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Effectiveness Assessment of Brand Microblog Marketing Communication under Trapezoidal Fuzzy Neutrosophic Sets

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Abstract: Brand communication tactics have changed to take use of new media channels, especially microblogging, in the age of digital transformation. It is now crucial to assess the success of brand microblog marketing communication to comprehend customer involvement, message distribution, and brand positioning. With an emphasis on elements like audience engagement, material quality, and brand perception, this study investigates the standards for evaluating the effectiveness of microblog marketing initiatives. The study offers insights into the tactics that are most important for effective communication using a systematic evaluation approach. We use multi-criteria decision making (MCDM) to deal with different criteria. We use the Trapezoidal Fuzzy Neutrosophic Sets (TFNSs) to deal with uncertainty information. The results are meant to help businesses maximize their microblog presence for more effective marketing.

Keywords: Brand Microblog Marketing; Communications; Uncertainty; Trapezoidal Fuzzy Neutrosophic Sets.

1. Introduction

The way businesses engage with their consumers has been completely transformed by the digital revolution, and microblogging platforms have become extremely effective communication tools. Social media sites like Twitter, Weibo, and Threads provide marketers with the chance to interact with customers directly, publish information quickly, and use viral material to spread their message[1], [2]. To make sure that microblog marketing initiatives accomplish the desired communication goals, a methodical assessment of their efficacy is necessary.

Brand microblogs are frequently assessed using metrics including reach, likes, shares, and comments. However, concentrating only on numeric engagement ignores important factors like audience emotional resonance, message clarity, and content relevancy[3], [4]. To properly evaluate marketing performance, a more thorough assessment model must take into consideration both quantitative and qualitative factors.

One of the most important measures of microblog performance is still the audience engagement rate. Posts with high levels of engagement are more likely to be discussed and shared, increasing brand awareness[5], [6]. Furthermore, audiences' perceptions and reactions to marketing messaging may be greatly influenced by the content's emotional tone and cultural alignment. Effective assessment therefore depends on having a comprehensive knowledge of involvement.

The content strategy that brands use is another important consideration. Posts that are timely, visually appealing, and related to popular subjects tend to do well. A post's efficacy may be further increased by utilizing hashtags strategically, creating a compelling tale, collaborating with influencers, and including interactive components like challenges or polls[7], [8]. Deeper understanding of best practices may be gained by evaluating these content techniques.

Consistency and regularity are also directly related to the success of microblog communication. Relationships between brands and their audience are strengthened by consistent posting schedules and the development of a consistent brand voice[9], [10]. Assessments need to consider how posts' tempo and theme coherence affect customer loyalty and trust.

Sentiment analysis's increasing significance emphasizes the necessity of evaluating both the quantity and quality of interactions with a post[11], [12]. A crucial component of microblog marketing assessment is positive brand sentiment, which correlated with higher customer retention and advocacy. Monitoring sentiment over time yields insightful information about communication tactics.

Another important indicator is conversion rates, which measure how many microblog conversations result in desired consumer actions. In addition to encouraging interaction, successful microblog marketing should provide measurable results like website visits, product queries, or purchases[13], [14]. Therefore, assessing the communication-to-conversion pathway is essential to comprehending marketing success in its whole.

All things considered; a multifaceted assessment framework is required to fully grasp the intricacies of brand microblog marketing. Brands may more accurately evaluate the success of their communication initiatives by using metrics for sentiment, conversion, engagement, content quality, and consistency[15], [16]. To support better-informed, strategic microblog marketing initiatives, this study aims to develop such a framework.

A strategic method for a thorough evaluation of options considering several competing criteria, multi-criteria decision-making (MCDM) has been effectively used for evaluations in the MCDM issues. One crucial contextual factor that might influence the decision-making process for evaluating MCDM issues is uncertainty. However, uncertainty and hesitation, which are prevalent in real-world decision-making situations, are difficult for standard MCDM models to handle. To get around these restrictions, Zadeh [17] developed the idea of a fuzzy set (FS), where each element is represented by a membership degree with a value ranging from 0 to 1.

The FS views the non-membership degree as a supplement to the membership degree, which is the sole degree it contains. However, in practical issues, this isn't always the case. Additionally, several FS generalizations have been proposed and used for diverse objectives. As an improvement on FS, Atanassov [18] developed the idea of Intuitionistic Fuzzy Set (IFS), which is represented by the degrees of membership and non-membership with. More focus has been placed on this set to address the ambiguity and uncertainty brought on by imperfect information.

There may be instances in which a decision-maker provides an independent rating in a variety of problems. For example, when we ask a decision-maker what they think about a certain phrase. He or she has a 0.7 chance of saying that the statement is accurate, a 0.3 chance of being unsure, and a 0.5 chance of saying that the statement is untrue. Smarandache [19], [20] developed the Neutrosophic Set (NS) theory to address these circumstances, according to which the functions of Truth Membership (TM), Indeterminacy Membership (IM), and Falsity Membership (FM) are independent. In addition to being helpful for handling incomplete information, this set may also be used to handle inconsistent and uncertain information[21], [22].

2. Proposed Approach

We use the trapezoidal fuzzy neutrosophic sets (TFNSs) to deal with uncertainty information in the decision-making process[23], [24]. We show the operations of the trapezoidal fuzzy neutrosophic numbers (TFNNs) such as:

Definition 1

We can define the TFNSs such as

$$A = \{(y, T_A(y), I_A(y), F_A(A))|a \in A\} \quad (1)$$

$$T_A(y) \subset [0,1], I_A(y) \subset [0,1], F_A(y) \subset [0,1] \quad (2)$$

$$T_A(y) = \left(t_A^1(y), t_A^2(y), t_A^3(y), t_A^4(y)\right): A \to [0,1] \quad (3)$$

$$I_A(y) = \left(i_A^1(y), i_A^2(y), i_A^3(y), i_A^4(y)\right): A \to [0,1] \quad (4)$$

$$F_A(y) = \left(f_A^1(y), f_A^2(y), f_A^3(y), f_A^4(y)\right): A \to [0,1] \quad (5)$$

$$0 \leq t_A^4(y) + i_A^4(y) + f_A^4(y) \leq 3 \quad (6)$$

Definition 2

We can define the TFNNs such as:

$$A = ((d_1, d_2, d_3, d_4), (e_1, e_2, e_3, e_4), (f_1, f_2, f_3, f_4))$$

$$T_A(y) = \begin{pmatrix} \frac{y-d_1}{d_2-d_1} & d_1 \le y \le d_2 \\ 1 & d_2 \le y \le d_3 \\ \frac{d_4-y}{d_4-d_3} & d_3 \le y \le d_4 \\ 0 & otherwise \end{pmatrix} \tag{7}$$

$$I_A(y) = \begin{pmatrix} \frac{e-y}{e_2-e_1} & e_1 \le y \le e_2 \\ 0 & e_2 \le y \le e_3 \\ \frac{y-e_3}{e_4-e_3} & e_3 \le y \le e_4 \\ 1 & otherwise \end{pmatrix} \tag{8}$$

$$F_A(y) = \begin{pmatrix} \frac{f_2-y}{f_2-f_1} & f_1 \le y \le f_2 \\ 0 & f_2 \le y \le f_3 \\ \frac{y-f_3}{f_4-f_3} & f_3 \le y \le f_4 \\ 1 & otherwise \end{pmatrix} \tag{9}$$

Definition 3

Let $A_1 = \big((d_1, d_2, d_3, d_4), (e_1, e_2, e_3, e_4), (f_1, f_2, f_3, f_4)\big)$ and $A_2 = \big((g_1, g_2, g_3, g_4), (h_1, h_2, h_3, h_4), (k_1, k_2, k_3, k_4)\big)$ be two TFNNs. We can show the operations of TFNNs such as:

$$A_1 \oplus A_2 = \begin{pmatrix} \begin{pmatrix} d_1 + g_1 - d_1 g_1, d_2 + g_2 - d_2 g_2, \\ d_3 + g_3 - d_3 g_3 - d_4 + g_4 - d_4 g_4 \end{pmatrix}, \\ (e_1 h_1, e_2 h_2, e_3 h_3, e_4 h_4), \\ (f_1 k_1, f_2 k_2, f_3 k_3, f_4 k_4) \end{pmatrix} \tag{10}$$

$$A_1 \otimes A_2 = \begin{pmatrix} (d_1 g_1, d_2 g_2, d_3 g_3, d_4 g_4), \\ \begin{pmatrix} e_1 + h_1 - e_1 h_1, e_2 + h_2 - e_2 h_2, \\ e_3 + h_3 - e_3 h_3 - e_4 + h_4 - e_4 h_4 \end{pmatrix}, \\ \begin{pmatrix} f_1 + k_1 - f_1 k_1, f_2 + k_2 - f_2 k_2, \\ f_3 + k_3 - f_3 k_3 - f_4 + k_4 - f_4 k_4 \end{pmatrix} \end{pmatrix} \tag{11}$$

$$\Upsilon A_1 = \begin{pmatrix} \begin{pmatrix} 1 - (1 - d_1)^{\Upsilon}, 1 - (1 - d_2)^{\Upsilon}, \\ 1 - (1 - d_3)^{\Upsilon}, 1 - (1 - d_4)^{\Upsilon} \end{pmatrix}, \\ (e_1^{\Upsilon}, e_2^{\Upsilon}, e_3^{\Upsilon}, e_4^{\Upsilon}), \\ (f_1^{\Upsilon}, f_2^{\Upsilon}, f_3^{\Upsilon}, f_4^{\Upsilon}) \end{pmatrix} \tag{12}$$

$$A_1^{\Upsilon} = \begin{pmatrix} (d_1^{\Upsilon}, d_2^{\Upsilon}, d_3^{\Upsilon}, d_4^{\Upsilon}), \\ \begin{pmatrix} 1 - (1 - e_1)^{\Upsilon}, 1 - (1 - e_2)^{\Upsilon}, \\ 1 - (1 - e_3)^{\Upsilon}, 1 - (1 - e_4)^{\Upsilon} \end{pmatrix}, \\ \begin{pmatrix} 1 - (1 - f_1)^{\Upsilon}, 1 - (1 - f_2)^{\Upsilon}, \\ 1 - (1 - f_3)^{\Upsilon}, 1 - (1 - f_4)^{\Upsilon} \end{pmatrix} \end{pmatrix} \tag{13}$$

We show the steps of the TODIM method to rank alternatives. Create the decision matrix between the criteria and alternatives. Experts use the TFNNs to evaluate the criteria and alternatives. We apply the score function to obtain crisp values. We combine the decision matrices into one matrix.

Compute the criteria weights.

The weights of criteria are computed using the average method.

Compute the normalized decision matrix for positive and negative criteria such as:

$$q_{ij} = \frac{y_{ij}}{\sum_{i=1}^{m} y_{ij}}; i = 1, \dots, m; j = 1, \dots, n \tag{14}$$

$$q_{ij} = \frac{1/\,q_{ij}}{\sum_{i=1}^{m} 1/q_{ij}}; i = 1, \dots, m; j = 1, \dots, n \tag{15}$$

Compute the relative weights

$$W_j^- = \frac{W_j}{\max W} \tag{16}$$

Obtain the dominance degree matrix such as:

$$q_i = q(D_i, D_{i'}) = \sum_{j=1}^{n} f_i(D_i, D_{i'}) \tag{17}$$

Where the f can be computed such as:

$$f_i(D_i, D_{i'}) = \begin{cases} -\frac{1}{H}\sqrt{\frac{\left(\sum_{j=1}^{n} w_j^-\right)|q_{ij}-q_{ji}|}{w_j^-}} & if\ \left(q_{ij} - q_{ji}\right) < 0 \\ 0 & if\ \left(q_{ij} - q_{ji}\right) = 0 \\ \sqrt{\frac{\left(w_j^-\right)|q_{ij}-q_{ji}|}{\sum_{j=1}^{n} w_j^-}} & if\ \left(q_{ij} - q_{ji}\right) > 0 \end{cases} \tag{18}$$

Where H refers to the attenuation factor for the losses.

Compute the overall dominance matrix.

$$S_i = \frac{f_i - \min f_i}{\max f_i - \min f_i} \tag{19}$$

3. Application

We show the application of the proposed approach to compute the criteria weights and ranking the alternatives. The proposed approach is applied for Effectiveness Evaluation of Brand Microblog Marketing Communication. We use ten criteria and ten alternatives. The criteria are: Audience Engagement Rate, Content Relevance, Message Clarity, Visual Appeal of Posts, Consistency of Posting, Audience Growth Rate, Shareability of Content, Brand Sentiment Score, Conversion Rate from Campaigns, Responsiveness to Audience Feedback. The alternatives are: Influencer Collaboration Campaign, User-Generated Content Promotion, Real-Time Event

Coverage, Hashtag Challenge Campaign, Product Launch Microblog Series, Storytelling and Brand Narrative Posts, Giveaway and Contest Campaigns, Educational or Informative Content Series, Social Issues and Corporate Social Responsibility, Interactive Polls and Surveys Strategy

Table 1. The first decision matrix.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
A_1	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))
A_2	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0.1,0.2,0.3,0.4),(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))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((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_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))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.1,0.2,0.3,0.4),(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))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((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	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.1,0.2,0.3,0.4),(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))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))
A_5	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0,0,0,0),(1,1,1,1),(1,1,1,1))
A_6	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((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))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))
A_7	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))
A_8	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((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),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))
A_9	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((1,1,1,1),(0,0,0,0),(0,0,0,0))
A_{10}	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.1,0.2,0.3,0.4),(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))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))

Table 2. The second decision matrix.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}

A1	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.1,0.2,0.3,0.4),(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))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0,0,0,0),(1,1,1,1),(1,1,1,1))
A2	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.1,0.2,0.3,0.4),(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))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))
A3	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))
A4	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))
A5	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))
A6	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))
A7	((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),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))
A8	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((1,1,1,1),(0,0,0,0),(0,0,0,0))
A9	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((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),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))
A10	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))

Table 3. The third decision matrix.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
A1	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.1,0.2,0.3,0.4),(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))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))
A2	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),

	(0,0.1,0.2,0.3))			(0.7,0.8,0.9,1))	.9),(0.4,0.6,0.7,0.9))	.7),(0.2,0.4,0.5,0.7))	),(0,0.2,0.3,0.4))	(0,0.1,0.2,0.3))		(0,0.1,0.2,0.3))
A_3	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.1,0.2,0.3,0.4),(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))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))
A_4	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))
A_5	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((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_6	((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),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))
A_7	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0.1,0.2,0.3,0.4),(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))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))
A_8	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((0.1,0.2,0.3,0.4),(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))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0,0,0,0),(1,1,1,1),(1,1,1,1))
A_9	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))
A_{10}	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((1,1,1,1),(0,0,0,0),(0,0,0,0))	((0.7,0.8,0.9,1),(0,0.1,0.2,0.3),(0,0.1,0.2,0.3))	((0.5,0.6,0.7,0.8),(0,0.2,0.3,0.4),(0,0.2,0.3,0.4))	((0.3,0.4,0.5,0.6),(0.2,0.4,0.5,0.7),(0.2,0.4,0.5,0.7))	((0.1,0.2,0.3,0.4),(0.4,0.6,0.7,0.9),(0.4,0.6,0.7,0.9))	((0,0.1,0.2,0.3),(0.7,0.8,0.9,1),(0.7,0.8,0.9,1))	((0,0,0,0),(1,1,1,1),(1,1,1,1))	((1,1,1,1),(0,0,0,0),(0,0,0,0))

Three experts create the decision matrix using the TFNNs as shown in Tables 1-3. We apply the score function to obtain crisp values. We combine the decision matrix into a single matrix. We compute the criteria weights using the average method such as: C1=0.096716059, C2=0.106728074, C3=0.088606328, C4=0.10402483, C5=0.131457749, C6=0.096015218, C7=0.09721666, C8=0.097917501, C9=0.11123348, C10=0.070084101.

Compute the normalized decision matrix for positive and negative criteria using eqs. (14 and 15) as shown in Fig 1.

Compute the relative weights using eq. (16).

Obtain the dominance degree matrix using eq. (17) as shown in Fig 2. The dominance degree matrix by the relative weights is shown in Fig 3.

Compute the overall dominance matrix using eq. (19) as shown in Fig 4. We rank the alternatives as shown in Fig 5.

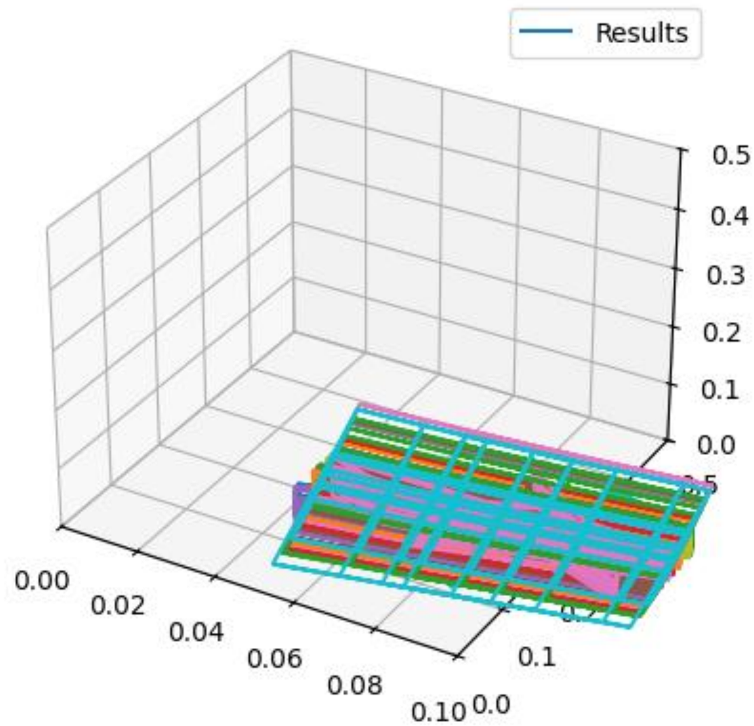

Fig 1. The normalized decision matrix.

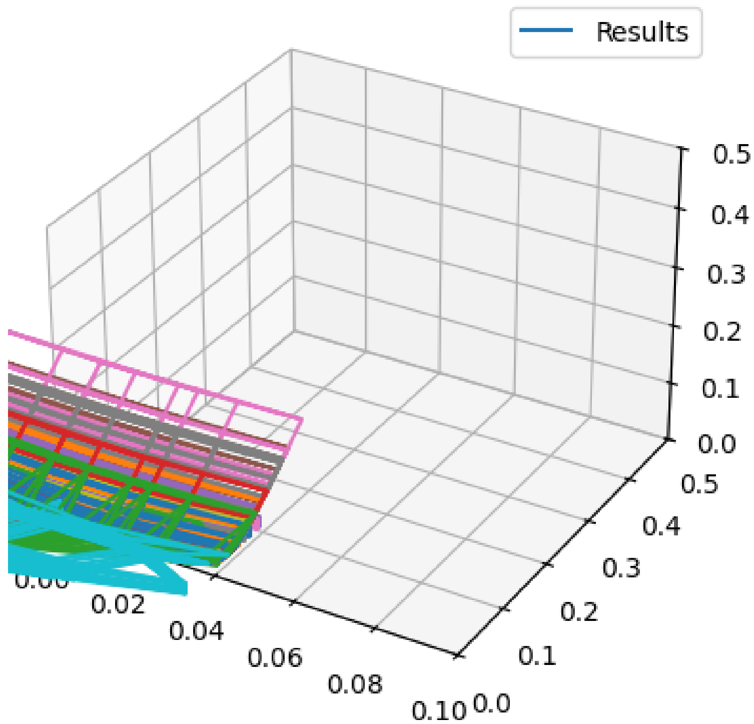

Fig 2-1. The dominance matrix.

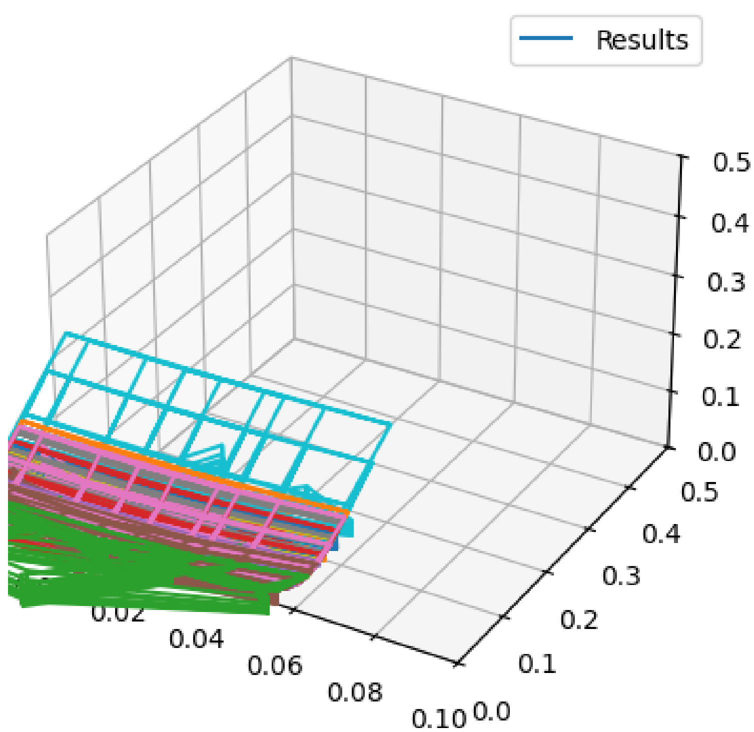

Fig 2-2. The dominance matrix.

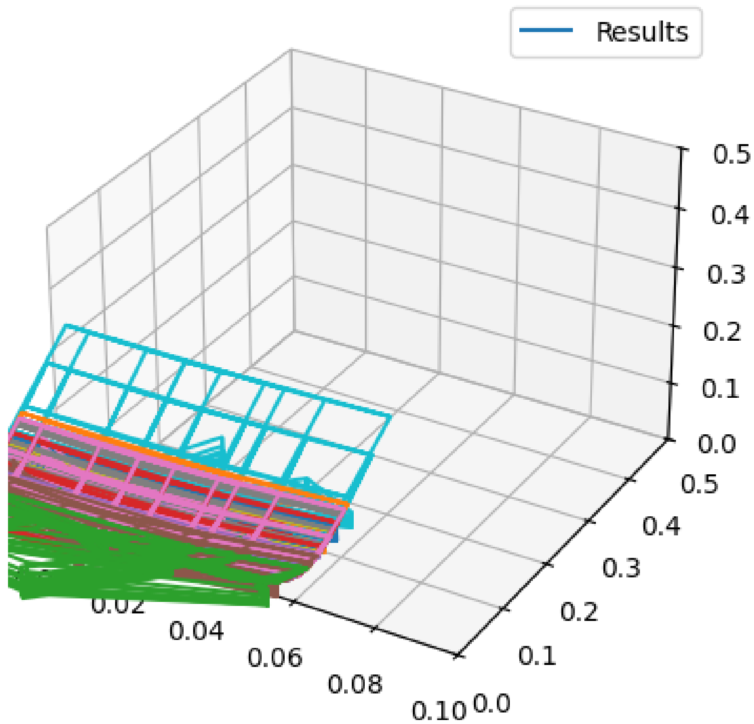

Fig 2-3. The dominance matrix.

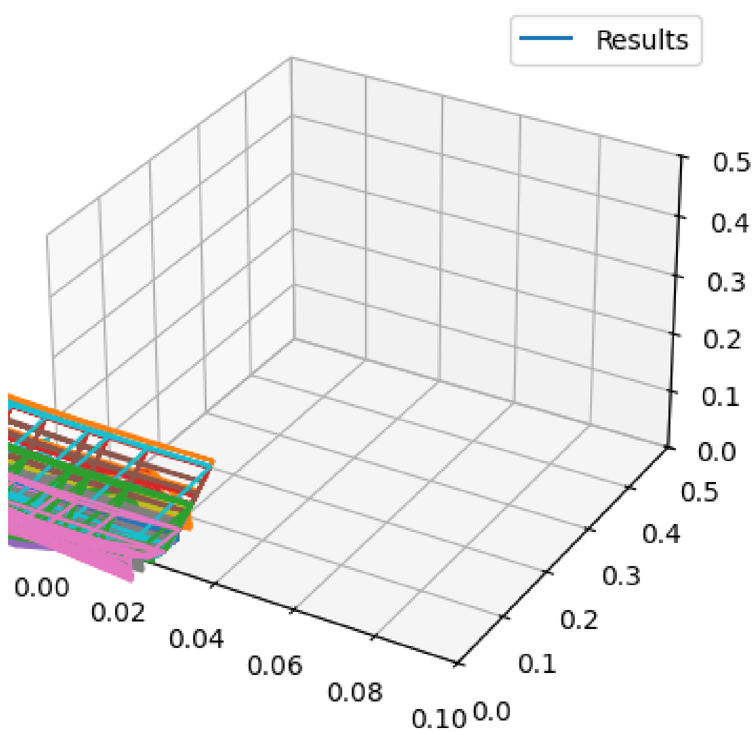

Fig 2-4. The dominance matrix.

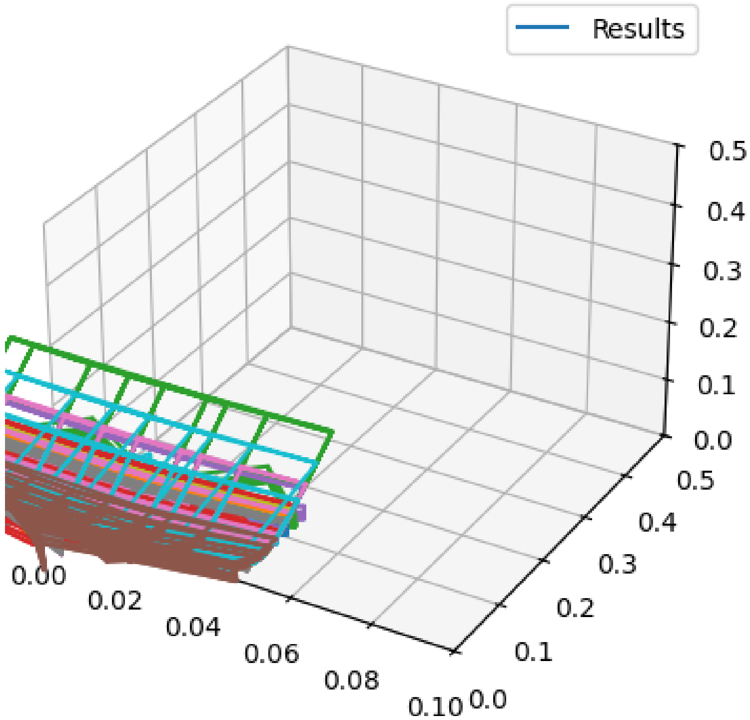

Fig 2-5. The dominance matrix.

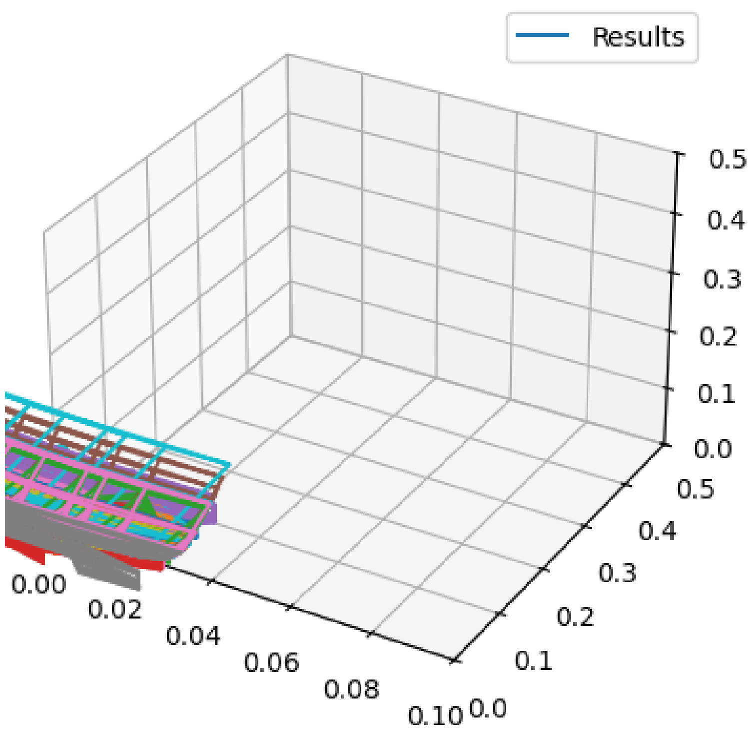

Fig 2-6. The dominance matrix.

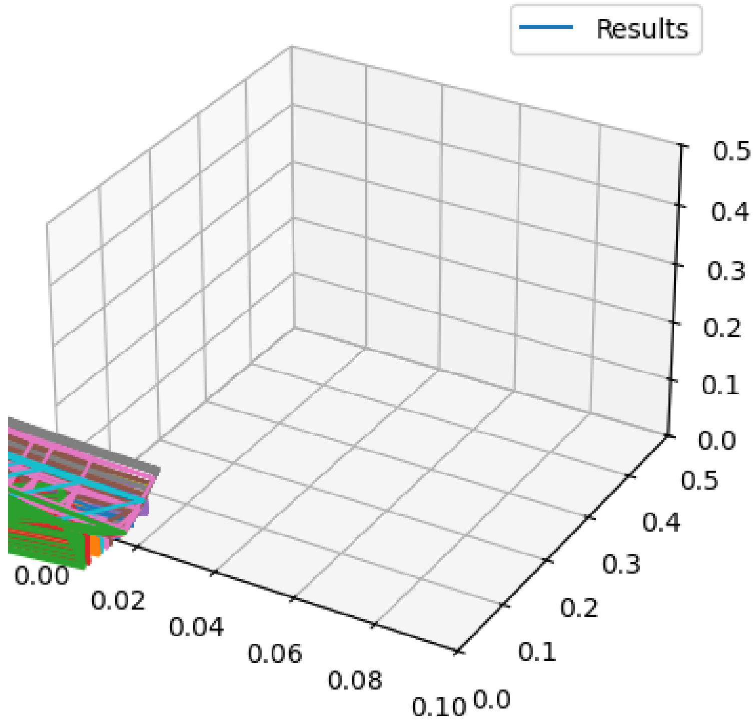

Fig 2-7. The dominance matrix.

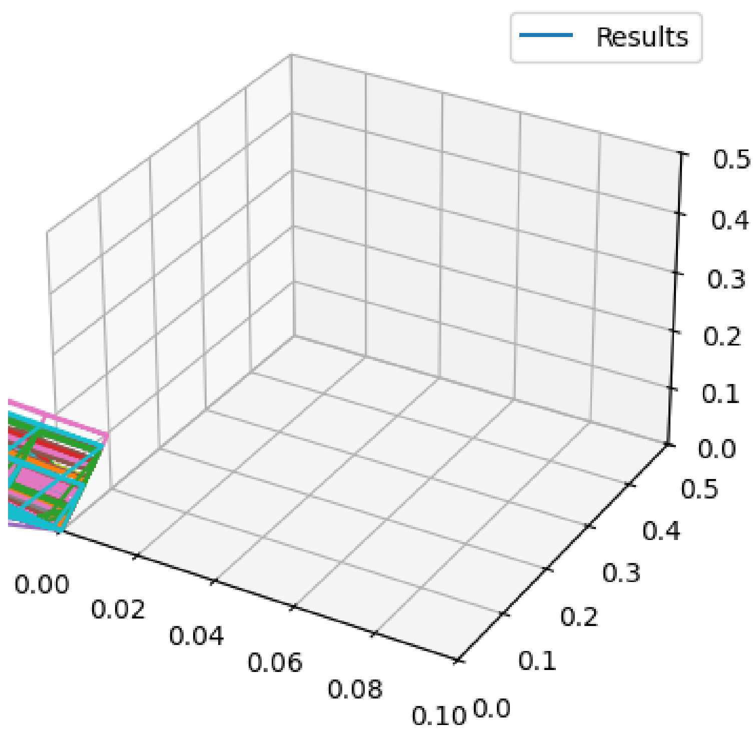

Fig 2-8. The dominance matrix.

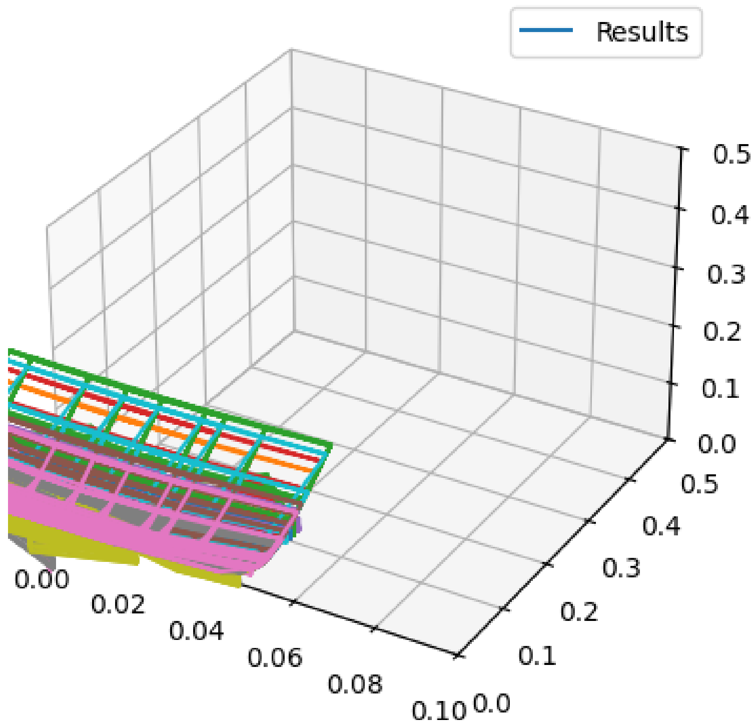

Fig 2-9. The dominance matrix.

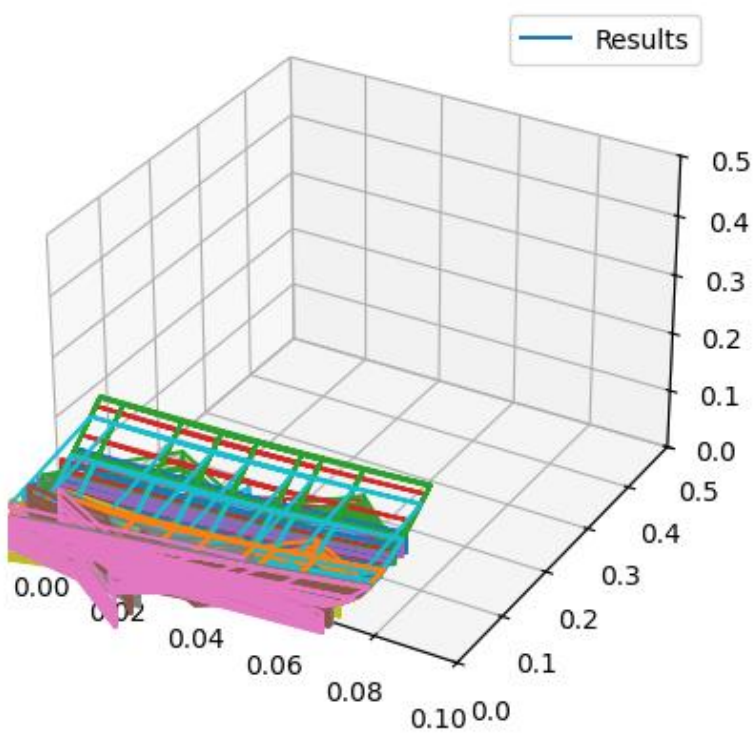

Fig 2-10. The dominance matrix.

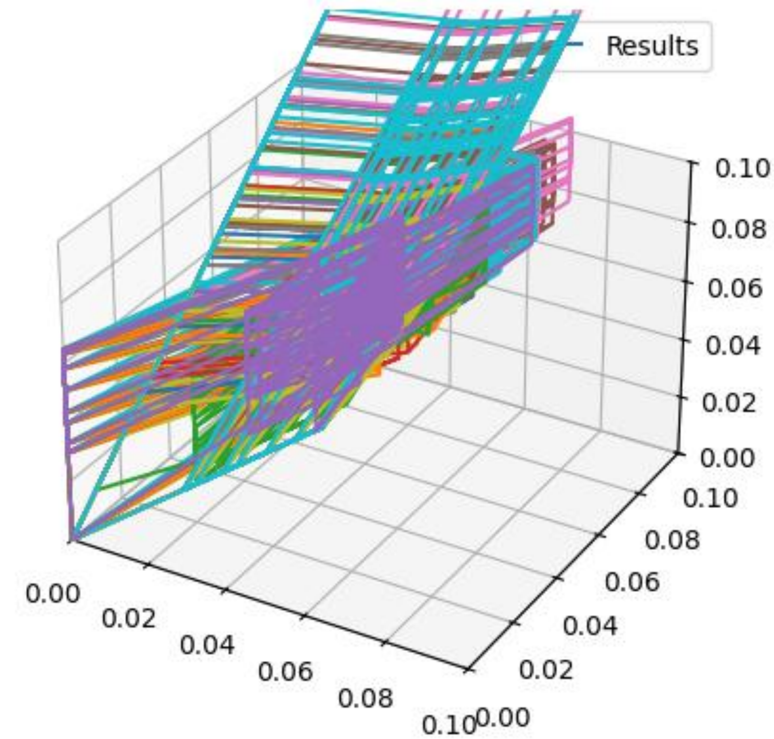

Fig 3-1. The dominance matrix by weights.

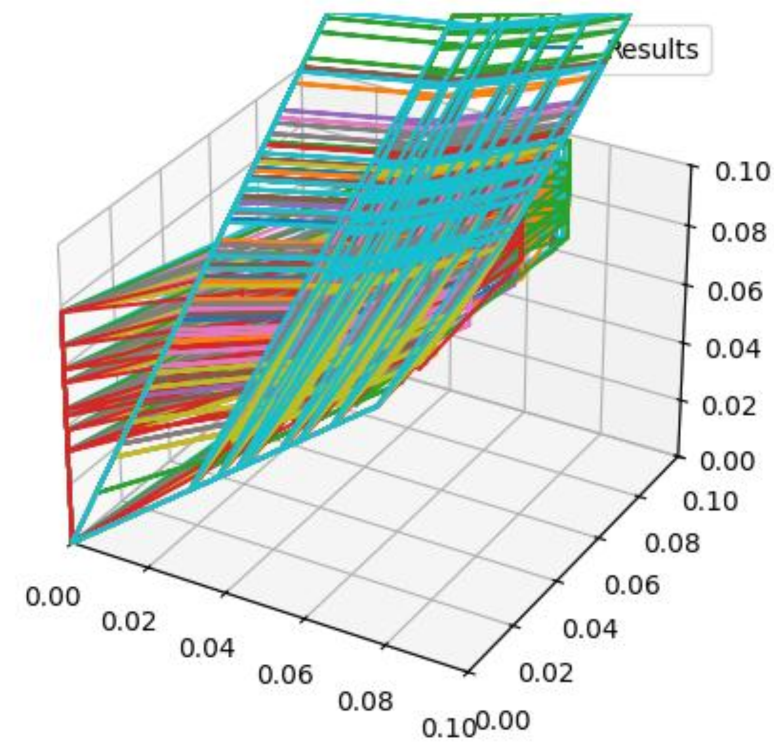

Fig 3-2. The dominance matrix by weights.

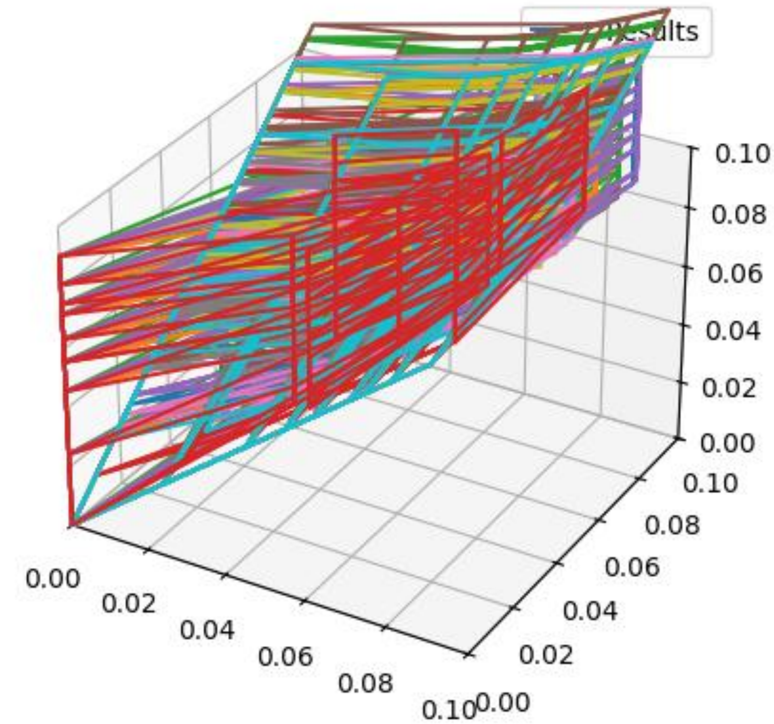

Fig 3-3. The dominance matrix by weights.

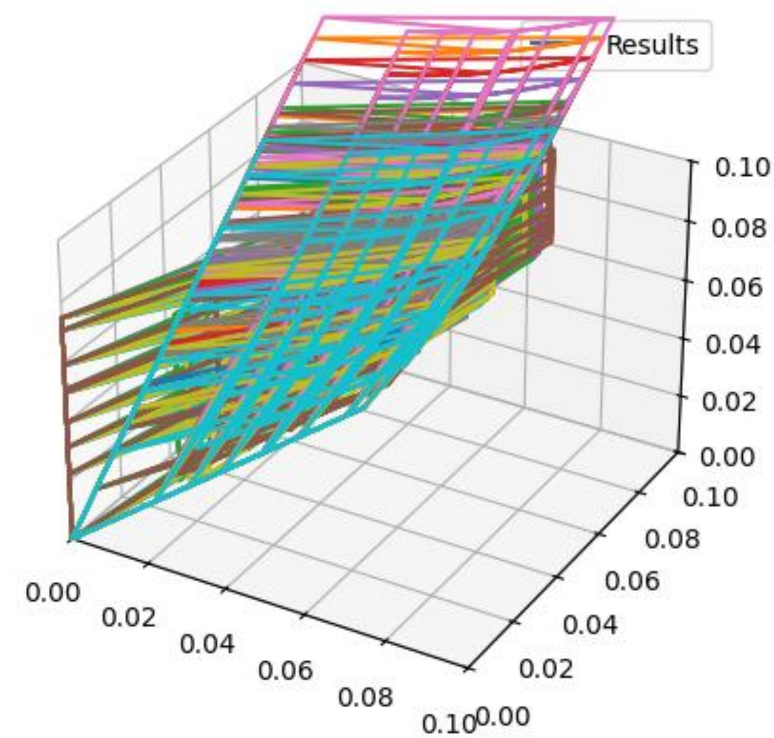

Fig 3-4. The dominance matrix by weights.

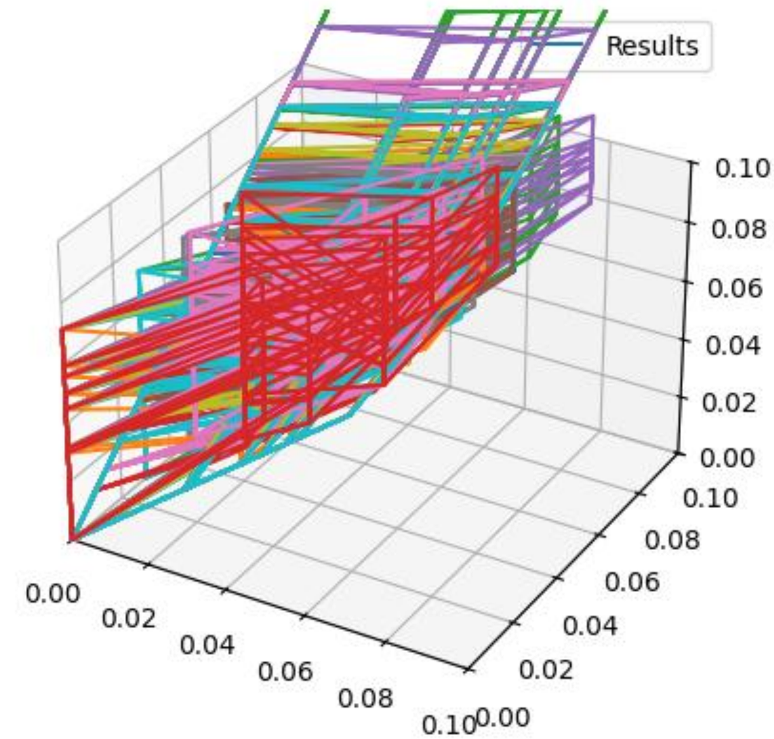

Fig 3-5. The dominance matrix by weights.

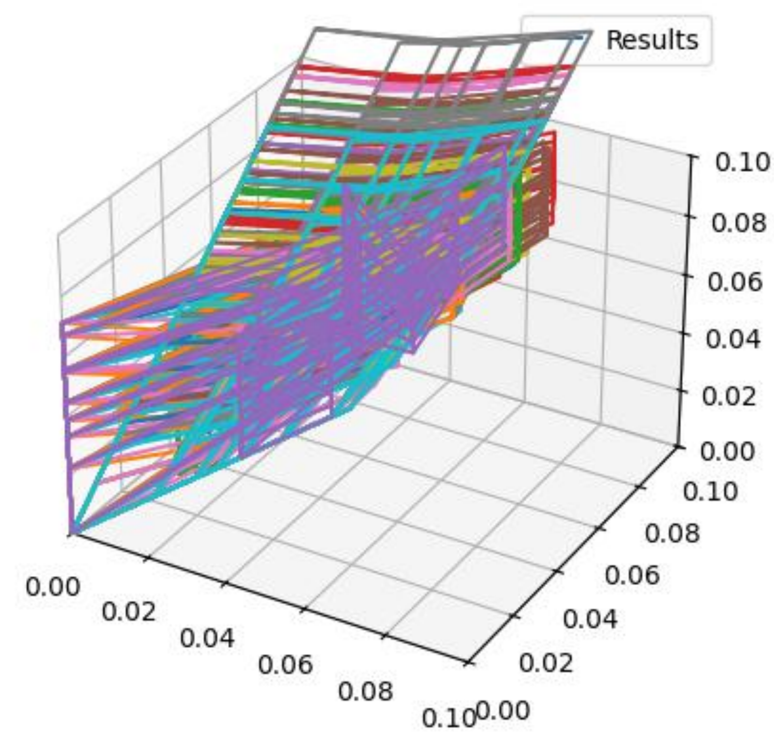

Fig 3-6. The dominance matrix by weights.

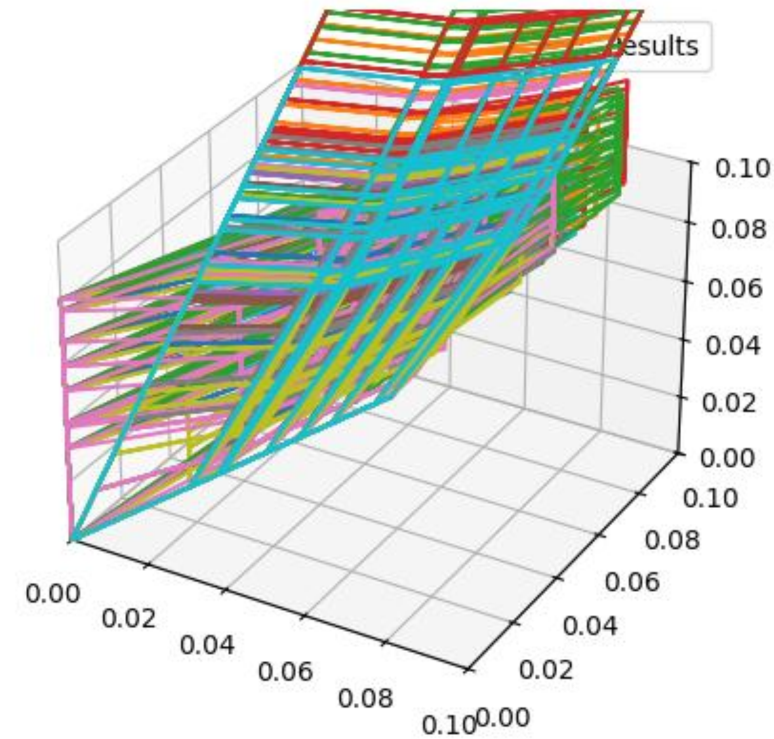

Fig 3-7. The dominance matrix by weights.

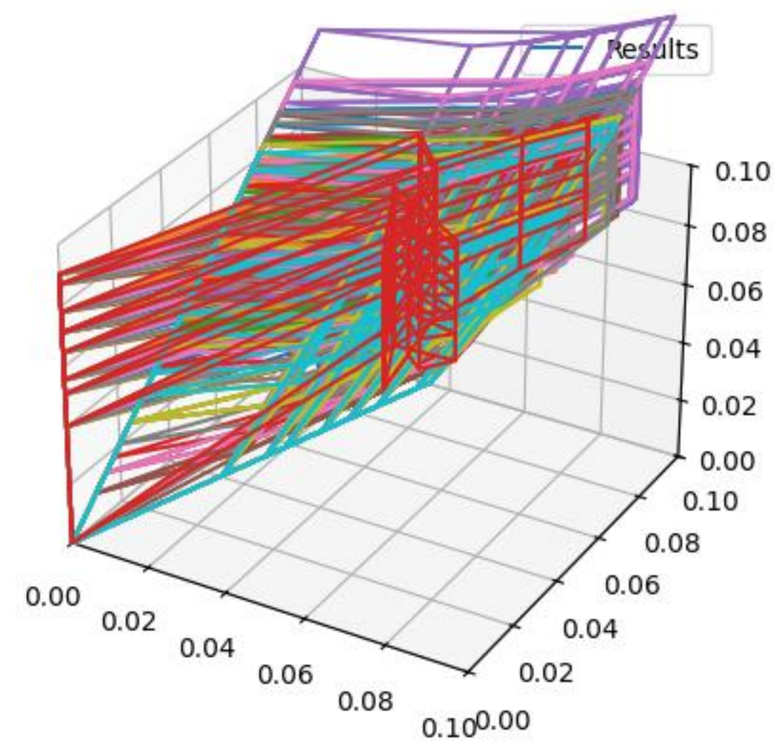

Fig 3-8. The dominance matrix by weights.

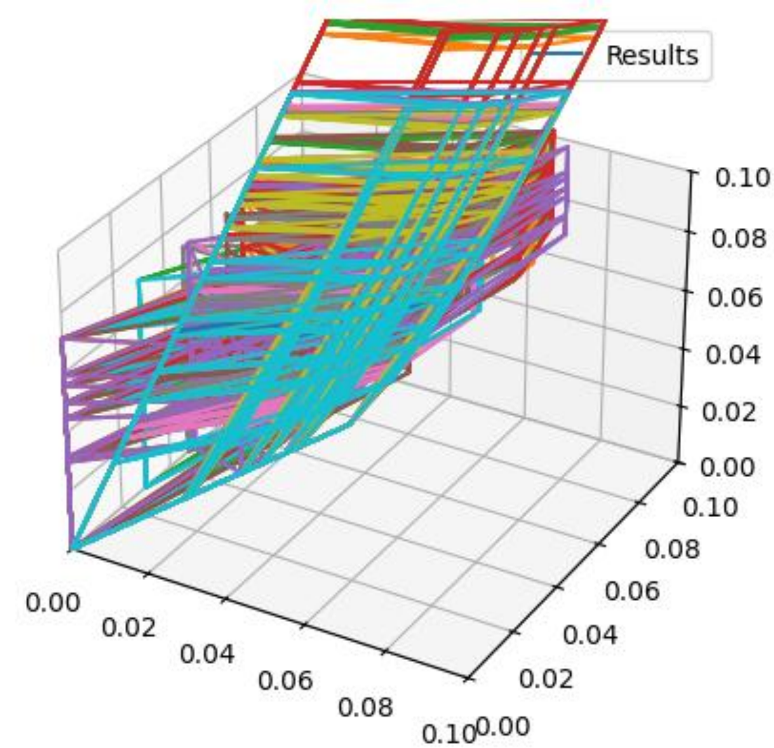

Fig 3-9. The dominance matrix by weights.

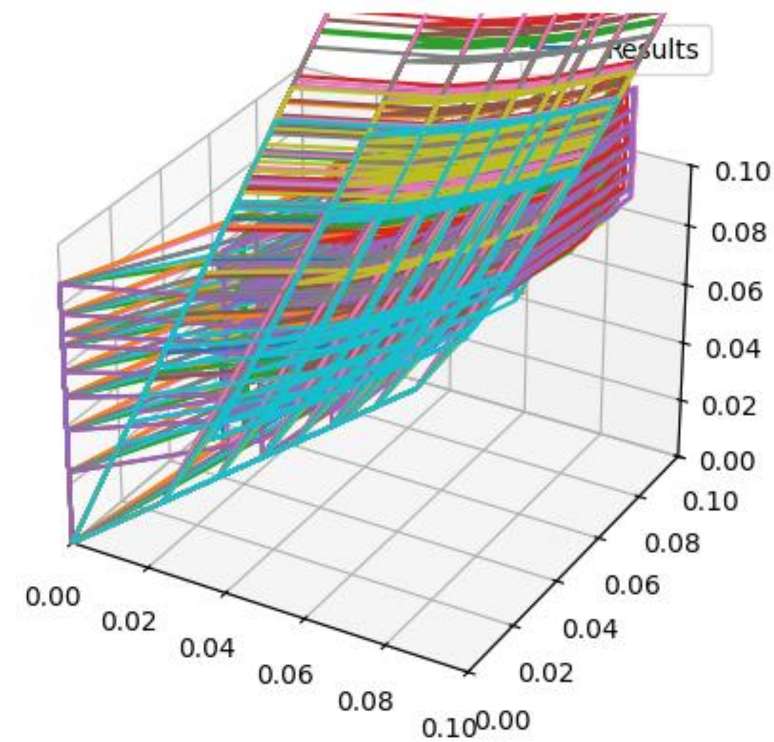

Fig 3-10. The dominance matrix by weights.

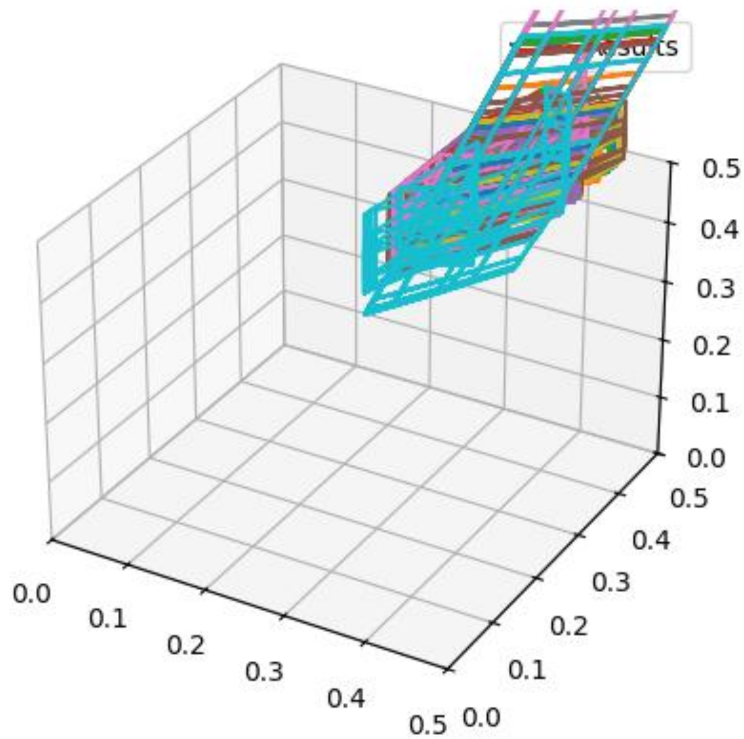

Fig 4. The overall dominance.

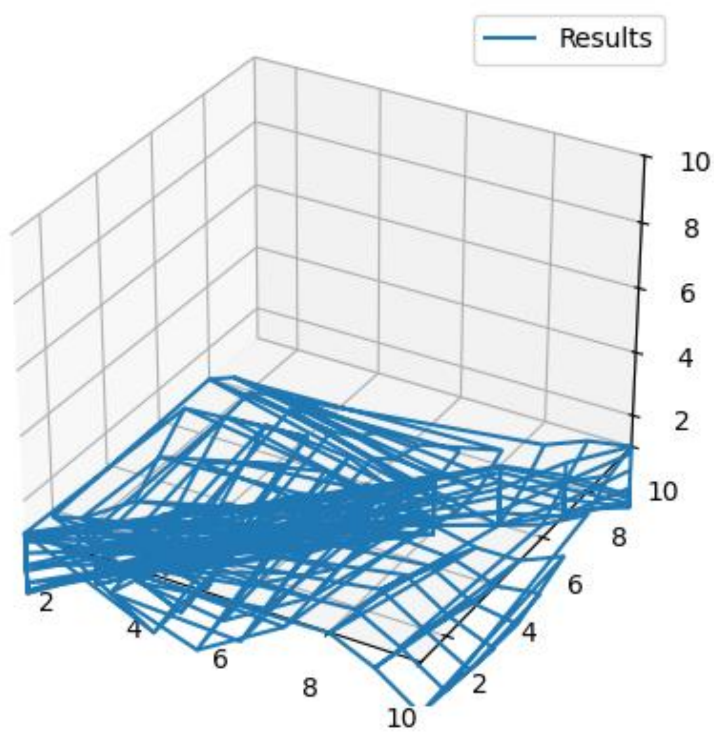

Fig 5. The rank of alternatives.

4. Conclusions

Using microblogging platforms to effectively communicate a brand is a dynamic process that is driven by several interconnected aspects. Beyond superficial engagement numbers, a thorough assessment must consider posting tactics, emotional effect, conversion success, and content relevancy. Brands may make data-driven enhancements and obtain deeper insights into the efficacy of their microblog marketing by implementing a multifaceted approach. For companies looking to maximize their communication tactics in the fiercely competitive and constantly changing digital market, this report provides a solid basis. We used the MCDM methodology such as TODIM methodology to rank alternatives. We used ten criteria and ten alternatives to validate the proposed approach. The results show alternative 1 is the best and alternative 6 is the worst.

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