University of New Mexico

High-Quality Development Evaluation of Cultural and Tourism Integration Empowered by the Digital Economy under Double Valued Neutrosophic Sets

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Abstract: This study proposed a decision-making approach to evaluate the cultural and tourism integration empowered by the digital economy. Two methods are used in this study, such as Entropy method to compute the criteria weights and the MABAC method to rank the alternatives. These methods are used under the neutrosophic sets. Neutrosophic sets (NSs) are used to represent ambiguous, inconsistent, and unpredictable data that arise in practical issues. Indeterminacy leaning toward truth membership and indeterminacy leaning toward falsity membership are two separate components of double-valued neutrosophic sets (DVNSs), a variant of NSs. Three experts have evaluated the criteria and alternatives. Ten criteria and six alternatives are used in this study. We show the Digital Infrastructure criterion has the highest weight.

Keywords: Neutrosophic Sets; Double Valued Neutrosophic sets; Entropy Method; MABAC Method; Cultural and Tourism; Digital Economy.

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1. Introduction

Zadeh proposed the fuzzy set (FS) theory, which has been successfully used in many different domains. A single number within the closed interval [0,1] represents an element's degree of membership in FSs[1], [2]. Nevertheless, in practical scenarios, it could not always be certain that an element's degree of non-membership in the FS is equivalent to one minus degree of membership. In other words, there might be some hesitancy. For this reason, Atanassov proposed the idea of intuitionistic fuzzy sets (IFSs), which are a generalization of FSs. The inability to describe the degree of hesitation individually is the only drawback of IFSs. To get beyond this flaw, as a generalization of IFSs and FSs, Smarandache introduced the idea of neutrosophic sets (NSs). Subclasses of NSs, including simplified neutrosophic sets (SNS), interval neutrosophic sets (INSs), and single-valued neutrosophic sets (SVNSs), were then defined by various scholars[3], [4]. Let's look at an example where we ask someone about a statement, and that person may be certain that the statement has a 0.8 chance of being true and a 0.4 chance of being false. Furthermore, 0.3 indicates that he or she is unsure but believes it to be true, and 0.4 indicates that he or she is unsure but believes it to be untrue. Kandasamy developed the idea of double-valued neutrosophic sets (DVNSs) as a substitute for NSs to handle this type of data, giving indeterminacy greater clarity and dependability. DVNSs distinguish between two types of indeterminacy: indeterminacy that leans toward truth membership and indeterminacy that leans toward falsity membership[5], [6]. Smarandache performed the first refinement of neutrosophic sets, splitting the truth value (T) into different sub-truths (T1, T2, etc.), splitting the indeterminacy (I) into different sub-indeterminacies (I1, I2, etc.), and splitting the sub-falsehood (F) into F1, F2, etc. A particular instance of n-valued neutrosophic sets is DVNSs[7], [8]. To give indeterminacy in this work greater accuracy and precision, the indeterminacy found in the neutrosophic set has been divided into two membership-based categories: indeterminacy leaning toward false membership and indeterminacy leaning toward truth membership. Indeterminacy leaning towards truth is the word used to describe indeterminacy that can be recognized as having a greater proportion of the truth value than the false value but cannot be categorized as truth. It is deemed to be indeterminacy leaning towards false when it is possible to identify indeterminacy that is more of a false value than the truth value but cannot be categorized as false[9], [10].

Since it is unclear whether indeterminacy favors truth or false membership, the single value of indeterminacy is ambiguous. The results or outcome will undoubtedly be better than when a single value is employed when the indeterminacy is favoring or leaning toward truth and when it is favoring or leaning toward false. Both truth-leaning and falsity-leaning indeterminacy make the scenario's indeterminacy more exact and accurate. A Double-Valued Neutrosophic Set (DVNS) is the definition of this modified neutrosophic set[11], [12].

Since there is currently little research on DVNSs, it is important to examine certain fundamental theories. Accordingly, this article's objectives were to:

(1) Proposed two decision-making methods to evaluate the decision-making issue.

(2) The entropy method is used to compute the criteria weights and the MABAC method is used to rank the alternatives.

(3) Ten criteria and six alternatives are used in this study.

(4) Sensitivity analysis is conducted to show the rank of alternatives under different criteria weights.

The rest of this article is organized as follows: Section 2 reviews some fundamental ideas about DVNSs; Section 3 proposes the two methods such as entropy to compute the criteria weights and the MABAC method to rank the alternatives; Section 4 shows the results of two methods; and Section 6 shows the conclusions of this study.

2. Double Valued Neutrosophic Set (DVNS)

We can define the DVNS with four membership functions such as truth $T_A(x)$, indeterminacy toward truth function $I_{TA}(x)$, indeterminacy toward falsity function $I_{FA}(x)$, and falsity function $F_A(x)$[8], [9].

$$\left(T_A(x), I_{TA}(x), I_{FA}(x), F_A(x)\right) \in [0,1] \quad (1)$$

$$0 \leq T_A(x), I_{TA}(x), I_{FA}(x), F_A(x) \leq 4 \quad (2)$$

$$A = \{(x, T_A(x), I_{TA}(x), I_{FA}(x), F_A(x) | x \in X)\} \quad (3)$$

Definition 1.

The complement of the DVNS can be defined as:

$$T_{c(A)}(x) = F_A(x) \quad (4)$$

$$I_{Tc(A)}(x) = 1 - I_{TA}(x) \quad (5)$$

$$I_{Fc(A)}(x) = 1 - I_{FA}(x) \quad (6)$$

$$F_{c(A)}(x) = T_A(x) \quad (7)$$

Definition 2.

The DVNS A is contained in DVNS B $A \sqsubseteq B$ if and only if

$$T_A(x) \leq T_B(x) \quad (8)$$

$$I_{TA}(x) \leq I_{TB}(x) \quad (9)$$

$$I_{FA}(x) \leq I_{FB}(x) \quad (10)$$

$$F_A(x) \geq F_B(x) \quad (11)$$

Definition 3.

The union of two DVNSs can be defined as:

$$T_c(x) = \max\left(T_A(x), T_B(x)\right) \quad (12)$$

$$I_{Tc}(x) = \max\left(I_{TA}(x), I_{TB}(x)\right) \quad (13)$$

$$I_{Fc}(x) = \max\left(I_{FA}(x), I_{FB}(x)\right) \quad (14)$$

$$F_c(x) = \min\left(F_A(x), F_B(x)\right) \quad (15)$$

Definition 4.

The intersection of two DVNSs can be defined as:

$$T_c(x) = \min\left(T_A(x), T_B(x)\right) \quad (16)$$

$$I_{Tc}(x) = \min\left(I_{TA}(x), I_{TB}(x)\right) \tag{17}$$

$$I_{Fc}(x) = \min\left(I_{FA}(x), I_{FB}(x)\right) \tag{18}$$

$$F_c(x) = \min\left(F_A(x), F_B(x)\right) \tag{19}$$

Definition 5.

The difference between the two DVNSs can be defined as:

$$T_c(x) = \min\left(T_A(x), F_B(x)\right) \tag{20}$$

$$I_{Tc}(x) = \min\left(I_{TA}(x), 1 - I_{TB}(x)\right) \tag{21}$$

$$I_{Fc}(x) = \min\left(I_{FA}(x), 1 - I_{FB}(x)\right) \tag{22}$$

$$F_c(x) = \min\left(F_A(x), T_B(x)\right) \tag{23}$$

Definition 6.

The falsity favorite of DVNS can be defined as:

$$T_B(x) = T_A(x) \tag{24}$$

$$I_{TB}(x) = 0 \tag{25}$$

$$I_{FB}(x) = 0 \tag{26}$$

$$F_B(x) = \min(F_A(x) + I_{FA}(x), 1) \tag{28}$$

Definition 7.

The truth favorite of DVNS can be defined as:

$$T_B(x) = \min(T_A(x) + I_{TA}(x), 1) \tag{29}$$

$$I_{TB}(x) = 0 \tag{30}$$

$$I_{FB}(x) = 0 \tag{31}$$

$$F_B(x) = F_A(x) \tag{32}$$

Definition 8.

The indeterminate nature of DVNS can be defined as:

$$T_B(x) = T_A(x) \tag{33}$$

$$I_{TB}(x) = \min(I_{TA}(x) + I_{TB}(x), 1) \tag{34}$$

$$I_{FB}(x) = 0 \tag{35}$$

$$F_B(x) = F_A(x) \tag{36}$$

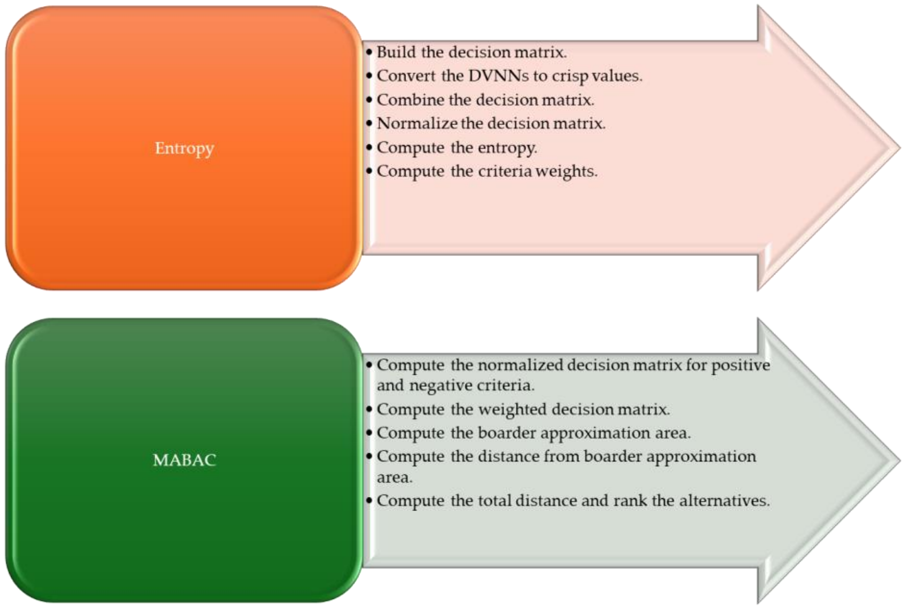

Figure 1. The DVNS-Entropy-MABAC Method.

3. DVNS-Entropy-MABAC Approach

This section shows the steps of the DVNS-Entropy-MABAC approach to the MCDM problem. The entropy method is used to compute the criteria weights. The MABAC method is used to rank alternatives[13], [14]. Fig 1 shows the steps of the proposed approach.

Step 1. Build the decision matrix.

We used the double-value neutrosophic numbers (DVNNs) to evaluate the criteria and alternatives to build the decision matrix.

Step 2. Convert the DVNNs to crisp values.

Step 3. Combine the decision matrix.

The decision matrix is combined into a single matrix.

Step 4. Normalize the decision matrix.

$$q_{ij} = \frac{r_{ij}}{\sum_{i=1}^{m} q_{ij}} \quad (37)$$

Step 5. Compute the entropy

$$e_j = -h\sum_{i=1}^{m} q_{ij} \ln q_{ij} \;\; and \;\; h = \frac{1}{\ln(m)} \quad (38)$$

Step 6. Compute the criteria weights.

$$w_j = \frac{1-e_j}{\sum_{j=1}^{n}(1-e_j)} \quad (39)$$

Step 7. Apply the steps of the MABAC method to rank the alternatives. Compute the normalized decision matrix for positive and negative criteria such as:

$$d_{ij} = \frac{r_{ij} - \min r_i}{\max r_i - \min r_i} \tag{40}$$

$$d_{ij} = \frac{r_{ij} - \max r_i}{\min r_i - \max r_i} \tag{41}$$

Step 8. Compute the weighted decision matrix

$$O_{ij} = w_j + w_j d_{ij} \tag{42}$$

Step 9. Compute the boarder approximation area

$$k_j = \left(\prod_{i=1}^{m} O_{ij}\right)^{\frac{1}{m}} \tag{43}$$

Step 10. Compute the distance from k_i

$$T_{ij} = Q_{ij} - k_i \tag{44}$$

Step 11. Compute the total distance and rank the alternatives

$$S_i = \sum_{j=1}^{n} T_{ij} \tag{45}$$

4. Illustrative Example

The digital economy plays a vital role in enabling the high-quality development of cultural and tourism integration. By leveraging cutting-edge technologies such as big data, artificial intelligence, and blockchain, it enhances the efficiency, innovation, and sustainability of cultural and tourism industries. Digital platforms enable better resource allocation, providing tourists with personalized experiences and seamless services. Smart tourism applications, such as virtual reality (VR) and augmented reality (AR), allow the immersive exploration of cultural heritage, enriching the visitor experience while preserving historical assets. The digital economy also fosters new business models, such as online travel services, digital marketing, and e-commerce for cultural products, expanding market reach and boosting revenue. Data-driven insights improve decision-making for destinations, aiding in the optimization of tourism capacity and environmental sustainability. Moreover, digital tools promote cultural exchange by making intangible heritage more accessible worldwide. Evaluating this integration focuses on indicators such as technological innovation, cultural preservation, economic impact, and consumer satisfaction. High-quality development is reflected in the sustainability of tourism ecosystems, the depth of cultural engagement, and the balance between economic growth and cultural heritage protection. Ultimately, the digital economy empowers the cultural and tourism sectors to align with the demands of modern consumers, driving growth and innovation. This section shows the results of the two MCDM methods to compute the criteria weights and rank the alternatives. Three experts and decision-makers who have experience in the field of the MCDM issue evaluated the criteria and alternatives. We gathered ten criteria and six alternatives from the previous studies as shown in Fig 2. Then we evaluated the decision matrix by the DVNNs as shown in Tables 1-3. Then we obtained crisp values. Then we combined these values into a single matrix.

Table 1. The first DVNNs

	A_1	A_2	A_3	A_4	A_5	A_6
C_1	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.9, 0.2, 0.3, 0.0)	(0.5, 0.1, 0.2, 0.4)	(0.2, 0.4, 0.3, 0.4)	(0.4, 0.2, 0.3, 0.4)
C_2	(0.8, 0.1, 0.2, 0.1)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.9, 0.2, 0.3, 0.0)	(0.3, 0.2, 0.1, 0.5)	(0.8, 0.1, 0.2, 0.1)
C_3	(0.6, 0.3, 0.2, 0.3)	(0.2, 0.4, 0.3, 0.4)	(0.3, 0.2, 0.1, 0.5)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.6, 0.3, 0.2, 0.3)
C_4	(0.7, 0.2, 0.3, 0.1)	(0.4, 0.2, 0.3, 0.4)	(0.8, 0.1, 0.2, 0.1)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.7, 0.2, 0.3, 0.1)
C_5	(0.4, 0.2, 0.3, 0.4)	(0.7, 0.2, 0.3, 0.1)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.5, 0.1, 0.2, 0.4)	(0.4, 0.2, 0.3, 0.4)
C_6	(0.2, 0.4, 0.3, 0.4)	(0.6, 0.3, 0.2, 0.3)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.4, 0.3, 0.4)
C_7	(0.5, 0.1, 0.2, 0.4)	(0.8, 0.1, 0.2, 0.1)	(0.4, 0.2, 0.3, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)
C_8	(0.9, 0.2, 0.3, 0.0)	(0.3, 0.2, 0.1, 0.5)	(0.2, 0.4, 0.3, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.9, 0.2, 0.3, 0.0)
C_9	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.5, 0.1, 0.2, 0.4)	(0.2, 0.4, 0.3, 0.4)	(0.6, 0.3, 0.2, 0.3)	(0.3, 0.2, 0.1, 0.5)
C_{10}	(0.8, 0.1, 0.2, 0.1)	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.7, 0.2, 0.3, 0.1)	(0.8, 0.1, 0.2, 0.1)

Table 2. The second DVNNs

	A_1	A_2	A_3	A_4	A_5	A_6
C_1	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.3, 0.2, 0.1, 0.5)	(0.4, 0.2, 0.3, 0.4)
C_2	(0.8, 0.1, 0.2, 0.1)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.2, 0.4, 0.3, 0.4)	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)
C_3	(0.6, 0.3, 0.2, 0.3)	(0.2, 0.4, 0.3, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.9, 0.2, 0.3, 0.0)	(0.3, 0.2, 0.1, 0.5)
C_4	(0.7, 0.2, 0.3, 0.1)	(0.2, 0.4, 0.3, 0.4)	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.7, 0.2, 0.3, 0.1)
C_5	(0.4, 0.2, 0.3, 0.4)	(0.2, 0.4, 0.3, 0.4)	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.3, 0.2, 0.1, 0.5)	(0.4, 0.2, 0.3, 0.4)
C_6	(0.2, 0.4, 0.3, 0.4)	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.4, 0.3, 0.4)
C_7	(0.5, 0.1, 0.2, 0.4)	(0.2, 0.4, 0.3, 0.4)	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.3, 0.2, 0.1, 0.5)	(0.5, 0.1, 0.2, 0.4)
C_8	(0.9, 0.2, 0.3, 0.0)	(0.3, 0.2, 0.1, 0.5)	(0.2, 0.4, 0.3, 0.4)	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.3, 0.2, 0.1, 0.5)
C_9	(0.3, 0.2, 0.1, 0.5)	(0.9, 0.2, 0.3, 0.0)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)
C_{10}	(0.8, 0.1, 0.2, 0.1)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.3, 0.2, 0.1, 0.5)

Table 3. The third DVNNs

	A_1	A_2	A_3	A_4	A_5	A_6
C_1	(0.2, 0.4, 0.3, 0.4)	(0.6, 0.3, 0.2, 0.3)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.2, 0.4, 0.3, 0.4)	(0.4, 0.2, 0.3, 0.4)
C_2	(0.8, 0.1, 0.2, 0.1)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.7, 0.2, 0.3, 0.1)	(0.3, 0.2, 0.1, 0.5)	(0.8, 0.1, 0.2, 0.1)
C_3	(0.6, 0.3, 0.2, 0.3)	(0.2, 0.4, 0.3, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.7, 0.2, 0.3, 0.1)	(0.3, 0.2, 0.1, 0.5)
C_4	(0.7, 0.2, 0.3, 0.1)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.6, 0.3, 0.2, 0.3)	(0.7, 0.2, 0.3, 0.1)	(0.3, 0.2, 0.1, 0.5)
C_5	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.6, 0.3, 0.2, 0.3)	(0.7, 0.2, 0.3, 0.1)	(0.3, 0.2, 0.1, 0.5)	(0.4, 0.2, 0.3, 0.4)
C_6	(0.2, 0.4, 0.3, 0.4)	(0.6, 0.3, 0.2, 0.3)	(0.7, 0.2, 0.3, 0.1)	(0.3, 0.2, 0.1, 0.5)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.4, 0.3, 0.4)
C_7	(0.5, 0.1, 0.2, 0.4)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.6, 0.3, 0.2, 0.3)	(0.7, 0.2, 0.3, 0.1)	(0.3, 0.2, 0.1, 0.5)
C_8	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.7, 0.2, 0.3, 0.1)	(0.3, 0.2, 0.1, 0.5)	(0.8, 0.1, 0.2, 0.1)	(0.9, 0.2, 0.3, 0.0)
C_9	(0.3, 0.2, 0.1, 0.5)	(0.9, 0.2, 0.3, 0.0)	(0.2, 0.1, 0.2, 0.7)	(0.7, 0.2, 0.3, 0.1)	(0.3, 0.2, 0.1, 0.5)	(0.3, 0.2, 0.1, 0.5)
C_{10}	(0.8, 0.1, 0.2, 0.1)	(0.5, 0.1, 0.2, 0.4)	(0.2, 0.4, 0.3, 0.4)	(0.6, 0.3, 0.2, 0.3)	(0.7, 0.2, 0.3, 0.1)	(0.3, 0.2, 0.1, 0.5)

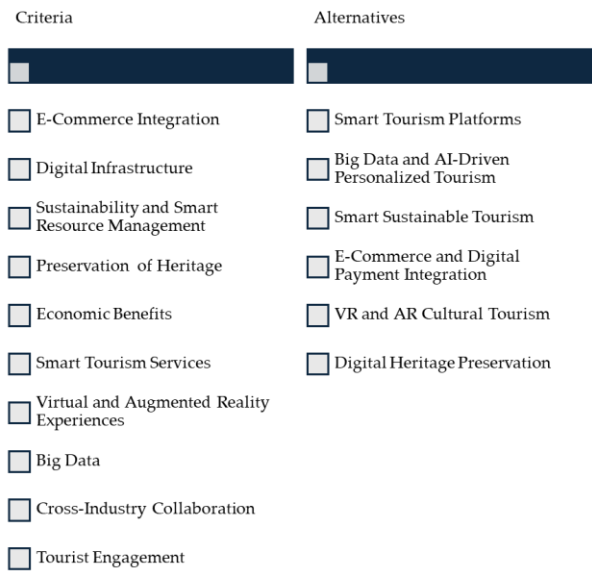

Figure 2. The MCDM criteria and alternatives.

Eq. (37) is used to normalize the decision matrix by the entropy method as shown in Table 4. Then we used Eq. (38) to compute the entropy value. Then we compute the criteria weights by using Eq. (39) as shown in Fig 3.

Table 4. The normalized DVNNs using the Entropy method.

	A_1	A_2	A_3	A_4	A_5	A_6
C_1	0.197889	0.137203	0.200528	0.163588	0.150396	0.150396
C_2	0.188406	0.202899	0.101449	0.173913	0.140097	0.193237
C_3	0.18509	0.14653	0.192802	0.143959	0.172237	0.159383
C_4	0.186104	0.163772	0.148883	0.198511	0.131514	0.171216
C_5	0.174603	0.153439	0.190476	0.177249	0.153439	0.150794
C_6	0.14467	0.172589	0.205584	0.119289	0.213198	0.14467
C_7	0.153453	0.186701	0.13555	0.204604	0.184143	0.13555
C_8	0.205379	0.127139	0.154034	0.163814	0.166259	0.183374
C_9	0.171429	0.181818	0.161039	0.150649	0.163636	0.171429
C_{10}	0.191646	0.167076	0.149877	0.142506	0.191646	0.157248

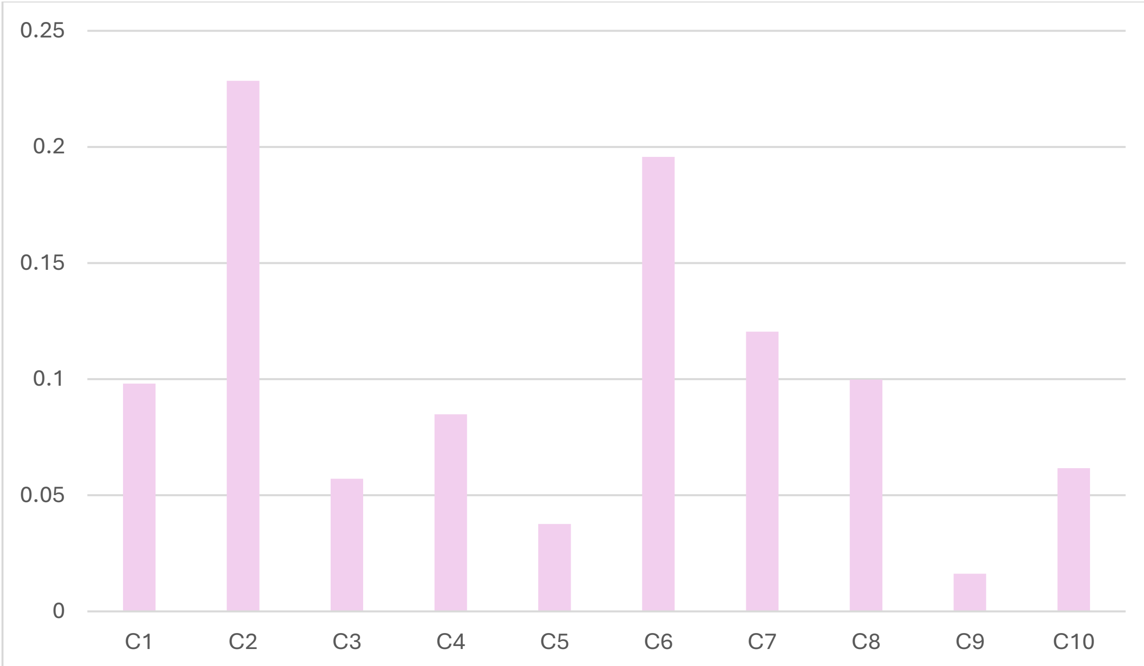

Figure 3. The criteria weights.

Then we used Eq. (40) to normalize the decision matrix by the MABAC method as shown in Table 5. Then we used Eq. (42) to compute the weighted decision matrix as shown in Table 6. Then we used Eq. (43) to compute the values of k_j. Then we used Eq. (44) to compute the distance from k_j as shown in Table 7. Then we compute the total distance as shown in Table 8. Then we ranked the alternatives as shown in Fig 4.

Table 5. The normalized DVNNs using the MABAC method.

	A_1	A_2	A_3	A_4	A_5	A_6
C_1	0.958333	0	1	0.416667	0.208333	0.208333
C_2	0.857143	1	0	0.714286	0.380952	0.904762
C_3	0.842105	0.052632	1	0	0.578947	0.315789
C_4	0.814815	0.481481	0.259259	1	0	0.592593
C_5	0.6	0.066667	1	0.666667	0.066667	0
C_6	0.27027	0.567568	0.918919	0	1	0.27027
C_7	0.259259	0.740741	0	1	0.703704	0
C_8	1	0	0.34375	0.46875	0.5	0.71875
C_9	0.666667	1	0.333333	0	0.416667	0.666667
C_{10}	1	0.5	0.15	0	1	0.3

Table 6. The weighted DVNNs using the MABAC method.

	A_1	A_2	A_3	A_4	A_5	A_6
C_1	0.192015	0.09805	0.1961	0.138904	0.118477	0.118477
C_2	0.424324	0.456965	0.228482	0.391684	0.315523	0.435204

C_3	0.105243	0.060139	0.114263	0.057132	0.090208	0.075173
C_4	0.154021	0.125731	0.106872	0.169738	0.084869	0.135161
C_5	0.060166	0.040111	0.075207	0.062673	0.040111	0.037604
C_6	0.248578	0.306755	0.375511	0.195689	0.391378	0.248578
C_7	0.151706	0.209712	0.120473	0.240946	0.20525	0.120473
C_8	0.199674	0.099837	0.134156	0.146635	0.149755	0.171595
C_9	0.026996	0.032395	0.021596	0.016197	0.022946	0.026996
C_{10}	0.123335	0.092502	0.070918	0.061668	0.123335	0.080168

Table 7. The distance from k_j.

	A_1	A_2	A_3	A_4	A_5	A_6
C_1	0.05306	-0.0409	0.057145	-5.1E-05	-0.02048	-0.02048
C_2	0.058857	0.091497	-0.13699	0.026216	-0.04994	0.069737
C_3	0.02435	-0.02075	0.033371	-0.02376	0.009316	-0.00572
C_4	0.027874	-0.00042	-0.01928	0.04359	-0.04128	0.009014
C_5	0.00938	-0.01067	0.024422	0.011887	-0.01067	-0.01318
C_6	-0.03724	0.020941	0.089697	-0.09013	0.105564	-0.03724
C_7	-0.01673	0.041276	-0.04796	0.07251	0.036814	-0.04796
C_8	0.052705	-0.04713	-0.01281	-0.00033	0.002787	0.024626
C_9	0.003029	0.008428	-0.00237	-0.00777	-0.00102	0.003029
C_{10}	0.034445	0.003611	-0.01797	-0.02722	0.034445	-0.00872

Table 8. The distance from k_j.

	Total distance
A_1	0.209735
A_2	0.045873
A_3	-0.03274
A_4	0.004942
A_5	0.065529
A_6	-0.02689

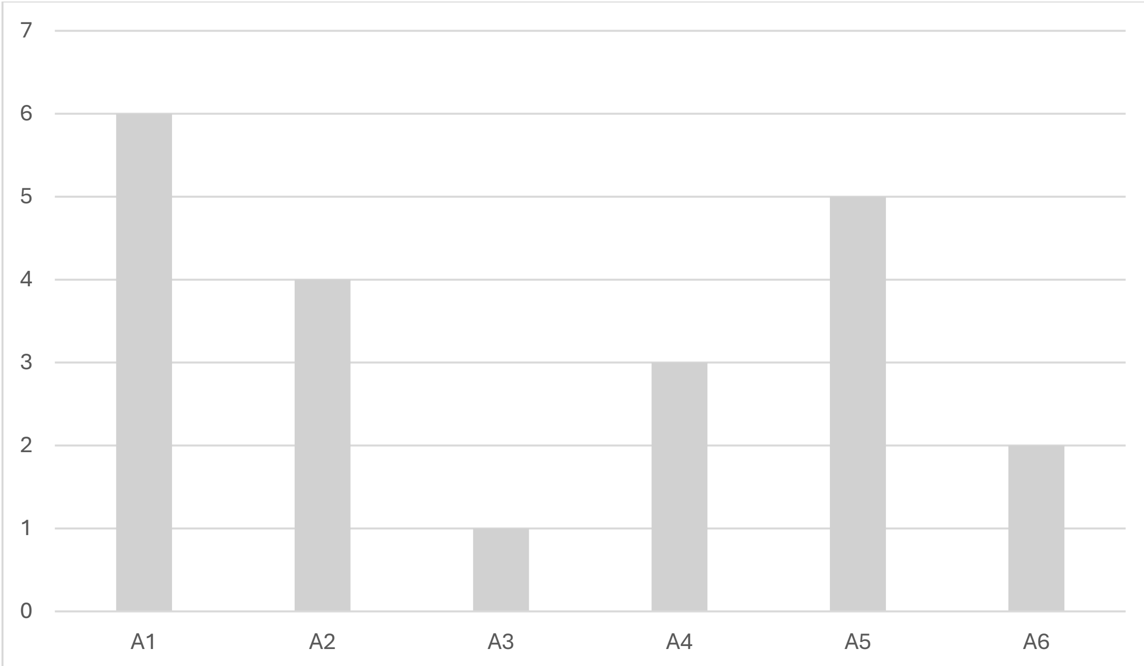

Fig 4. The rank of alternatives.

Sensitivity analysis

This part shows the sensitivity analysis between the rank of alternatives by changing the criteria weights under different cases. We change the criteria weights by the 11 cases as shown in Fig 5. In the first case, we put all criteria weights by the same weights. Then in the second case, we increase the first criterion by 22% and other criteria with the same weights. Then in the third case, we increase the second criterion by 22% and other criteria with the same weights. Then in the fourth case, we increase the third criterion by 22% and other criteria with the same weights.

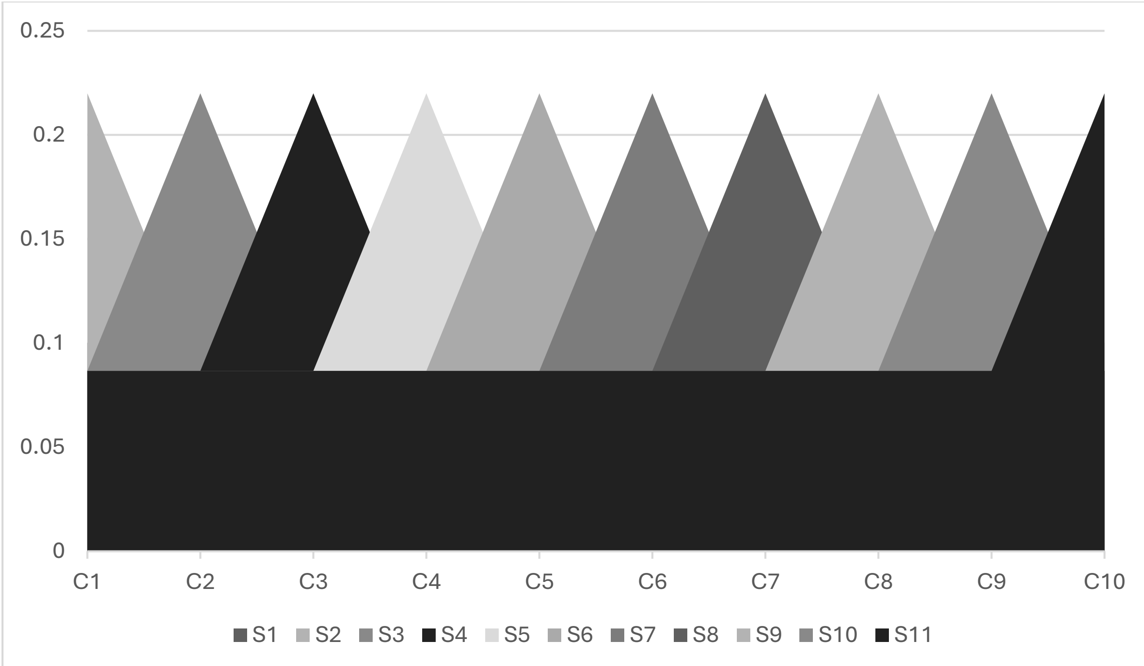

Figure 5. The different criteria weights.

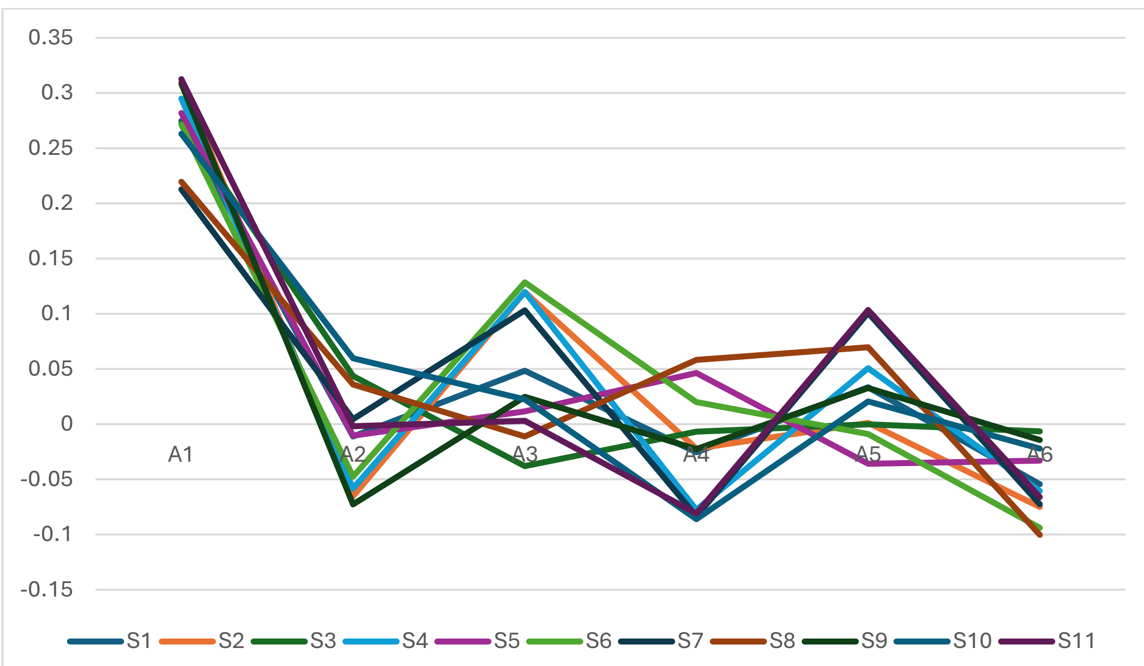

Figure 6. The total distance with different weights.

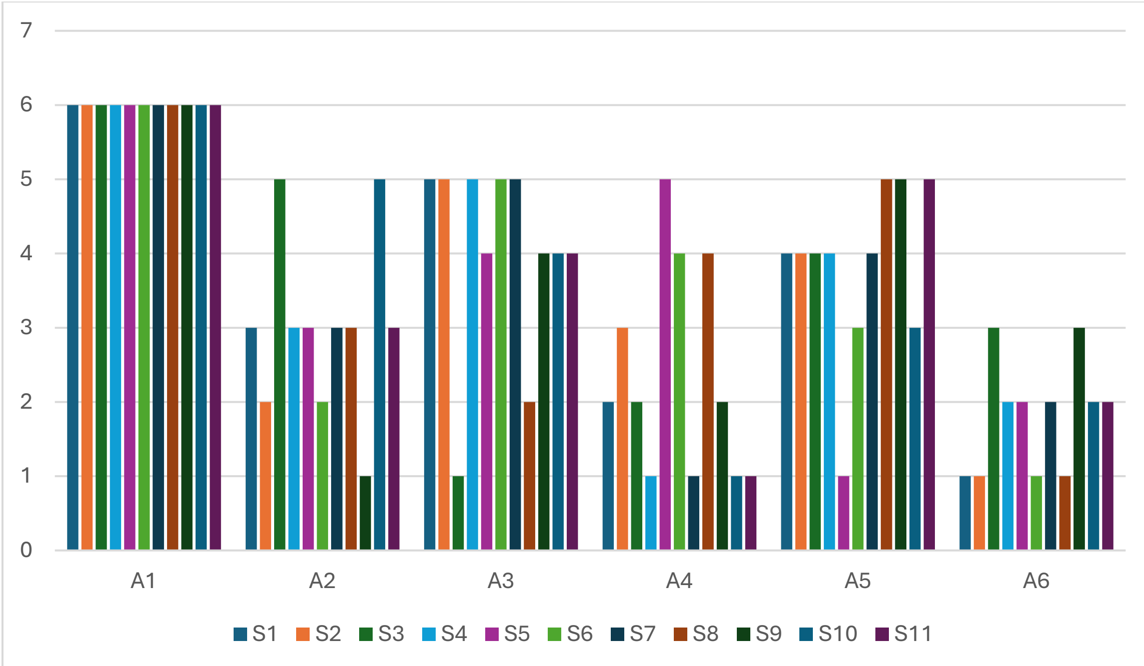

Figure 7. The rank of alternatives under different weights.

Then we rank the alternatives by 11 cases by obtaining the total distance as shown in Fig 6. The results show alternative 1 is the best and alternative 3 is the worst. We show that alternative 1 is the best in all cases. So, the ranks of alternatives are stale under different cases as Fig 7.

5. Conclusions

Uncertain, inconsistent, and indeterminate information that arises in real-world problems is illustrated via neutrophilic sets (NSs). A kind of neutrosophic sets known as double-valued neutrosophic sets (DVNSs) include indeterminacy that is composed of two different components: indeterminacy that leans toward truth membership and indeterminacy that leans toward falsehood membership. This article's objective was to evaluate the cultural and Tourism Integration Empowered by the Digital Economy. This study proposed two methods such as the Entropy method to compute the criteria weights and rank the alternatives. The two methods are used under the DVNSs. The results show that alternative 1 is the best and alternative 3 is the worst.

Acknowledgments

This work was supported by the Social Science Development Research Project of Hebei Province in 2024 (202403087).

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Received: Oct 17, 2024. Accepted: Feb 4, 2025