 37.

[11] Z. Xu, An Analysis of the Influence of University Counselors' Charisma on the Effectiveness of Ideological and Political Education for College Students, Kaoshi Zhoukan, 2017 (2017) 122.

[12] J. Liu, X. Cui, A Study on the Path to Improving the Effectiveness of University Counselors' Heart-to-Heart Talks, Modern Communication, 2019 (2019) 138-139.

[13] Q. Guo, Deepening the 'Five-in-One' Evaluation to Enhance the Effectiveness of University Counselors' Ideological and Political Work: Based on the 'Overall Plan for Deepening Education Evaluation Reform in the New Era', Jilin Education, 2021 (2021) 86-88.

[14] H. Yan, Exploring the Path to Enhancing the Effectiveness of University Counselors' Psychological Education Work from the Perspective of Moral Education, Inner Mongolia

Education, 2022 (2022) 4-10.
[15] Z. Jin, X. Wang, From the Popularity of Campus History Dramas: A New Approach to Enhancing the Effectiveness of University Counselors in Sino-Foreign Cooperative Universities, Juying Monthly, 2022 (2022) 98-100.
[16] Y. Liao, Exploring the Path to Enhancing the Effectiveness of University Counselors' Online Ideological and Political Education: A Case Study of Student Work in Regional Colleges, Success Pathway, 2023 (2023) 21-24.
[17] Y. Peng, J. Ge, A Study on the Evaluation Method of the Effectiveness of Ideological and Political Work in the Digital Era: Using University Counselors' Heart-to-Heart Talks as an Example, Guizhou Education, 2024 (2024) 35-38.
[18] L.A. Zadeh, Fuzzy sets, Information and Control, 8 (1965) 338-353.
[19] K. Atanassov, Intuitionistic fuzzy sets, Fuzzy Sets Syst., 20 (1986) 87-96.
[20] F. Smarandache, Neutrosophic Set: A Generalization of the Intuitionistic Fuzzy Set, International Journal of Pure and Applied Mathematics, 24 (2005) 287-297.
[21] H. Wang, F. Smarandache, Y. Zhang, R. Sunderraman, Single valued neutrosophic sets, in: Multispace & Multistructure-Neutrosophic Transdisciplinarity (100 Collected Papers of Sciences), North-European Scientific Publishers, Hanko, Finland, 2010, pp. 410-413.
[22] M.Z. Ma, W. Yang, Symmetric Intuitionistic Fuzzy Weighted Mean Operators Based on Weighted Archimedian t-Norm and t-Conorms for Multi-Criteria Decision Making, Informatica, 3 (2020) 89-112.
[23] H. Wu, Y. Yuan, L. Wei, L. Pei, On entropy, similarity measure and cross entropy of single-valued neutrosophic sets and their application in multi-attribute decision making, Soft Comput., 22 (2018) 7367-7376.
[24] K. Qin, L. Wang, New similarity and entropy measures of single-valued neutrosophic sets with applications in multi-attribute decision making, Soft Comput., 24 (2020) 16165-16176.
[25] F. Smarandache, Neutrosophic Hedge Algebras, Broad Research in Artificial Intelligence and Neuroscience, 10 (2019) 117-123.
[26] I. Hanafy, A. Salama, K. Mahfouz, Correlation of Neutrosophic Data, International Journal of Engineering and Science, 1 (2012) 39-43.
[27] S. Singh, S. Sharma, S. Lalotra, Generalized Correlation Coefficients of Intuitionistic Fuzzy Sets with Application to MAGDM and Clustering Analysis, Int. J. Fuzzy Syst., 22 (2020) 1582-1595.
[28] P. Biswas, S. Pramanik, B. Giri, TOPSIS method for multi-attribute group decision-making under single-valued neutrosophic environment, Neural Computing and Applications, 27 (2016) 727-737.
[29] F. Jin, Z. Ni, X. Zhu, H. Chen, R. Langari, X. Mao, H. Yuan, Single-valued neutrosophic entropy and similarity measures to solve supplier selection problems, J. Intell. Fuzzy Syst., 35 (2018) 6513-6523.
[30] S. Singh, S. Lalotra, S. Sharma, Dual concepts in fuzzy theory: Entropy and knowledge measure, Int. J. Intell. Syst., 34 (2019) 1034-1059.
[31] S. Lalotra, S. Singh, Knowledge measure of hesitant fuzzy set and its application in multi-attribute decision-making, Computational and Applied Mathematics, 39 (2020) 1-31.
[32] J. Wang, G.W. Wei, M. Lu, TODIM Method for Multiple Attribute Group Decision Making

under 2-Tuple Linguistic Neutrosophic Environment, Symmetry-Basel, 10 (2018) 15.
[33] C.E. Shannon, A mathematical theory of communication, Bell System Technical Journal, 27 (1948) 379-423.
[34] A. Tversky, D. Kahneman, Prospect Theory: An Analysis of Decision under Risk, Econometrica, 47 (1979) 263-291.
[35] S.J. Wu, J. Wang, G.W. Wei, Y. Wei, Research on Construction Engineering Project Risk Assessment with Some 2-Tuple Linguistic Neutrosophic Hamy Mean Operators, Sustainability, 10 (2018) 26.
[36] H. Liu, Performance evaluation of family business strategic transition based on the 2-tuple linguistic neutrosophic number multiple attribute group decision making, Journal of Intelligent & Fuzzy Systems, 44 (2022) 3271-3283.
[37] P. Wang, J. Wang, G.W. Wei, J. Wu, C. Wei, Y. Wei, CODAS Method for Multiple Attribute Group Decision Making Under 2-Tuple Linguistic Neutrosophic Environment, Informatica, 31 (2020) 161-184.

Received: Aug 6, 2024. Accepted: Nov 7, 2024