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Balancing Usability and Protection: A Decision-Making Approach to Computer Network Security Evaluation using the Neutrosophic Fuzzy Dombi Operator

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Abstract: In an era where data is a vital organizational asset, the challenge of safeguarding digital infrastructure while maintaining system usability has become increasingly complex. Network security solutions must not only protect against evolving threats but also support efficient and user-friendly operations. This study explores a multi-criteria decision-making (MCDM) approach to evaluate various computer network security strategies by balancing the trade-offs between usability, scalability, responsiveness, and compliance. By integrating qualitative and quantitative evaluation metrics, this framework provides a systematic methodology for selecting optimal security systems that align with organizational needs. The framework has two main steps; in the first step we show the criteria weights by the WENSLO method. In the second step we show rank of alternatives by the COBRA method. We use the Trapezoidal Fuzzy Neutrosophic numbers (TFNNs) to deal with uncertainty. Also, we use the Dombi operator with the TFNNs to combine the different TFNNs.

Keywords: Dombi Operator; Neutrosophic Fuzzy; Computer Network Security Evaluation; Balancing Usability and Protection.

1. Introduction

In today's interconnected digital landscape, the protection of networked systems is a critical concern for organizations across industries. As businesses increasingly rely on data-driven applications and cloud infrastructure, cyber threats have become more sophisticated and harder to predict. Traditional perimeter-based security models are no longer sufficient, prompting a shift toward more adaptive and intelligent computer network security architectures. However, in striving for advanced protection, organizations must ensure that security systems remain accessible and efficient for end-users[1], [2]. Network security is inherently a multidimensional issue. It involves a delicate balance between technical robustness and operational usability. While high-performance firewalls and intrusion detection systems provide vital safeguards, they can also introduce latency, user friction, and compatibility issues. Moreover, ensuring compliance with data privacy regulations adds another layer of complexity. Organizations must therefore evaluate not only the protective strength of a solution but also its practical implications for daily operations[3], [4]. To navigate these complexities, structured evaluation frameworks are essential. Multi-criteria decision-making (MCDM) methods offer a promising approach for assessing diverse aspects of security solutions. By quantifying and ranking alternatives across multiple criteria—such as response time, user-friendliness, threat detection accuracy, and system resource demands, MCDM supports transparent and rational decision-making. These methods are particularly valuable when trade-offs are unavoidable, as they highlight the strengths and weaknesses of each option in a comprehensive manner. The evaluation of computer network security solutions must also consider scalability and adaptability. With the rapid evolution of technologies like AI-driven anomaly detection, zero-trust architecture, and cloud-native platforms, solutions must be capable of integrating into heterogeneous environments. MCDM techniques can incorporate future-oriented criteria, helping organizations anticipate performance across changing digital ecosystems. A robust evaluation model thus becomes a strategic asset for aligning cybersecurity with organizational growth[5]. Another vital dimension is the role of human factors in computer network security. The usability of a security solution directly impacts compliance and effectiveness. Complex authentication methods, unclear interfaces, or frequent disruptions can reduce user cooperation and create vulnerabilities. By including usability as a central evaluation criterion, organizations can promote a culture of security that is supported, rather than hindered, by everyday users[6], [7].

Furthermore, the regulatory landscape continues to evolve, with frameworks enforcing stringent data protection standards. Any evaluation of security infrastructure must, therefore, address the solution's capacity to meet current and future compliance requirements. MCDM approaches can incorporate these legal dimensions into the decision-making model, ensuring that selected solutions are not only effective and usable but also lawful.

This research aims to establish a comprehensive decision-making framework that captures the multifaceted nature of computer network security. Using a structured set of criteria and real-world alternatives, the study applies MCDM to assess and rank modern computer network security solutions. The goal is to support IT managers, cybersecurity professionals, and strategic planners in making well-informed decisions that optimize both security performance and operational continuity

Despite the many precise and tangible methods that have been put out, uncertainty is always a very difficult problem in decision-making research. It is inevitable for research initiatives to deal with the unpredictability of complicated decision-making situations. Experts can more easily and consistently convey their opinions and preferences by employing linguistic terminology. Thus, utilizing linguistic fuzzy concepts to express expert preferences in decision-making situations is a duty that must be handled well[8], [9].

When uncertainty predominates, fuzzy sets were created to adapt to and meet decision-making criteria. Using neutrosophic fuzzy sets and logic, several real-world decision-making tasks involving imprecise, inconsistent, and partial information have been developed and resolved. One of the most used study themes among the vast array of fuzzy logic-based methodologies is the use of neutrosophic sets and their applications in decision-making processes. Fuzzy intuitionistic sets and logic are a generalization of neutrosophic sets and logic[10], [11].

In the past ten years, we have seen a sharp increase in the use of neutrosophic sets and logic in MCDM, system optimization, and control problems, as well as their applications to a variety of fields. Neutosophic sets can handle the higher type of uncertainty that exists in both natural and human system[12], [13].

2. Trapezoidal fuzzy neutrosophic numbers (TFNNs) with Dombi operator

This section shows the definitions of TFNNs with the Dombi operator[14].

The Dombi operator can be defined as:

$$Dombi(p,q) = \frac{1}{1+\left\{\left(\frac{1-p}{p}\right)^{p}+\left(\frac{1-q}{q}\right)^{q}\right\}^{\frac{1}{p}}} \tag{1}$$

$$Dombi^{c}(p,q) = 1-\frac{1}{1+\left\{\left(\frac{p}{p}\right)^{p}+\left(\frac{q}{q}\right)^{q}\right\}^{\frac{1}{p}}} \tag{2}$$

Operations of TFNNs with the Dombi operator

$$n_1+n_2=\left(\begin{matrix}\left(\begin{matrix}1-\left(\frac{1}{1+\left\{\left(\frac{a_1}{1-a_1}\right)^p+\left(\frac{d_1}{1-d_1}\right)^p\right\}^{\frac{1}{p}}}\right),\\ 1-\left(\frac{1}{1+\left\{\left(\frac{a_2}{1-a_2}\right)^p+\left(\frac{d_2}{1-d_2}\right)^p\right\}^{\frac{1}{p}}}\right),\\ 1-\left(\frac{1}{1+\left\{\left(\frac{a_3}{1-a_3}\right)^p+\left(\frac{d_3}{1-d_3}\right)^p\right\}^{\frac{1}{p}}}\right),\\ 1-\left(\frac{1}{1+\left\{\left(\frac{a_4}{1-a_4}\right)^p+\left(\frac{d_4}{1-d_4}\right)^p\right\}^{\frac{1}{p}}}\right)\end{matrix}\right),\\ \left(\begin{matrix}\frac{1}{1+\left\{\left(\frac{1-b_1}{b_1}\right)^p+\left(\frac{1-e_1}{e_1}\right)^p\right\}^{\frac{1}{p}}},\\ \frac{1}{1+\left\{\left(\frac{1-b_2}{b_2}\right)^p+\left(\frac{1-e_2}{e_2}\right)^p\right\}^{\frac{1}{p}}},\\ \frac{1}{1+\left\{\left(\frac{1-b_3}{b_3}\right)^p+\left(\frac{1-e_3}{e_3}\right)^p\right\}^{\frac{1}{p}}},\\ \frac{1}{1+\left\{\left(\frac{1-b_4}{b_4}\right)^p+\left(\frac{1-e_4}{e_4}\right)^p\right\}^{\frac{1}{p}}}\end{matrix}\right),\\ \left(\begin{matrix}\frac{1}{1+\left\{\left(\frac{1-c_1}{c_1}\right)^p+\left(\frac{1-f_1}{f_1}\right)^p\right\}^{\frac{1}{p}}},\\ \frac{1}{1+\left\{\left(\frac{1-c_2}{c_2}\right)^p+\left(\frac{1-f_2}{f_2}\right)^p\right\}^{\frac{1}{p}}},\\ \frac{1}{1+\left\{\left(\frac{1-c_3}{c_3}\right)^p+\left(\frac{1-f_3}{f_3}\right)^p\right\}^{\frac{1}{p}}},\\ \frac{1}{1+\left\{\left(\frac{1-c_4}{c_4}\right)^p+\left(\frac{1-f_4}{f_4}\right)^p\right\}^{\frac{1}{p}}}\end{matrix}\right)\end{matrix}\right) \tag{3}$$

$$n_1 \times n_2 = \left(\begin{array}{c} \left(\begin{array}{c} \frac{1}{1+\left\{\left(\frac{1-a_1}{a_1}\right)^p + \left(\frac{1-d_1}{d_1}\right)^p\right\}^{\frac{1}{p}}}, \\ \frac{1}{1+\left\{\left(\frac{1-a_2}{a_2}\right)^p + \left(\frac{1-d_2}{d_2}\right)^p\right\}^{\frac{1}{p}}}, \\ \frac{1}{1+\left\{\left(\frac{1-a_3}{a_3}\right)^p + \left(\frac{1-d_3}{d_3}\right)^p\right\}^{\frac{1}{p}}}, \\ \frac{1}{1+\left\{\left(\frac{1-a_4}{a_4}\right)^p + \left(\frac{1-d_4}{d_4}\right)^p\right\}^{\frac{1}{p}}} \end{array} \right), \\ \left(\begin{array}{c} 1-\left(\frac{1}{1+\left\{\left(\frac{b_1}{1-b_1}\right)^p + \left(\frac{e_1}{1-e_1}\right)^p\right\}^{\frac{1}{p}}}\right), \\ 1-\left(\frac{1}{1+\left\{\left(\frac{b_2}{1-b_2}\right)^p + \left(\frac{e_2}{1-e_2}\right)^p\right\}^{\frac{1}{p}}}\right), \\ 1-\left(\frac{1}{1+\left\{\left(\frac{b_3}{1-b_3}\right)^p + \left(\frac{e_3}{1-e_3}\right)^p\right\}^{\frac{1}{p}}}\right), \\ 1-\left(\frac{1}{1+\left\{\left(\frac{b_4}{1-b_4}\right)^p + \left(\frac{e_4}{1-e_4}\right)^p\right\}^{\frac{1}{p}}}\right) \end{array} \right), \\ 1-\left(\frac{1}{1+\left\{\left(\frac{a_1}{1-a_1}\right)^p + \left(\frac{d_1}{1-d_1}\right)^p\right\}^{\frac{1}{p}}}\right), 1-\left(\frac{1}{1+\left\{\left(\frac{a_2}{1-a_2}\right)^p + \left(\frac{d_2}{1-d_2}\right)^p\right\}^{\frac{1}{p}}}\right), 1 \\ -\left(\frac{1}{1+\left\{\left(\frac{a_3}{1-a_3}\right)^p + \left(\frac{d_3}{1-d_3}\right)^p\right\}^{\frac{1}{p}}}\right), 1-\left(\frac{1}{1+\left\{\left(\frac{a_4}{1-a_4}\right)^p + \left(\frac{d_4}{1-d_4}\right)^p\right\}^{1/p}}\right) \end{array} \right) \quad (4)$$

$$hn_1 = \left(\begin{array}{c} \left(\begin{array}{c} 1 - \left(\frac{1}{1 + \left\{ h \left(\frac{a_1}{1 - a_1} \right)^p \right\}^{\frac{1}{p}}} \right), 1 - \left(\frac{1}{1 + \left\{ h \left(\frac{a_2}{1 - a_2} \right)^p \right\}^{\frac{1}{p}}} \right), \\ 1 - \left(\frac{1}{1 + \left\{ h \left(\frac{a_3}{1 - a_3} \right)^p \right\}^{\frac{1}{p}}} \right), 1 - \left(\frac{1}{1 + \left\{ h \left(\frac{a_4}{1 - a_4} \right)^p \right\}^{\frac{1}{p}}} \right) \end{array} \right), \\ \left(\begin{array}{c} \left(\frac{1}{1 + \left\{ h \left(\frac{b_1}{1 - b_1} \right)^p \right\}^{\frac{1}{p}}} \right), \left(\frac{1}{1 + \left\{ h \left(\frac{b_2}{1 - b_2} \right)^p \right\}^{\frac{1}{p}}} \right), \\ \left(\frac{1}{1 + \left\{ h \left(\frac{b_3}{1 - b_3} \right)^p \right\}^{\frac{1}{p}}} \right), \left(\frac{1}{1 + \left\{ h \left(\frac{b_4}{1 - b_4} \right)^p \right\}^{\frac{1}{p}}} \right) \end{array} \right), \\ \left(\begin{array}{c} \left(\frac{1}{1 + \left\{ h \left(\frac{c_1}{1 - c_1} \right)^p \right\}^{\frac{1}{p}}} \right), \left(\frac{1}{1 + \left\{ h \left(\frac{c_2}{1 - c_2} \right)^p \right\}^{\frac{1}{p}}} \right), \\ \left(\frac{1}{1 + \left\{ h \left(\frac{c_3}{1 - c_3} \right)^p \right\}^{\frac{1}{p}}} \right), \left(\frac{1}{1 + \left\{ h \left(\frac{c_4}{1 - c_4} \right)^p \right\}^{\frac{1}{p}}} \right) \end{array} \right) \end{array} \right) \quad (5)$$

$$n_1^h = \left(\begin{array}{c} \left(\begin{array}{c} \left(\frac{1}{1+\left\{h\left(\frac{a_1}{1-a_1}\right)^p\right\}^{\frac{1}{p}}}\right), \left(\frac{1}{1+\left\{h\left(\frac{a_2}{1-a_2}\right)^p\right\}^{\frac{1}{p}}}\right), \\ \left(\frac{1}{1+\left\{h\left(\frac{a_3}{1-a_3}\right)^p\right\}^{\frac{1}{p}}}\right), \left(\frac{1}{1+\left\{h\left(\frac{a_4}{1-a_4}\right)^p\right\}^{\frac{1}{p}}}\right) \end{array} \right), \\ \left(\begin{array}{c} 1-\left(\frac{1}{1+\left\{h\left(\frac{b_1}{1-b_1}\right)^p\right\}^{\frac{1}{p}}}\right), 1-\left(\frac{1}{1+\left\{h\left(\frac{b_2}{1-b_2}\right)^p\right\}^{\frac{1}{p}}}\right), \\ 1-\left(\frac{1}{1+\left\{h\left(\frac{b_3}{1-b_3}\right)^p\right\}^{\frac{1}{p}}}\right), 1-\left(\frac{1}{1+\left\{h\left(\frac{b_4}{1-b_4}\right)^p\right\}^{\frac{1}{p}}}\right) \end{array} \right), \\ \left(\begin{array}{c} 1-\left(\frac{1}{1+\left\{h\left(\frac{c_1}{1-c_1}\right)^p\right\}^{\frac{1}{p}}}\right), 1-\left(\frac{1}{1+\left\{h\left(\frac{c_2}{1-c_2}\right)^p\right\}^{\frac{1}{p}}}\right), \\ 1-\left(\frac{1}{1+\left\{h\left(\frac{c_3}{1-c_3}\right)^p\right\}^{\frac{1}{p}}}\right), 1-\left(\frac{1}{1+\left\{h\left(\frac{c_4}{1-c_4}\right)^p\right\}^{\frac{1}{p}}}\right) \end{array} \right) \end{array} \right) \quad (6)$$

3. Decision Making Approach

This section shows the steps of the decision-making process. First, we show the steps of the WENSLO and in the second, we show the steps of the COBRA.

Build the decision matrix. Experts use the TFNNs to evaluate the criteria and alternatives.

Normalize the decision matrix

$$y_{ij} = \frac{z_{ij}}{\sum_{i=1}^{m} z_{ij}} \quad (7)$$

Obtain the ultimate ranking of alternatives

$$U_j = \frac{\max_{1<i\le m} y_{ij} - \min_{1<i\le m} y_{ij}}{1+3.322\times\log(m)} \quad (8)$$

The slope of the criterion is computed.

$$s_j = \frac{\sum_{i=1}^{m} y_{ij}}{(m-1)\times U_j} \quad (9)$$

The envelope of criterion is computed.

$$K_j = \sum_{i=1}^{m-1} \sqrt{\left(y_{i+1j} - U_{ij}\right)^2 + U_j^2} \tag{10}$$

Obtain the envelope-slope ratio

$$E_j = \frac{K_j}{S_j} \tag{11}$$

Obtain the criteria weights.

$$w_j = \frac{E_j}{\sum_{i=1}^{n} E_j} \tag{12}$$

The steps of the COBRA method are shown as:

The decision matrix is normalized

$$d_{ij} = \frac{z_{ij}}{\max z_{ij}} \tag{13}$$

The weighted decision matrix is computed.

$$WD_{ij} = w_j d_{ij} \tag{14}$$

Obtain the distance values for positive ideal solution and negative ideal solution

$$A_j = \max q_{ij}\,;\; B_j = \min q_{ij} \tag{15}$$

$$A_j = \min q_{ij}\,; B_j = \max q_{ij} \tag{16}$$

$$C_j = \frac{\sum_{i=1}^{m} q_{ij}}{m} \tag{17}$$

Obtain the distance to positive and negative criteria

$$G(A_j) = \sqrt{\sum_{j=1}^{n} \left(A_j - WD_{ij}\right)^2} \tag{18}$$

$$G(B_j) = \sqrt{\sum_{j=1}^{n} \left(B_j - WD_{ij}\right)^2} \tag{19}$$

$$G(AS_j) = \sqrt{\sum_{j=1}^{n} \left(AS_j - WD_{ij}\right)^2} \tag{20}$$

Obtain the overall distance

$$G_i = \frac{G(A_j) - G(B_j) - g(AS_j)}{3} \tag{21}$$

4. Results

This section shows the results of the proposed approach. We collect six criteria and eight alternatives as:

- Threat Detection Accuracy
- User Accessibility and Interface Usability
- Response Time to Security Incidents
- Scalability and Integration
- Data Privacy and Compliance
- System Resource Efficiency
  - Next-Generation Firewall
  - Intrusion Detection & Prevention System
  - Zero Trust Network Access
  - AI-Based Behavioral Anomaly Detection
  - Cloud-Native Security Platform
  - Endpoint Detection and Response
  - Unified Threat Management
  - Network Access Control Systems

Three experts use the TFNNs to evaluate the criteria and alternatives as shown in Tables 1-3. These TFNNs are combined using the Dombi operator. Then they are converted to the crisp values.

Eq. (7) is used to normalize the decision matrix as shown in Fig 1.

Eq. (8) is used to obtain the ultimate ranking of alternatives.

Eq. (9) is used to obtain the slope of the criterion.

Eq. (10) is used to obtain the envelope of criteria as shown in Fig 2.

Eq. (11) is used to obtain the envelope-slope ratio.

Obtain the criteria weights using eq. (12) as shown in Fig 3.

Table 1. The first TFNNs.

	C_1	C_2	C_3	C_4	C_5	C_6
A_1	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩
A_2	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩
A_3	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩

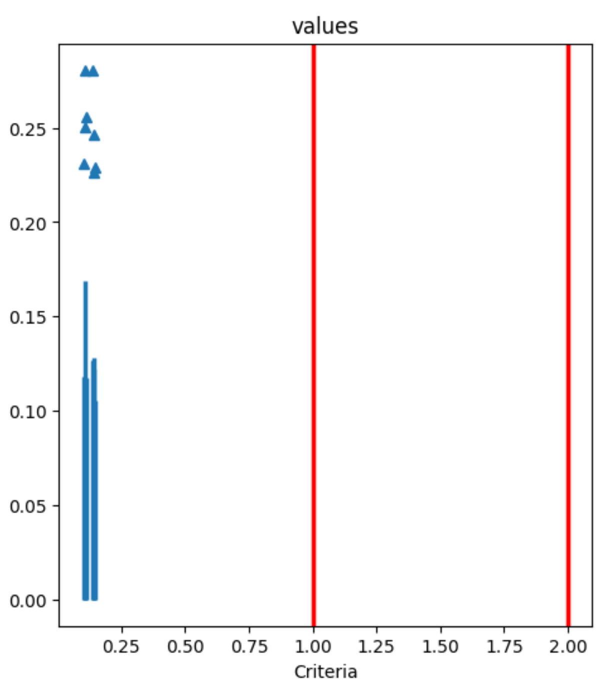
A_4	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩
A_5	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩
A_6	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩
A_7	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩
A_8	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩

Table 2. The second TFNNs.

	C_1	C_2	C_3	C_4	C_5	C_6
A_1	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩
A_2	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩
A_3	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩
A_4	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩
A_5	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩
A_6	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩
A_7	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩
A_8	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩

Table 3. The third TFNNs.

	C_1	C_2	C_3	C_4	C_5	C_6
A_1	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩
A_2	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩
A_3	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩
A_4	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩
A_5	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9),(0.7,0.8,0.9,0.9)⟩
A_6	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3),(0.1,0.1,0.2,0.3)⟩
A_7	⟨(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9),(0.9,0.9,0.9,0.9)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩
A_8	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4),(0.1,0.2,0.3,0.4)⟩	⟨(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1),(0.1,0.1,0.1,0.1)⟩	⟨(0.5,0.6,0.7,0.8),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩	⟨(0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7)⟩



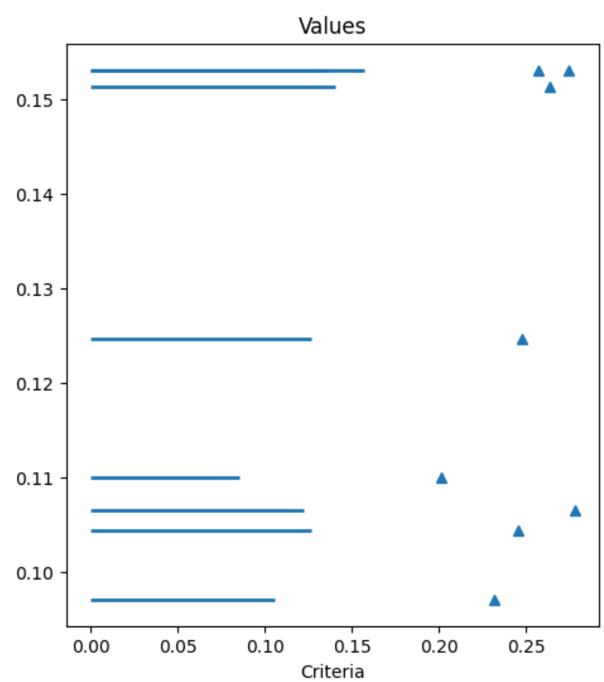


Fig 1. Normalized decision matrix.

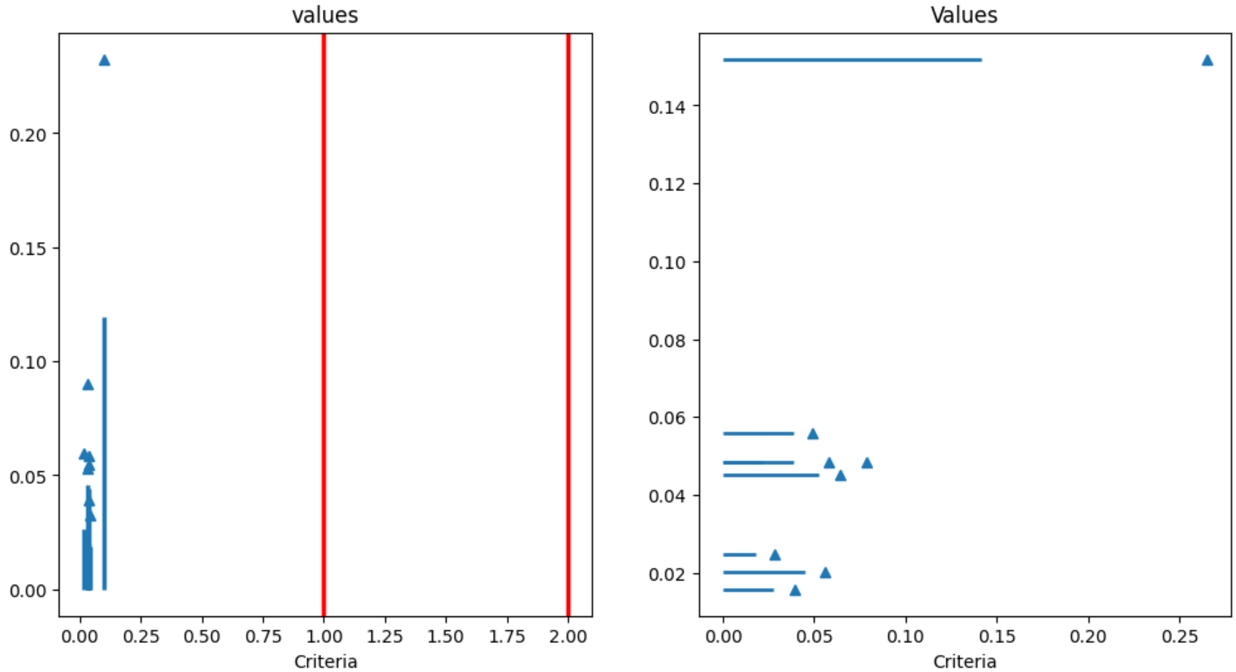


Fig 2. the envelope of criteria

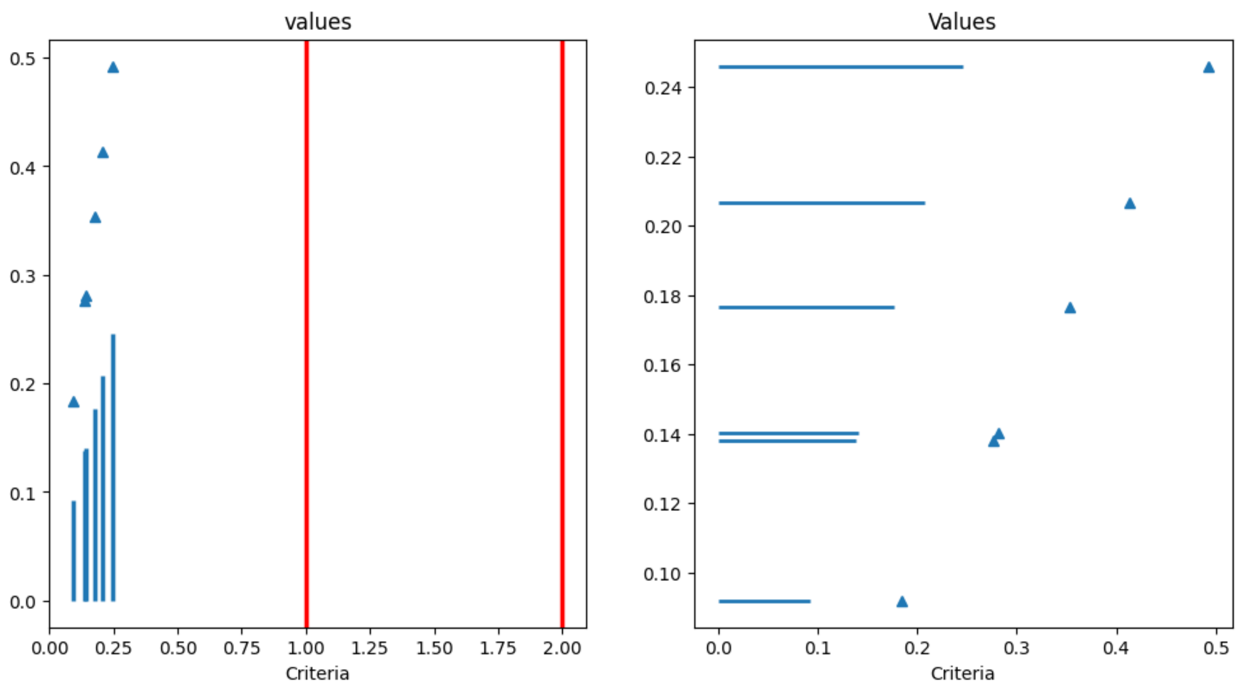


Fig 3. The criteria weights.

The steps of the COBRA method are implemented. Eq. (13) is used to normalize the decision matrix as shown in Fig 4.

The weighted decision matrix is computed using Eq. (14) as shown in Fig 5.

Obtain the distance values for positive ideal solution and negative ideal solution using eqs. (15-17).

Obtain the distance to positive and negative criteria using eqs. (18-20) as shown in Figs 6-8.

Obtain the overall distance using eq. (21). The rank of alternatives is obtained as shown in Fig 9.

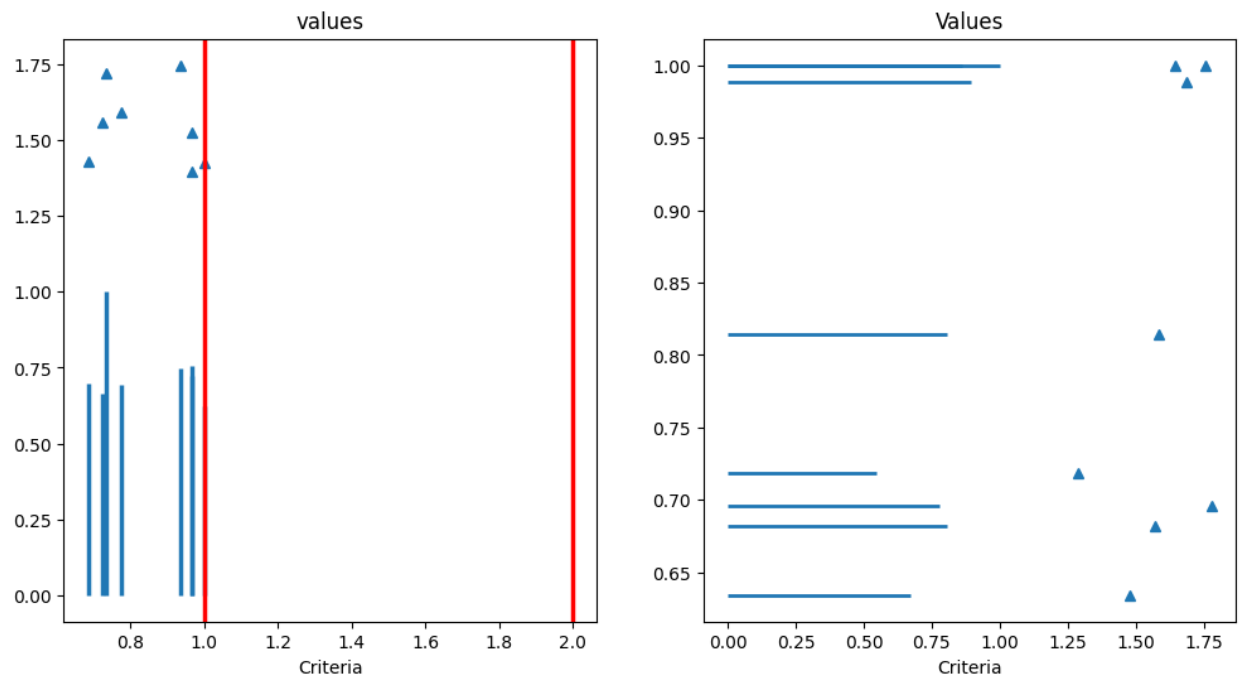


Fig 4. Normalized decision matrix.

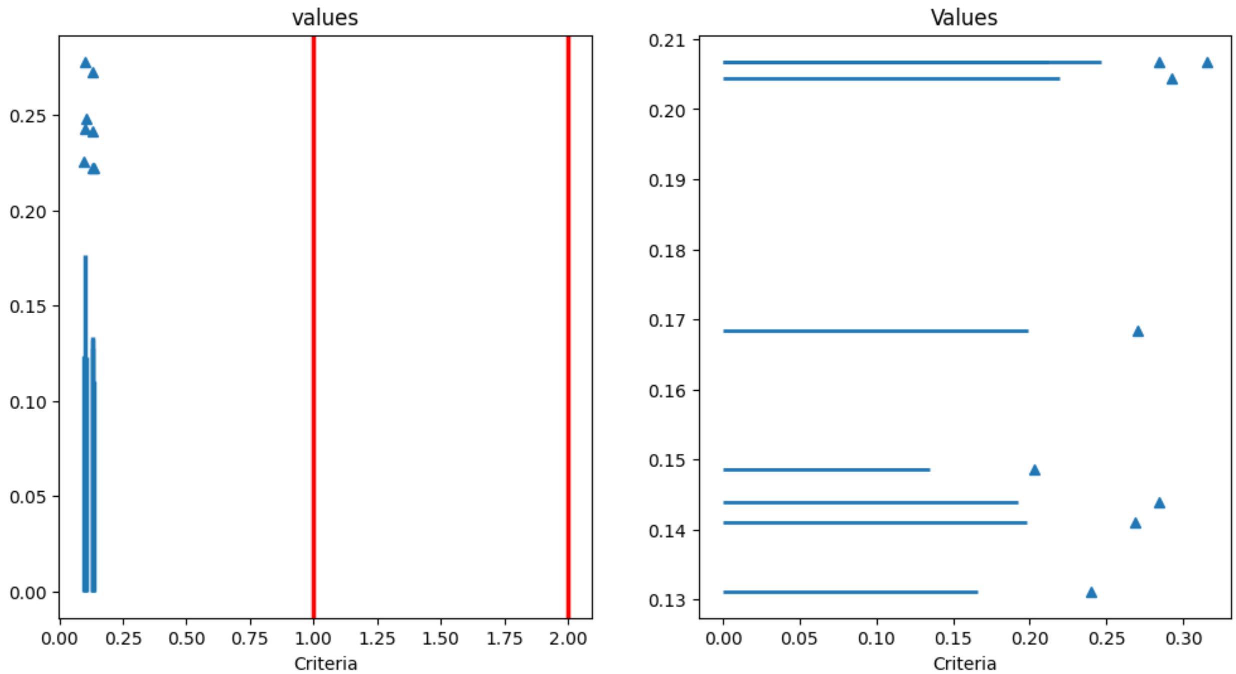


Fig 5. Weighted normalized decision matrix.

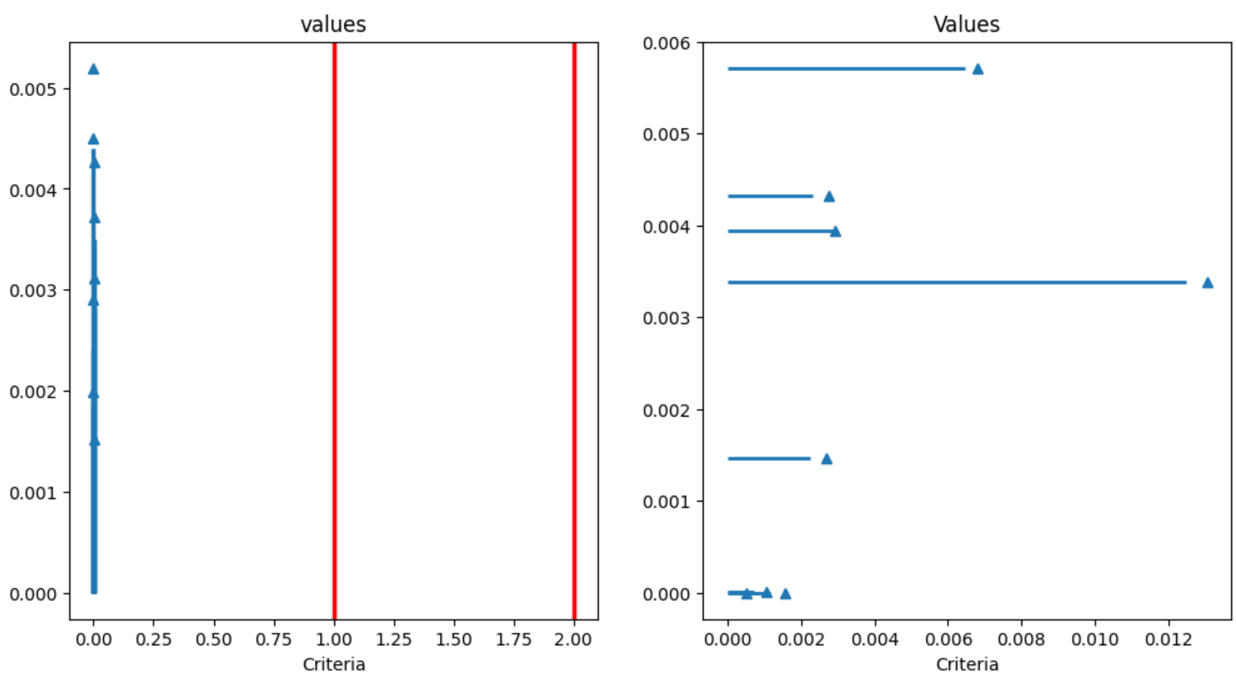


Fig 6. The values of $G(A_j)$.

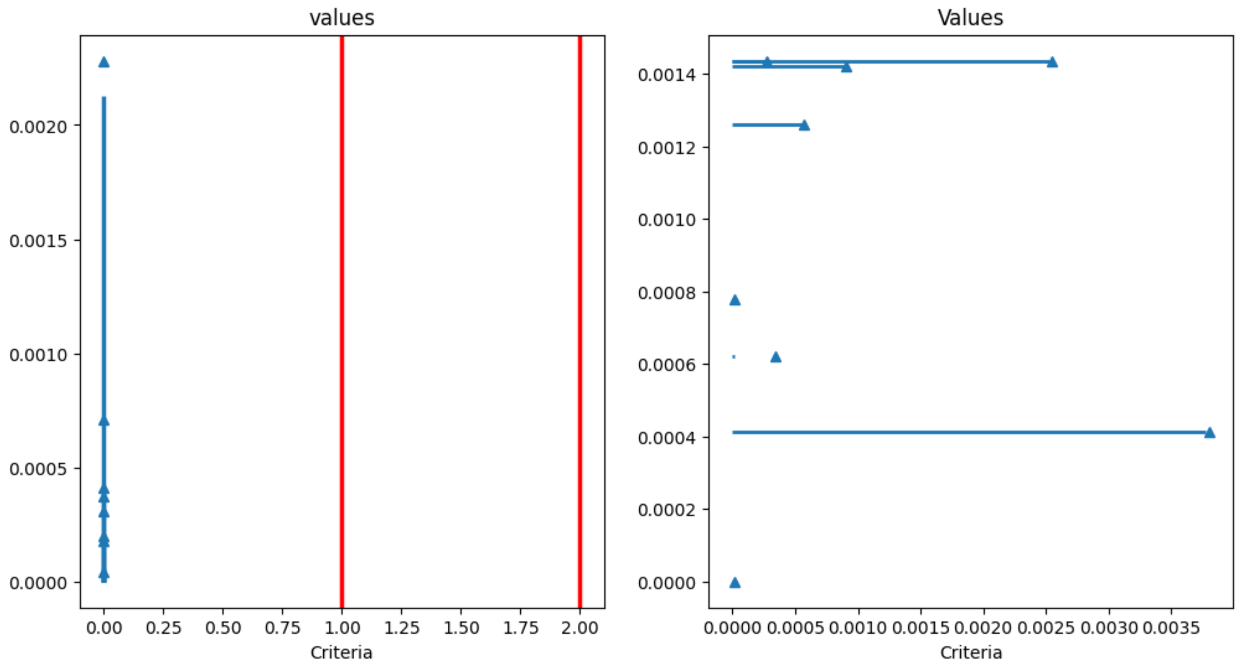


Fig 7. The values of $G(B_j)$.

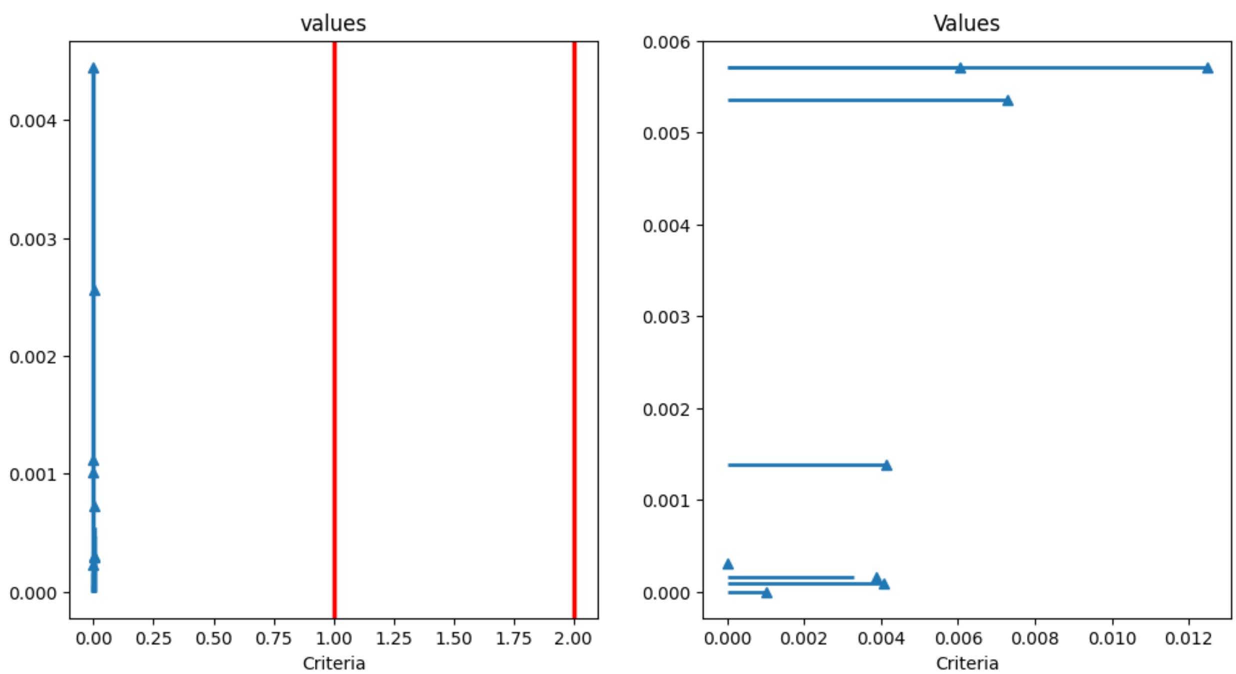


Fig 8. The values of $G(AS_j)$.

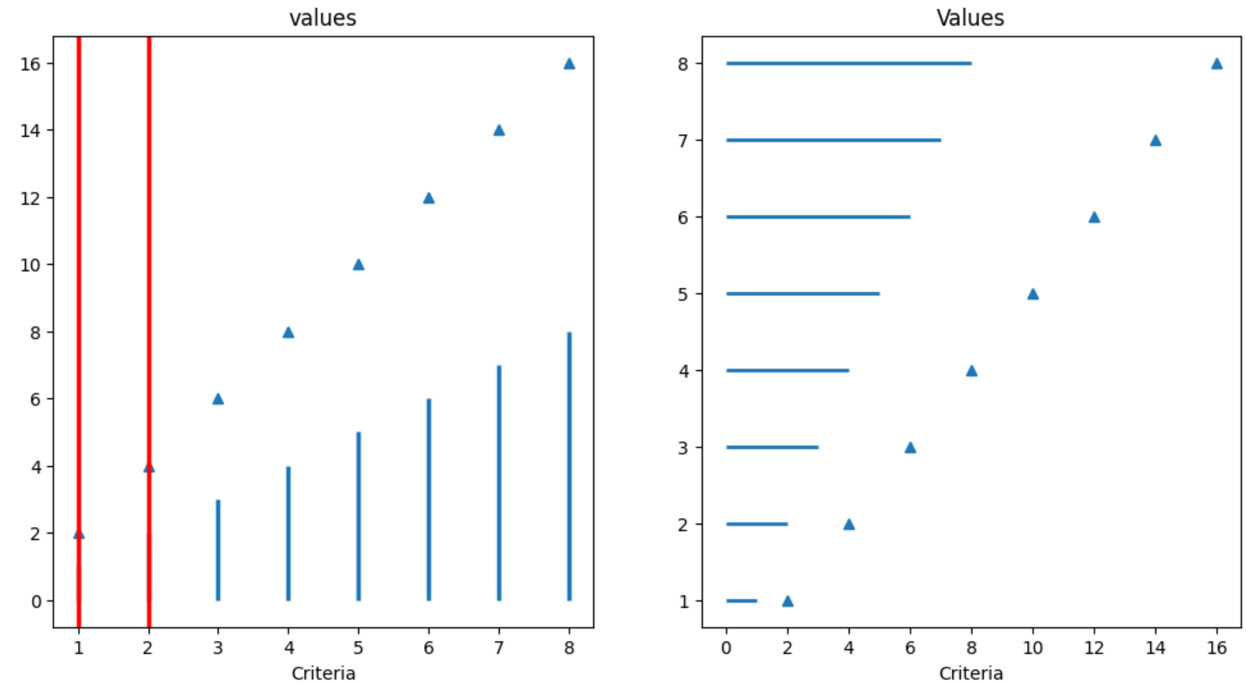


Fig 9. The rank of alternatives.

5. Conclusions

Balancing security and usability in network environments are a strategic imperative that requires more than technical acumen—it demands a multidimensional, data-informed decision-making process. By employing MCDM methodologies, organizations can holistically evaluate computer network security solutions based on diverse performance indicators. This ensures that selections not only defend against modern threats but also support scalable, compliant, and user-friendly operations. As digital infrastructures continue to evolve, the fusion of robust security protocols with operational practicality will define the next generation of resilient and adaptable IT systems. We used the two methods to obtain the criteria weights and rank the alternatives by the COBRA method. We use the Trapezoidal Fuzzy Neutrosophic numbers (TFNNs) to overcome vague information. The Dombi operator is used with the TFNNs to combine the decision matrix into a single matrix. Six criteria and eight alternatives are used to validate the proposed approach.

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