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Toward Educational Excellence: A Comprehensive Measuring of Ideological and Political Theory Courses in Universities using Neutrosophic Z-Rough Numbers

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Abstract: In the evolving landscape of higher education, ideological and political theory courses play a vital role in cultivating critical thinking, national identity, and civic responsibility among university students. This study develops a multi-criteria decision-making (MCDM) framework for evaluating the effectiveness and quality of such courses. Twelve criteria, encompassing pedagogical innovation, theoretical clarity, emotional resonance, and student engagement, are employed to assess ten selected course models. This study uses the MABAC method to rank the alternatives. We use the Neutrosophic Z-Rough Numbers to overcome uncertainty and vague information. The evaluation reveals the multifaceted dimensions that contribute to the perceived success of ideological education and highlights areas requiring enhancement. The results provide a foundation for curriculum improvement, aligning instructional delivery with contemporary societal values and learning needs.

Keywords: Neutrosophic Z-Rough Numbers; Ideological and Political Theory Courses; Education; Analysis.

1. Introduction

Ideological and political theory courses form the philosophical and civic backbone of university education, especially in contexts where national ideology is integral to cultural and institutional development. These courses aim to instill core socialist values, foster historical understanding, and develop analytical frameworks that guide student decision-making in real-world scenarios[1], [2]. Despite their significance, the effectiveness of ideological education remains a contested subject. Challenges such as outdated pedagogical techniques, limited student interaction, and low perceived relevance often hinder course impact. Evaluating the quality of these courses thus becomes essential for educators, administrators, and policymakers[3], [4].

Traditional assessment methods often focus on exam performance or attendance, which overlook the nuances of course influence. In response, this study adopts a Multi-Criteria Decision-Making (MCDM) approach, offering a structured and quantitative lens for analyzing different instructional models and institutional practices.

The study identifies 12 critical evaluation criteria derived from literature review, expert interviews, and pilot surveys. These criteria span cognitive, affective, and behavioral dimensions of learning, reflecting the complex objectives of ideological and political theory education[5], [6].

Moreover, ten course models from various universities were selected as alternatives for evaluation. These represent diverse teaching styles, institutional contexts, and technological integrations, allowing for a comprehensive and comparative analysis[7], [8].

The evaluation process aims to uncover which models excel in promoting student understanding, ideological alignment, and critical reasoning, and to identify the most influential factors contributing to these outcomes. Techniques like normalization, weighting, and ranking are employed to ensure objectivity. Ultimately, this research contributes to improving course design and instructional strategies. It provides actionable insights for stakeholders seeking to modernize ideological and political theory courses in alignment with student expectations and national educational goals[9], [10].

Because it is hard to handle using conventional methods, this data explosion presents a serious decision-making difficulty. In response to these complications, Neutrosophic Z-Rough Numbers offer a framework that enables a more heuristic assessment of ambiguity, uncertainty, and inconsistency[11], [12]. In contrast, incomplete data sets are the consequence of education, while contradicting information may simultaneously originate from many sources due to calibration discrepancies or noise. However, when data is inconsistent or lacking, these conventional systems suffer. The foundation of conventional multi-criteria decision-making (MCDM) methods is the belief that data are accurate, consistent, and comprehensive[13], [14].

To clarify contradictory and incomplete data, we integrate the MCDM with the features of NZRN using sine-trigonometric functions in combination with neutrosophic Z-rough numbers. To capture the intricacies of industry environment data, we particularly built these recently released rough neutrosophic z-number sine-trigonometric aggregation operations[15], [16].

Literature Review

The estimate of the neutrosophic Z-number becomes a crucial tool in complex situations, such as missing and contradictory data, to overcome the limitations of current fuzzy decision-making models. Kamran [17] combined rough set theory, neutrosophic set theory, and Z-numbers to introduce Neutrosophic Z-Rough data, which addresses the shortcomings of techniques such as multi-criteria decision-making (MCDM), trapezoidal neutrosophic numbers (TrNNs), and neutrosophic Z-numbers (NZNs). Neutrosophic Z-Rough numbers (NZRNs) and advanced aggregation techniques can be used to overcome problems such as measurement reliability in

TrNNs and continuity issues in NZNs. They explored sine-trigonometric approaches to Neutrosophic Z-Rough numbers using the periodicity and symmetry of the sine-trigonometric function (STF).

They combined the properties of the STF with the NZRNs to create new Rough Neutrosophic Z-number sine-trigonometric aggregation operators. By applying these operational concepts to the MCDM approach, which promotes sustainable decision-making in commercial situations, the method's usefulness inside the NZRN framework is illustrated. They ensured a reliable and consistent assessment approach while also enhancing the NZRN domain's decision-making logic and efficiency. Since traditional MCDM frameworks cannot manage the uncertainties introduced by Industry 4.0, new methods based on NZRNs are required. The results of a series of tests, such as comparison studies, sensitivity analyses, and reliability assessments, demonstrate that the proposed approach is novel, reliable, and superior for measuring corporate sustainability.

In supply chain operations, horizontal collaboration (HC) has become a strategic technique to increase competitive advantage, sustainability, and efficiency while lowering CO_2 emissions. Notwithstanding its potential, HC implementation is fraught with difficulties, such as decision-making complexity, strategy alignment, and trust management. To discover and rank the key success factors (CSFs) affecting HC, Nguyen et al. [18] suggested an integrated methodology that combines the Delphi technique and the DEMATEL framework, augmented by Neutrosophic Z-number (NZN) theories. The suggested model's practicality and robustness are confirmed by a case study conducted in Vietnam.

The results emphasize economic elements as important determinants of effective HC, including data exchange, financial stability, and innovation uptake. Economic performance is also found to be closely related to social issues, such as company culture and dispute resolution. Environmental considerations highlight how important resource optimization and green techniques are. To advance logistics efficiency and sustainability in Vietnam and other emerging economies, this research offers practical insights for governments and logistics businesses looking to support successful HC. Additionally, the suggested framework provides a useful starting point for further study and useful advancements in logistics collaboration optimization.

1.1 Aim of this study

By handling the inherent complexity of MCDM data, especially using fuzzy logic and sophisticated aggregation operators, the suggested approaches seek to close these gaps. These techniques may work with varying levels of ambiguity, offer a more accurate model when goals are at odds, and enable decision-making with greater rigor. In this sense, by including all the cutting-edge methods, we can guarantee that the framework for making decisions stays adaptable, versatile, and better suited to the complex requirements of modern industrial ecosystems. Considering this, our research offers a novel strategy for getting over the limitations of traditional approaches when applying MCDM.

1.2 Motivation of this study

New aggregation techniques have taken a prominent place in the list of characteristics defining the changing landscape of decision-making due to the increasing complexity of data and the need for final, trustworthy outcomes. In fact, aggregation operators such are widely used in applications for processing fuzzy data and associated decision-making difficulties. However, traditional approaches frequently prove to be extremely inadequate when complex data structures and the more nuanced requirements of contemporary applications are involved. This paper develops and theoretically validates MCDM methodology to compute the criteria weights and ranking the alternatives.

2. Neutrosophic Z-rough numbers (NZRNs)

This section shows the definition of the NZRNS and their operations[17].

Description of the NZRNs such as:

$$G = \left\{ \begin{pmatrix} x, \left\{ \left(D^{-}_{P\,JI}(x), D^{-}_{V\,JI}(x) \right), \left(D_{-P_{JI}}(x), D_{-V_{JI}}(x) \right) \right\}, \\ \left\{ \left(S^{-}_{P\,JI}(x), S^{-}_{V\,JI}(x) \right), \left(S_{-P_{JI}}(x), S_{-V_{JI}}(x) \right) \right\}, \\ \left\{ \left(U^{-}_{P\,JI}(x), U^{-}_{V\,JI}(x) \right), \left(U_{-P_{JI}}(x), U_{-V_{JI}}(x) \right) \right\} \end{pmatrix} | X \in N \right\} \tag{1}$$

$$\left\{ \begin{pmatrix} \left\{ \left(D^{-}_{P\,JI}(x), D^{-}_{V\,JI}(x) \right), \left(D_{-P_{JI}}(x), D_{-V_{JI}}(x) \right) \right\}, \\ \left\{ \left(S^{-}_{P\,JI}(x), S^{-}_{V\,JI}(x) \right), \left(S_{-P_{JI}}(x), S_{-V_{JI}}(x) \right) \right\}, \\ \left\{ \left(U^{-}_{P\,JI}(x), U^{-}_{V\,JI}(x) \right), \left(U_{-P_{JI}}(x), U_{-V_{JI}}(x) \right) \right\} \end{pmatrix} : N \to \emptyset \right\} \tag{2}$$

$$0 \le \left\{ \begin{pmatrix} \left\{ \left(D^{-}_{P\,JI}(x), D^{-}_{V\,JI}(x) \right), \left(D_{-P_{JI}}(x), D_{-V_{JI}}(x) \right) \right\}, \\ \left\{ \left(S^{-}_{P\,JI}(x), S^{-}_{V\,JI}(x) \right), \left(S_{-P_{JI}}(x), S_{-V_{JI}}(x) \right) \right\}, \\ \left\{ \left(U^{-}_{P\,JI}(x), U^{-}_{V\,JI}(x) \right), \left(U_{-P_{JI}}(x), U_{-V_{JI}}(x) \right) \right\} \end{pmatrix} \right\} \le 3 \tag{3}$$

$G_1 \sqsubseteq G_2$ if and only if

$$\left\{\begin{pmatrix} \left\{\left(D_{P\,1}^{-}(x), D_{V\,1}^{-}(x)\right)\left(D_{-P_1}(x), D_{-V_1}(x)\right)\right\} \leq \\ \left\{\left(D_{P\,2}^{-}(x), D_{V\,2}^{-}(x)\right)\left(D_{-P_2}(x), D_{-V_2}(x)\right)\right\}, \\ \left\{\left(S_{P\,1}^{-}(x), S_{V\,1}^{-}(x)\right), \left(S_{-P_1}(x), S_{-V_1}(x)\right)\right\} \geq \\ \left\{\left(S_{P\,2}^{-}(x), S_{V\,2}^{-}(x)\right), \left(S_{-P_2}(x), S_{-V_2}(x)\right)\right\}, \\ \left\{\left(U_{P\,1}^{-}(x), U_{V\,1}^{-}(x)\right), \left(U_{-P_1}(x), U_{-V_1}(x)\right)\right\} \geq \\ \left\{\left(U_{P\,2}^{-}(x), U_{V\,2}^{-}(x)\right), \left(U_{-P_2}(x), U_{-2}(x)\right)\right\} \end{pmatrix}\right\} \tag{4}$$

$$G_1 \cap G_2 = \left\{\begin{matrix} \left(\inf\begin{pmatrix} \left(D_{P\,1}^{-}(x), D_{V\,1}^{-}(x)\right)\left(D_{-P_1}(x), D_{-V_1}(x)\right), \\ \left(D_{P\,2}^{-}(x), D_{V\,2}^{-}(x)\right)\left(D_{-P_2}(x), D_{-V_2}(x)\right) \end{pmatrix}\right), \\ \sup\begin{pmatrix} \left(S_{P\,1}^{-}(x), S_{V\,1}^{-}(x)\right), \left(S_{-P_1}(x), S_{-V_1}(x)\right), \\ \left(S_{P\,2}^{-}(x), S_{V\,2}^{-}(x)\right), \left(S_{-P_2}(x), S_{-V_2}(x)\right) \end{pmatrix}, \\ \sup\begin{pmatrix} \left(U_{P\,1}^{-}(x), U_{V\,1}^{-}(x)\right), \left(U_{-P_1}(x), U_{-V_1}(x)\right), \\ \left(U_{P\,2}^{-}(x), U_{V\,2}^{-}(x)\right), \left(U_{-P_2}(x), U_{-2}(x)\right) \end{pmatrix} \end{matrix}\right\} \tag{5}$$

$$G_1 \cup G_2 = \left\{\begin{matrix} \left(\sup\begin{pmatrix} \left(D_{P\,1}^{-}(x), D_{V\,1}^{-}(x)\right)\left(D_{-P_1}(x), D_{-V_1}(x)\right), \\ \left(D_{P\,2}^{-}(x), D_{V\,2}^{-}(x)\right)\left(D_{-P_2}(x), D_{-V_2}(x)\right) \end{pmatrix}\right), \\ \inf\begin{pmatrix} \left(S_{P\,1}^{-}(x), S_{V\,1}^{-}(x)\right), \left(S_{-P_1}(x), S_{-V_1}(x)\right), \\ \left(S_{P\,2}^{-}(x), S_{V\,2}^{-}(x)\right), \left(S_{-P_2}(x), S_{-V_2}(x)\right) \end{pmatrix}, \\ \inf\begin{pmatrix} \left(U_{P\,1}^{-}(x), U_{V\,1}^{-}(x)\right), \left(U_{-P_1}(x), U_{-V_1}(x)\right), \\ \left(U_{P\,2}^{-}(x), U_{V\,2}^{-}(x)\right), \left(U_{-P_2}(x), U_{-2}(x)\right) \end{pmatrix} \end{matrix}\right\} \tag{6}$$

$$G_1^c = \left\{\begin{matrix} \left\{\left(D_{P\,1}^{-}(x), D_{V\,1}^{-}(x)\right)\left(D_{-P_1}(x), D_{-V_1}(x)\right)\right\}, \\ \left\{\left(S_{P\,1}^{-}(x), S_{V\,1}^{-}(x)\right), \left(S_{-P_1}(x), S_{-V_1}(x)\right)\right\}, \\ \left\{\left(U_{P\,1}^{-}(x), U_{V\,1}^{-}(x)\right), \left(U_{-P_1}(x), U_{-V_1}(x)\right)\right\} \end{matrix}\right\} \tag{7}$$

3. The MCDM Approach

This section shows the proposed approach by introducing the steps of the MCDM approach.

Create the decision matrix

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix}_{m \times n} \tag{8}$$

Compute the criteria weights.

The criteria weights are computed using the average method.

The MABAC method is introduced to rank alternatives.

Normalize the decision matrix

$$y_{ij} = \frac{x_{ij} - x_i^-}{x_i^+ - x_i^-} \tag{9}$$

$$y_{ij} = \frac{x_{ij} - x_i^+}{x_i^- - x_i^+} \tag{10}$$

Create the weighted decision matrix.

$$q_{ij} = w_j + w_j y_{ij} \tag{11}$$

Calculate the border approximation area matrix.

$$A_j = \left(\prod_{i=1}^{m} q_{ij}\right)^{\frac{1}{m}} \tag{12}$$

Calculate the distance from the A_j score.

$$S_j = q_{ij} - A_j \tag{13}$$

Calculate the sum distance

$$H_i = \sum_{j=1}^{n} s_{ij} \tag{14}$$

4. Results

This section shows the results of the proposed approach. We use 12 criteria and ten alternatives as shown in Fig 1. Three experts are created the decision matrix using the NZRN as shown in Table 1-3. These numbers are changed to crip values and combined to single matrix. Then we obtain the weights of criteria as shown in Fig 2.

Table 1. The first NZRNs.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
A_1	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})
A_2	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})

A3	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})
A4	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})
A5	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})
A6	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})
A7	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})
A8	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})
A9	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})
A10	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})

Table 2. The second NZRNs.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
A1	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})
A2	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})
A3	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})
A4	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})
A5	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})
A6	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})
A7	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})

A8	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})
A9	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})
A10	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})

Table 3. The third NZRNs.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
A1	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})
A2	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})
A3	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})
A4	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})
A5	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})
A6	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})
A7	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})
A8	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.3},{0.7,0.6},{0.5,0.1},{0.4,0.6},{0.2,0.1},{0.9,0.5})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})
A9	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})
A10	({0.6,0.8},{0.4,0.3},{0.2,0.3},{0.6,0.4},{0.1,0.5},{0.2,0.8})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.3},{0.9,0.4},{0.2,0.6},{0.3,0.7},{0.7,0.8},{0.5,0.2})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.3,0.1},{0.7,0.3},{0.2,0.9},{0.6,0.3},{0.6,0.2},{0.8,0.9})	({0.4,0.6},{0.7,0.3},{0.2,0.5},{0.7,0.1},{0.9,0.4},{0.6,0.1})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})	({0.1,0.5},{0.8,0.2},{0.2,0.3},{0.8,0.4},{0.7,0.5},{0.3,0.7})	({0.8,0.7},{0.5,0.2},{0.1,0.8},{0.4,0.7},{0.2,0.6},{0.8,0.1})

Fig 1. The criteria and alternatives.

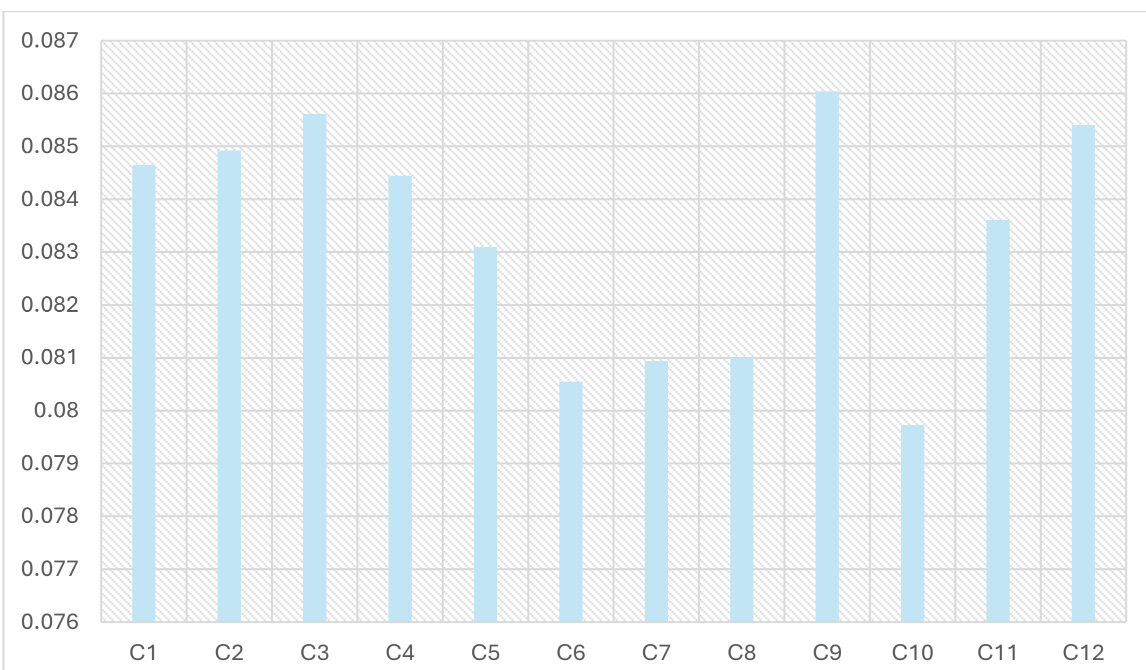

Fig 2. The weights of criteria.

Fig 2 shows the criteria weights:

1. C1 (0.0846) – This criterion holds moderate influence in the assessment, suggesting that it plays an important but not dominant role in determining overall effectiveness.
2. C2 (0.0849) – Slightly more influential than C1, this factor is crucial and consistently considered in evaluating performance.
3. C3 (0.0856) – With one of the higher weights among the group, this criterion is considered a key contributor.
4. C4 (0.0844) – Similar in weight to C1 and C2, this reflects a steady and meaningful impact, possibly aligned with technological integration.
5. C5 (0.0831) – A slightly lower weight than previous ones, but still significant, this criterion may reflect support systems.
6. C6 (0.0805) – This criterion holds a modest influence, likely representing contextual or background variables.
7. C7 (0.0809) – Close in value to C6, this factor suggests consistent but moderate importance,.
8. C8 (0.0810) – Marginally higher than C7, this factor may deal with consistency in content delivery.
9. C9 (0.0860) – The highest-weighted criterion, indicating it is the most influential aspect in the evaluation—perhaps representing outcomes.
10. C10 (0.0797) – The lowest among all, this weight suggests a lesser but still relevant role, potentially linked to administrative support or auxiliary components.
11. C11 (0.0836) – A mid-weight factor that provides balance in the evaluation, likely assessing feedback.
12. C12 (0.0854) – Among the top influential criteria, this likely reflects outcome-based effectiveness.

This paper normalizes the decision matrix using eqs. (9 and 10) as shown in Fig 3.

This study creates the weighted decision matrix using eq. (11) as shown in Fig 4.

This study calculates the border approximation area matrix using eq. (12) as shown in Fig 5.

This study calculates the distance from the A_j score using eq. (13) as shown in Fig 6.

This study calculates the sum distance using eq. (14) as shown in Fig 7. Then we rank the alternatives as shown in Fig 8.

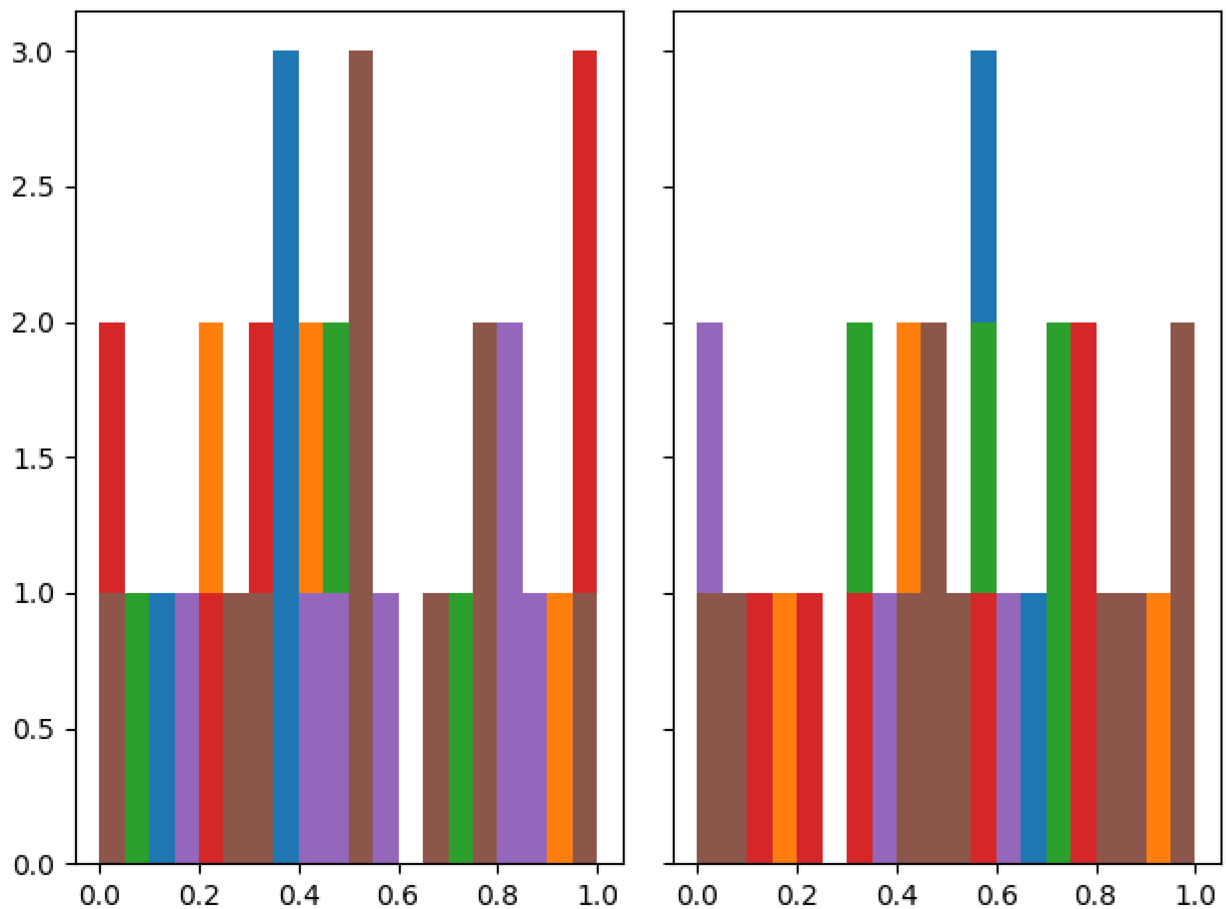

Fig 3. The normalized decision matrix.

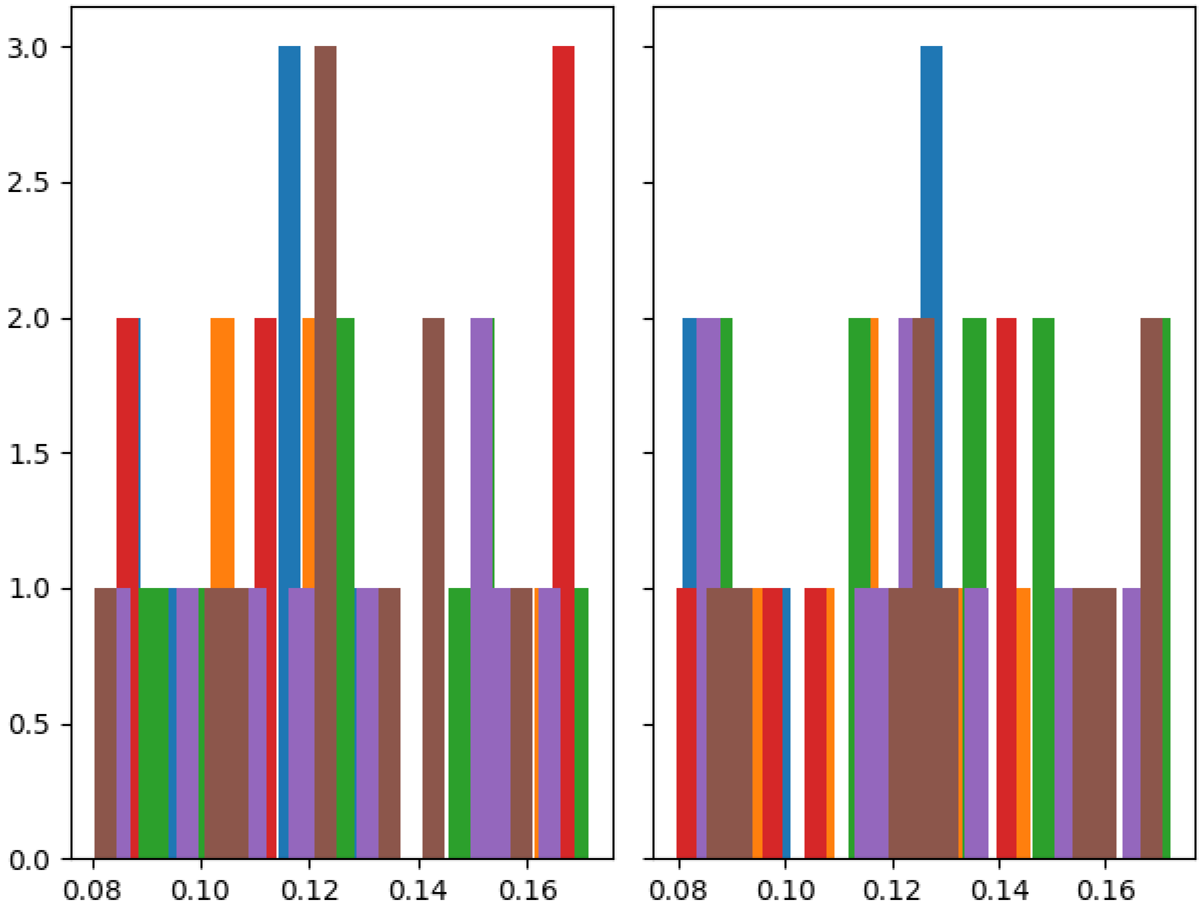

Fig 4. The weighted decision matrix.

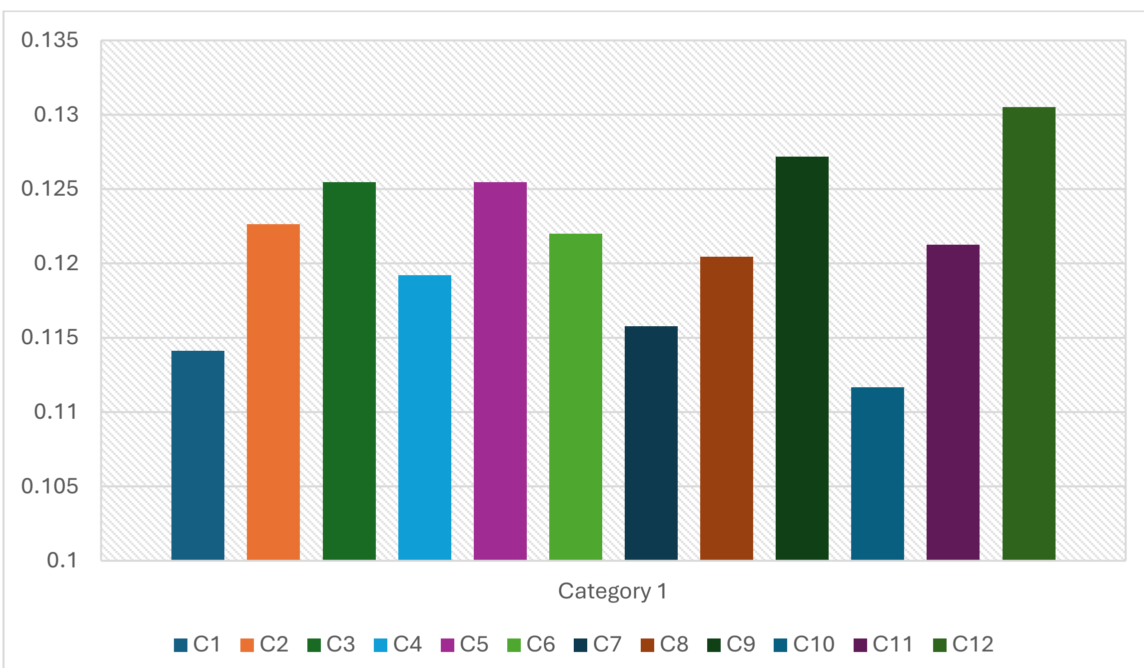

Fig 5. The values of A_j.

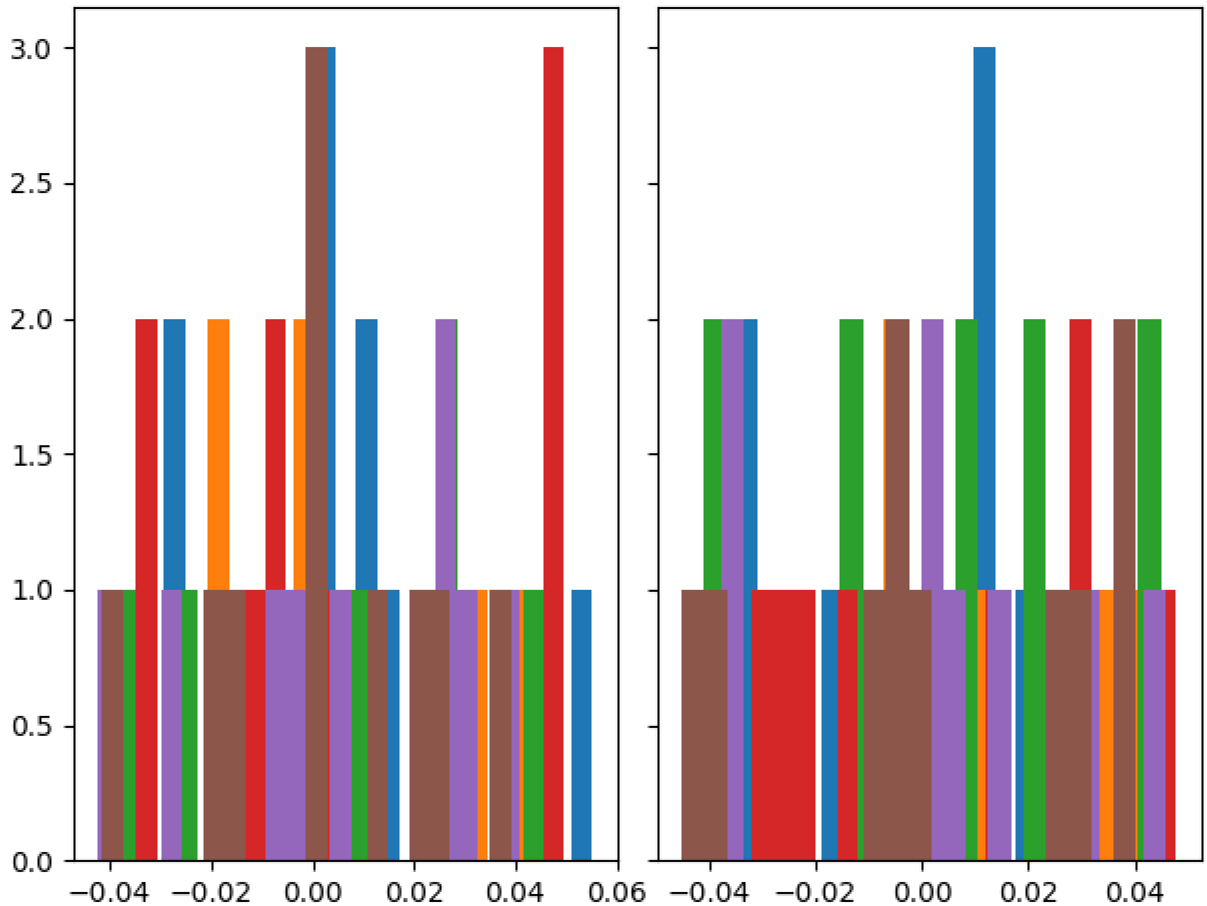

Fig 6. The values of S_j.

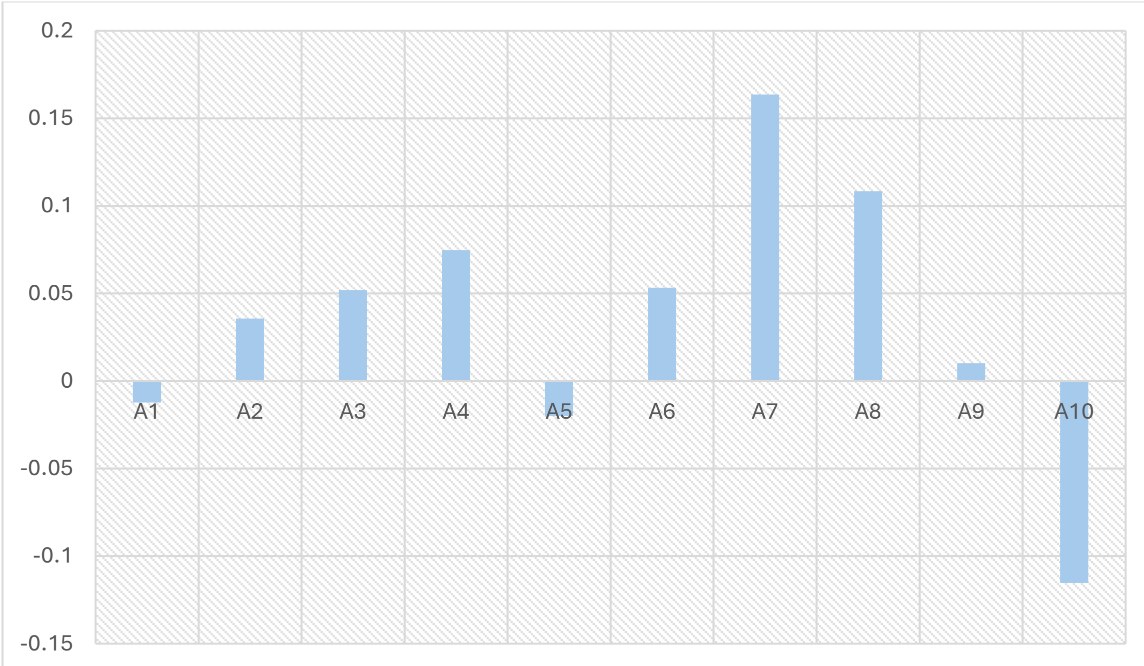

Fig 7. The values of H_i.

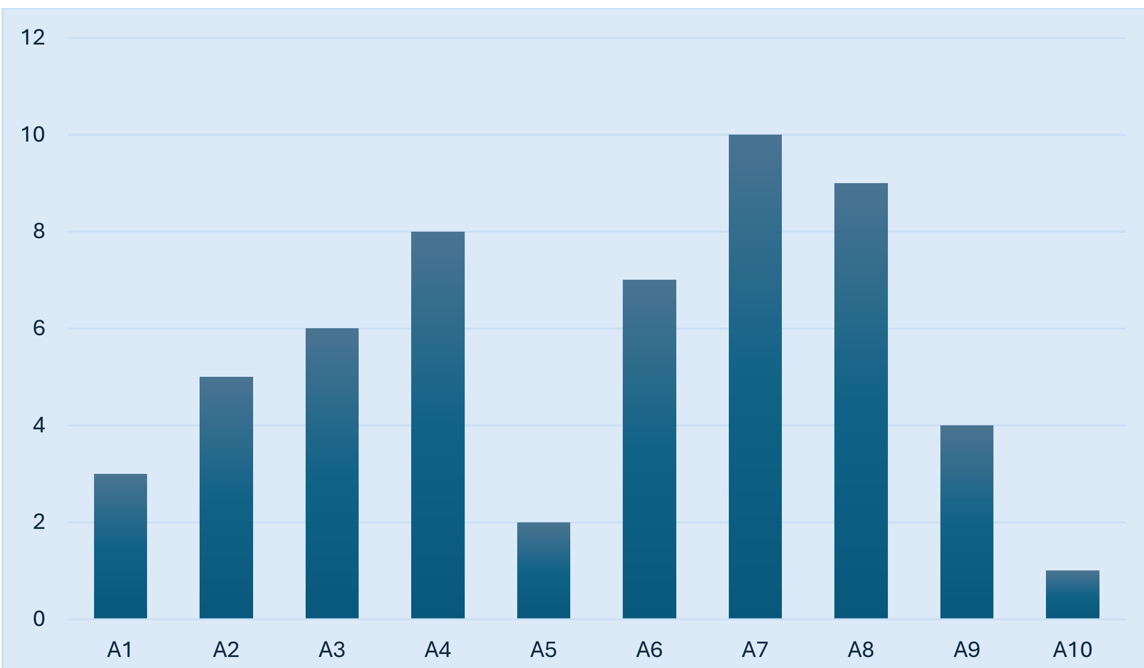

Fig 8. The rank of alternatives.

1. A1 – Rank 3, This alternative performed strongly, placing within the top tier. It demonstrates solid effectiveness, though with slight room for improvement compared to the best performers.

2. A2 – Rank 5, Positioned in the upper-middle range, A2 shows moderate effectiveness. It has strengths but may lack consistency or excellence in some key areas.
3. A3 – Rank 6, Just below the midpoint, these alternative displays average performance. It may be reliable in some criteria but requires significant improvements to be among the top.
4. A4 – Rank 8, With a lower rank, A4 reflects subpar performance in the evaluation. It likely struggles in multiple areas and needs targeted enhancement.
5. A5 – Rank 2, A5 is one of the best-performing alternatives. It's nearly the most effective, indicating strong outcomes and alignment with evaluation criteria.
6. A6 – Rank 7, This alternative performed below average, suggesting that it may be inconsistent or lacking in several key instructional elements.
7. A7 – Rank 10, The lowest-ranked alternative, A7 appears to be the least effective. Major revisions or improvements are likely needed to elevate its performance.
8. A8 – Rank 9, Slightly better than A7 but still among the weakest, A8 underperforms in most areas, highlighting significant gaps in effectiveness.
9. A9 – Rank 4, A9 is effective, sitting just outside the top three. It demonstrates strong potential with minor areas for growth.
10. A10 – Rank 1, The top performer in this evaluation. A10 ranks highest in effectiveness and sets the benchmark for others, excelling across most criteria.

5. Conclusions and Future Work

This evaluation framework highlights the multidimensional nature of effective ideological and political theory courses. The results affirm that factors such as pedagogical innovation, emotional resonance, and real-world relevance are critical to student engagement and understanding. Among the evaluated models, those incorporating blended learning and real-time feedback mechanisms scored highest in holistic impact. As universities strive to nurture responsible, thoughtful citizens, this evaluation offers a roadmap for enriching course design and ensuring that ideological education remains both meaningful and modern. This study uses the MCDM approach to obtain the criteria weights and ranking the alternatives. We use the Neutrosophic Z-Rough Number to overcome the uncertainty and vague information. 12 criteria and 10 alternatives are used in this study. Future research may explore longitudinal impacts of these courses on student worldviews and civic behavior beyond graduation.

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References

[1] Y. Liu, "Design and application of the network evaluation system for ideological and political courses of college students," in *2021 4th International Conference on Information Systems and Computer Aided Education*, 2021, pp. 2624–2627.

[2] X. Liu and J. Ma, "A Research on the Assessment and Evaluation Mechanism of Ideological and Political Course Teachers in Colleges and Universities," in *SHS Web of Conferences*, EDP Sciences, 2021, p. 1011.

[3] L. Runyan, "The Reform Path of Ideological and Political Theory Courses in Universities Under the Integration of Ideological and Political Theory Courses in Universities, Middle Schools, and Primary Schools [J]," *J. Philos. Study*, vol. 13, no. 9, pp. 375–382, 2023.

[4] X. Wang, L. Zhang, and Y. Zhang, "A Review of Research on Online Ideological and Political Education of College Students in the Past Ten Years-Qualitative Analysis Based on Grounded Theory," *Int. J. Educ. Manag.*, vol. 6, no. 1, 2021.

[5] X. Zhao, "Evaluation Model of Practical Teaching of Ideological and Political Theory Course in Higher Vocational Colleges under Network Environment," in *2020 12th International Conference on Measuring Technology and Mechatronics Automation (ICMTMA)*, IEEE, 2020, pp. 861–868.

[6] Y. Li, "A Study on University Students' Participation in College Ideological and Political Education from the Perspective of the" Big Ideological and Political Course"," *Int. Educ. Res.*, vol. 8, no. 2, pp. p117–p117, 2025.

[7] T. U. Liyan, "Comprehensive Evaluation of College Students' Ideological and Political Education Effectiveness Based on Interval Analytic Hierarchy Process.," *Res. Explor. Lab.*, vol. 38, no. 11, 2019.

[8] Y. Yanping and Y. Lu, "Research on the ideological and political implementation of university education courses from the perspective of" three complete education".

[9] Z. Rui, "Research on evaluation system of ideological and political education of college students based on decision system," *Soft Comput.*, vol. 26, no. 20, pp. 10805–10812, 2022.

[10] M. Liu, "Ideological and Political Evaluation of English Courses in Heterogeneous Campuses Based on UAV Network," *J. Multimed. Inf. Syst.*, vol. 10, no. 3, pp. 279–290, 2023.

[11] F. Zhang and W. Ma, "Study on chaotic multi-attribute group decision making based on weighted neutrosophic fuzzy soft rough sets," *Mathematics*, vol. 11, no. 4, p. 1034, 2023.

[12] F. Smarandache, M. Ali, and M. Khan, "Arithmetic operations of neutrosophic sets, interval neutrosophic sets and rough neutrosophic sets," *Fuzzy Multi-criteria Decis. Using Neutrosophic Sets*, pp. 25–42, 2019.

[13] Y.-L. Liu and H.-L. Yang, "Further research of single valued neutrosophic rough sets," *J. Intell. Fuzzy Syst.*, vol. 33, no. 3, pp. 1467–1478, 2017.

[14] Y.-L. Bao and H.-L. Yang, "On single valued neutrosophic refined rough set model and its application," *J. Intell. Fuzzy Syst.*, vol. 33, no. 2, pp. 1235–1248, 2017.

[15] M. Akram, S. Shahzadi, and F. Smarandache, "Multi-attribute decision-making method based on neutrosophic soft rough information," *Axioms*, vol. 7, no. 1, p. 19, 2018.

[16] A. Al-Quran, N. Hassan, and E. Marei, "A novel approach to neutrosophic soft rough set under uncertainty," *Symmetry (Basel).*, vol. 11, no. 3, p. 384, 2019.

[17] M. Kamran, N. Salamat, C. Jana, and Q. Xin, "Decision-making technique with neutrosophic Z-rough set approach for sustainable industry evaluation using sine trigonometric operators," *Appl. Soft Comput.*, vol. 169, p. 112539, 2025.

[18] P.-H. Nguyen, L.-A. T. Nguyen, H.-Q. Le, T.-H. T. Nguyen, T.-G. Vu, and H.-G. H. Le, "Optimizing Horizontal Collaboration in Logistics with Neutrosophic Z-Number Decision Models," *Neutrosophic Sets Syst.*, vol. 81, pp. 306–342, 2025.

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