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Application of the SuperHyperSoft Set for Comprehensive Teaching Quality Analysis in College English Translation Courses for Enhanced Learning Results

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Abstract: This paper applies the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and the SIWEC for Teaching Quality Assessment in College English Translation Courses. The impacts of normalization on the SIWEC-based TOPSIS approach are examined using SIWEC. It has been discovered that normalization can influence the solution, which in turn influences the contribution of attributes to the distance of each alternative from the ideal solution and the negative ideal solution. The SIWEC method is used to compute the criteria weights and the TOPSIS method is used to rank the alternatives. SuperHyperSoft set is used to deal with different criteria and sub-criteria. Eight criteria and seven alternatives are used in this study. The results show the stability of the ranks under the SuperHyperSoft Set.

Keywords: SuperHyperSoft Set; MCDM Method; Translation Courses; Teaching Quality; College English.

1. Introduction

To ensure that students acquire the linguistic, technical, and critical thinking abilities needed for professional translation, teaching quality evaluation is essential to assessing and enhancing college English translation programs. Universities must constantly improve their curricula, teaching practices, and evaluation techniques to meet industry demands considering the growing globalization and need for qualified translators. A multifaceted study is required for an effective teaching quality evaluation, considering elements including student involvement, faculty expertise, curriculum design, and technology integration[1], [2]. It is difficult to gauge the effectiveness of translation initiatives and make significant changes in the absence of a well-organized assessment mechanism. For the assessment process to offer a thorough grasp of teaching efficacy, both qualitative and quantitative indicators must be considered. Although they offer insights, traditional evaluation techniques including course completion rates, staff self-evaluations, and student feedback might not adequately convey the complexity of translation education. More sophisticated methods, such data-driven analytics, AI-based evaluation tools, and Multi-Criteria Decision-Making (MCDM) models, can aid in a more accurate analysis of the efficacy of translation training. Institutions can determine the programs' strengths and shortcomings and modify their teaching strategies to better support students' learning outcomes by using these contemporary assessment techniques. The findings of teaching quality evaluation studies frequently point to important areas that require development, including gaps in the actual application of skills, a lack of exposure to industry-standard translation software, and inadequate practical translation training. Some institutions place more of an emphasis on practical experience, such internships and project-based learning, while others prioritize academic understanding[3], [4]. The effectiveness of translation education is greatly impacted by the incorporation of industry collaborations, AI-powered language processing, and technology-driven translation tools. The findings of the assessment emphasize the necessity of a well-rounded strategy that ensures graduates are prepared for the workforce by combining academic knowledge with real-world practice. In the end, a systematic and data-driven approach to teaching quality evaluation facilitates ongoing curriculum improvement and improves students' entire educational experience. The findings of these evaluations help curriculum designers, educators, and legislators improve corporate partnerships, integrate contemporary teaching approaches, and strengthen faculty training. Institutions may improve the quality of English translation instruction by examining assessment results and creating evidence-based plans that guarantee students get the skills necessary to thrive in a fast-paced, technologically advanced translation sector[5], [6]. People have been involved in making decisions pertaining to their everyday lives ever since the beginning of time. The investigation of how humans do this activity has long piqued the curiosity of academics. In this regard, it is essential to model the environment in which we will be moving, that is, in a way that simplifies (represents) the actual system, if it is easily comprehensible and implementable. Therefore, we examine the available options as well as the standards by which those options will be judged. This, which appears straightforward at first glance, is a component of the entire field known as MCDM. MCDM methodology is applied in different issues [7], [8]. When it comes to decision dilemmas, there are several schools of thinking. Multiple objective programming and multiple criteria evaluation are the two types of MCDM challenges. In our instance, the second group is highlighted to concentrate on the evaluation issues. The two primary schools of multicriteria approaches comprise most of these techniques.

There is a subset of MCDM's several compensating techniques that take costs and benefits into account. Among these is the TOPSIS approach, which stands for Technique for Order Performance by Similarity to Ideal Solution[9], [10].

This strategy is used for four primary reasons:

I. The TOPSIS idea enables the search for the best options for each criterion represented in a basic mathematical form.
II. the computing techniques are simple.
III. the logic is logical and intelligible; and

IV. the importance weights are integrated into the comparison procedures[11], [12].

Nevertheless, there are certain disadvantages to the TOPSIS approach. Ranking alternatives is a phenomenon that may be caused by TOPSIS, which is one of its issues. In this phenomenon, adding or removing one option from the choice issue alters the order of preference for the alternatives. This can sometimes result in what is known as total rank alternatives, in which the order of preferences is completely reversed; that is, the best choice becomes the worst when it is added to or removed from the process[13], [14]. In many situations, such an occurrence might not be acceptable.

2. Framework for TOPSIS and SIWEC Evaluation

Numerous options must be assessed and contrasted with MCDM based on several criteria. Aiding the decision-maker when they are choosing between options is the goal of MCDM. In this sense, practical situations are typically defined by numerous competing requirements, and there may be no solution which fulfills all criteria simultaneously. Considering the decision-maker's choices, the answer is thus a compromise. In this regard, TOPSIS is predicated on the idea that the option that is selected ought to be the one that is most far from the Negative Ideal Solution (NIS) and the closest to the Positive Ideal Solution (PIS). The final ranking is calculated by the proximity index[15], [16]. The following steps make up the TOPSIS and SIWEC [17] techniques.

Forming the initial decision matrix

$$Y = \begin{bmatrix} y_{11} & \cdots & y_{1n} \\ \vdots & \ddots & \vdots \\ y_{m1} & \cdots & y_{mn} \end{bmatrix} \tag{1}$$

Normalize the decision matrix

The decision matrix is normalized as:

$$q_{ij} = \frac{y_{ij}}{\max y_{ij}} \tag{2}$$

Compute the standard deviation

Multiply the normalization values by the standard deviation

$$p_{ij} = q_{ij} \times \sigma_j \tag{3}$$

Where σ_j refers to the standard deviation

Compute the sum of each row in p_{ij}

$$r_{ij} = \sum_{j=1}^{n} p_{ij} \tag{4}$$

Compute the criteria weights.

$$W_j = \frac{r_{ij}}{\sum_{j=1}^{n} r_{ij}} \tag{5}$$

The steps of the TOPSIS method are organized as follows:

Normalize the decision matrix

$$e_{ij} = \frac{y_{ij}}{\sqrt{\sum_{j=1}^{m} \left(y_{ij}\right)^2}} \tag{6}$$

Calculate the weighted decision matrix.

$$v_{ij} = w_j e_{ij} \tag{7}$$

Calculate the positive ideal and negative ideal solutions

$$A^+ = \{v_1^+, \dots, v_n^+\} = \left\{\left(\max_i v_{ij}, j \in J\right)\left(\min_i v_{ij}, j \in B\right)\right\} \tag{8}$$

$$A^- = \{v_1^-, \dots, v_n^-\} = \left\{\left(\min_i v_{ij}, j \in J\right)\left(\max_i v_{ij}, j \in B\right)\right\} \tag{9}$$

Calculate the separation measures

$$d_i^+ = \left\{\sum_{j=1}^{n} \left(v_{ij} - v_j^+\right)^2\right\}^{\frac{1}{2}} \tag{10}$$

$$d_i^- = \left\{\sum_{j=1}^{n} \left(v_{ij} - v_j^-\right)^2\right\}^{\frac{1}{2}} \tag{11}$$

Calculate the relative closeness to ideal solution

$$H_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{12}$$

SuperHyperSoft Set

Let U be a universe of discourse, and let P(U) presents the power set of U. Let $a_1, \dots a_n$ be n distinct attributes and $n \geq 1$. Every attribute a_i has a corresponding set of attributes values A_i, with the $A_i \cap A_j = \emptyset \; for \; all \; i \neq j$ [18], [19].

Let $P(A_i)$ presents the power set of A_i for every $i = 1,2, \dots, n$.

Then the pair $\left(F, P(A_1) \times \; P(A_2) \times P(A_3) \times P(A_4) \times \dots \times P(A_n)\right)$ (13)

$$F: P(A_1) \times \; P(A_2) \times P(A_3) \times P(A_4) \times \dots \times P(A_n) \rightarrow P(U) \tag{14}$$

This is called a SuperHyperSoft Set over U.

3. An application

This section shows an application of the proposed approach to show the validation of the proposed approach. We use eight criteria and seven alternatives in this study. The criteria of this study are organized as: Employment and Certification Success Rate (High, Medium), Student Engagement (High, Low), Practical Training (Extensive, Moderate, Limited), Technological Integration (Advanced, Moderate, Basic), Industry Collaboration (Strong, Moderate, Weak), Curriculum Design (Excellent, Good, Average, Poor), Assessment Methods (Diverse, Standard, Limited), Faculty Expertise (Highly Skilled, Skilled, Basic Knowledge). Alternatives are seven colleges.

We are forming the initial decision matrix using Eq. (1). Four experts rate the criteria and alternatives based on scale between 0.1 to 0.99. They build the decision matrix based on eight criteria and seven alternatives.

Eq. (2) is used to normalize the decision matrix as shown in Fig 1.

We compute the standard deviation.

Eq. (3) is used to multiply the normalization values by the standard deviation as shown in Fig 2.

Eq. (4) is used to compute the sum of each row in p_{ij}.

Eq. (5) is used to compute the criteria weights as shown in Fig 3.

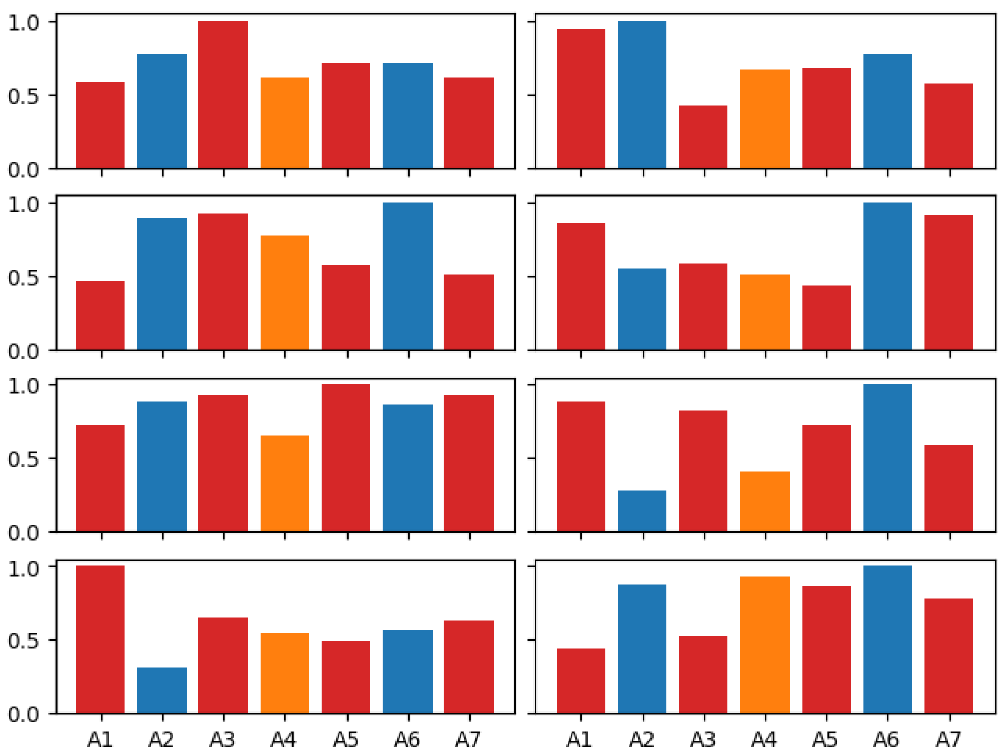

Fig 1. Normalized matrix by the weighting approach.

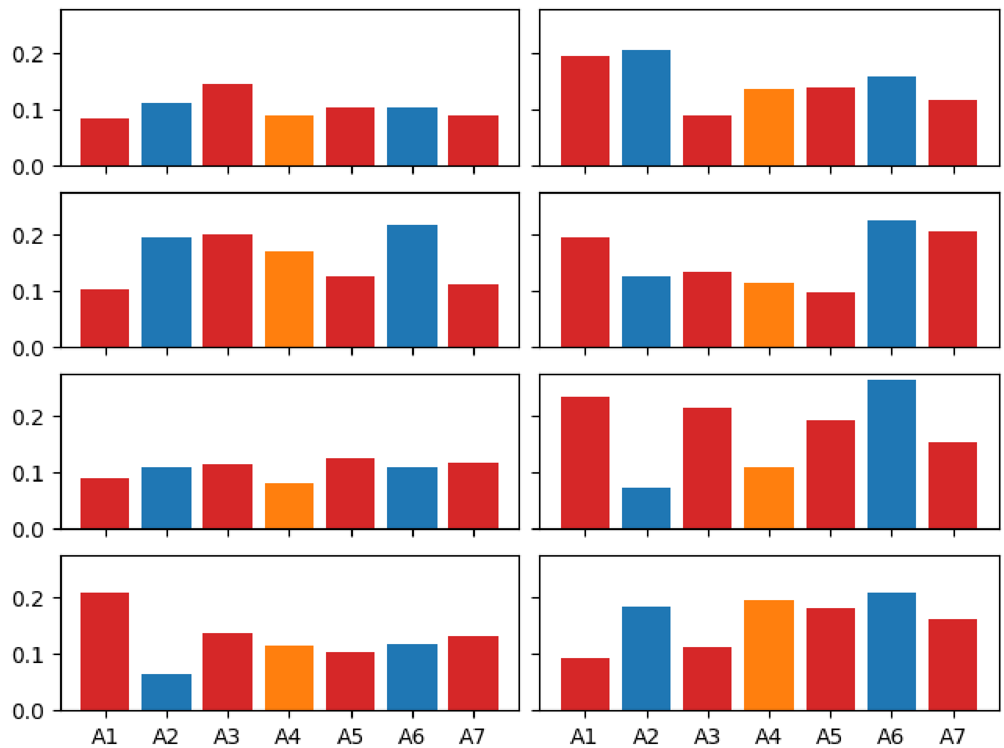

Fig 2. The normalization values by the standard deviation.

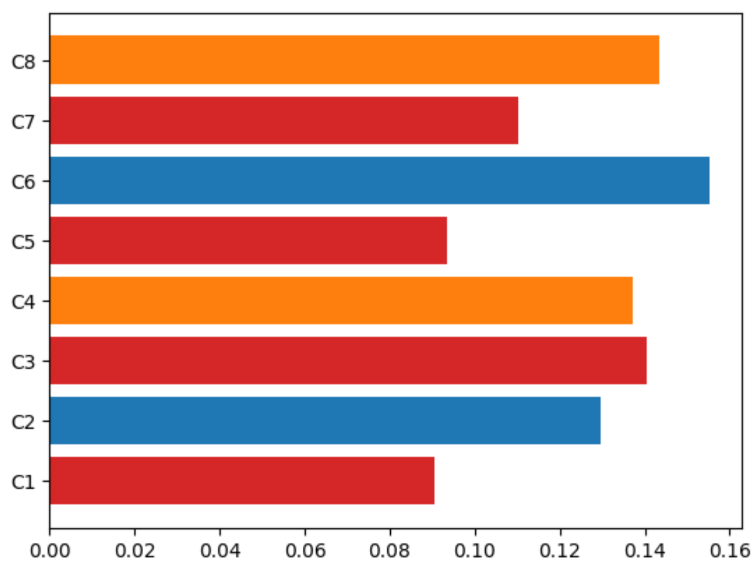

Fig 3. The importance of criteria.

Then we ranked the alternatives based on the TOPSIS method. This study uses the SuperHyperSoft set to deal with the criteria and sub criteria. We select the values of the criteria such as:

{(High, Medium), (High, Low) (Extensive), (Advanced), (Strong), (Good), (Standard), (Skilled)}

So, we propose four cases, each case has a set of values such as:

Case 1: {(High), (High) (Extensive), (Advanced), (Strong), (Good), (Standard), (Skilled)}

Case 2: {(High), (Low) (Extensive), (Advanced), (Strong), (Good), (Standard), (Skilled)}

Case 3: {(Medium), (High) (Extensive), (Advanced), (Strong), (Good), (Standard), (Skilled)}

Case 4: {(Medium), (Low) (Extensive), (Advanced), (Strong), (Good), (Standard), (Skilled)}

Then we ranked the alternatives based on these four cases and finally, we compute the final rank of the alternatives and select the best and the worst.

In Case 1.

Eq. (6) is used to normalize the decision matrix as shown in Fig 4.

Eq. (7) is used to calculate the weighted decision matrix as shown in Fig 5.

Eq. (8 and 9) are used to calculate the positive ideal and negative ideal solutions.

Eq. (10 and 11) are used to calculate the separation measures.

Eq. (12) is used to calculate relative closeness to ideal solution.

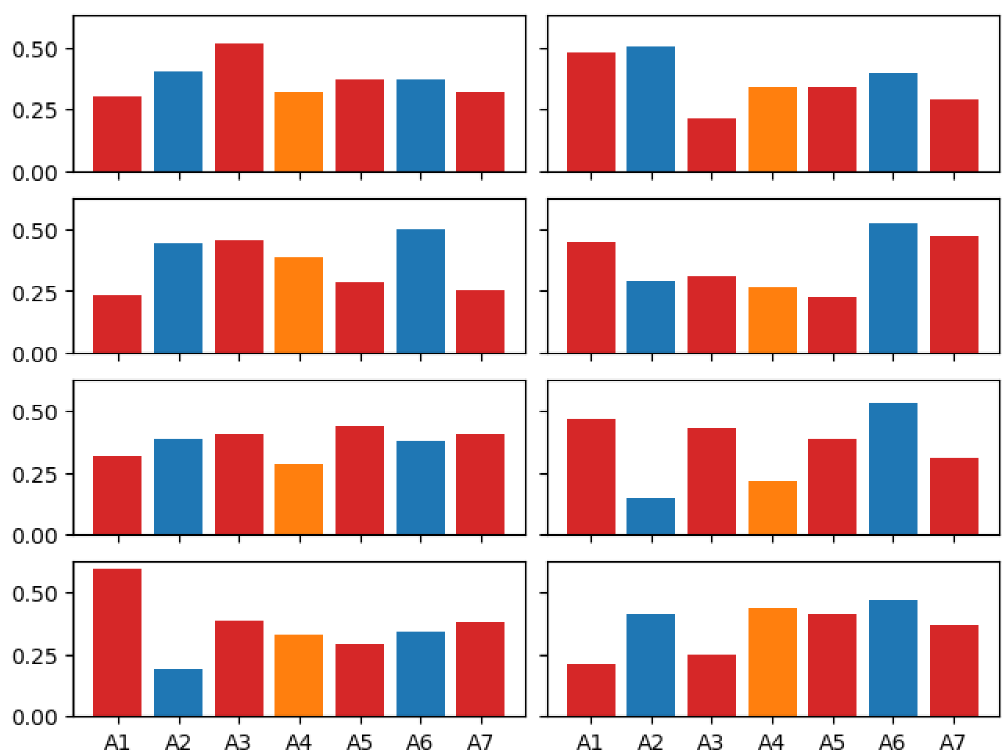

Fig 4. Normalized decision matrix.

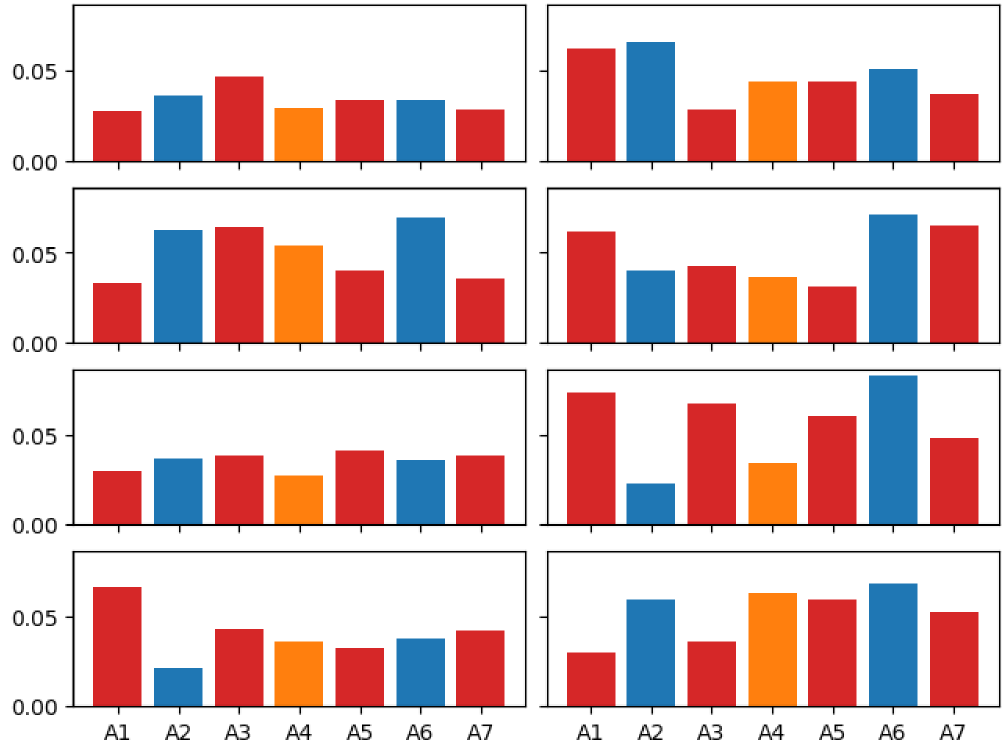

Fig 5. The weighted decision matrix.

In Case 2

We obtain the normalized decision matrix as shown in Fig 6.

The weighted decision matrix as shown in Fig 7.

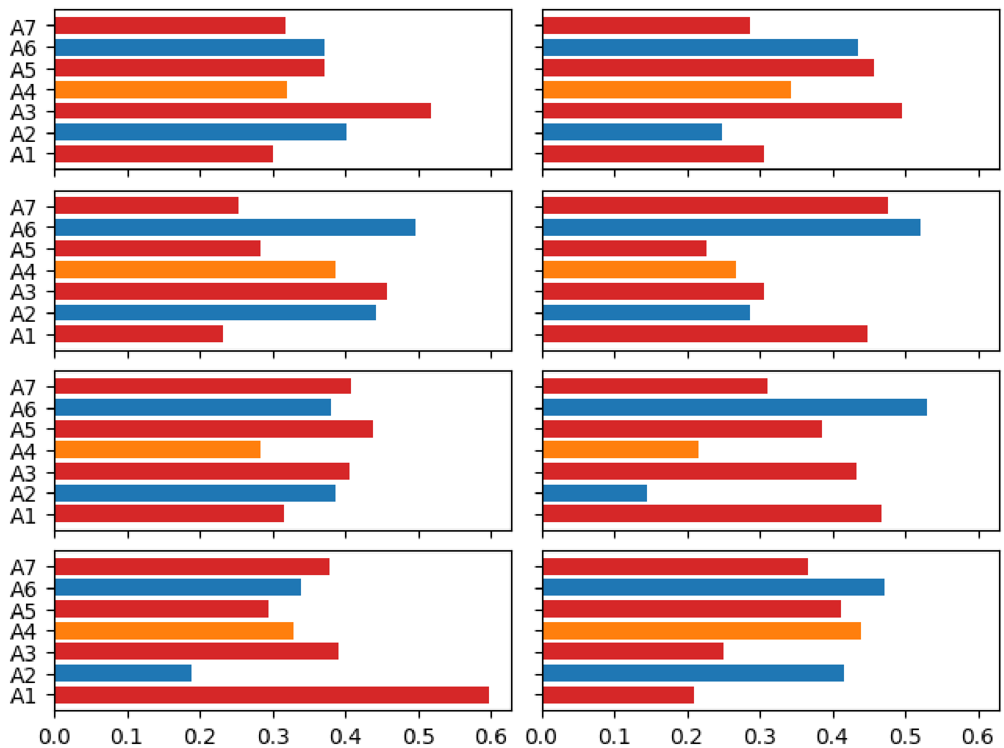

Fig 6. Normalized decision matrix.

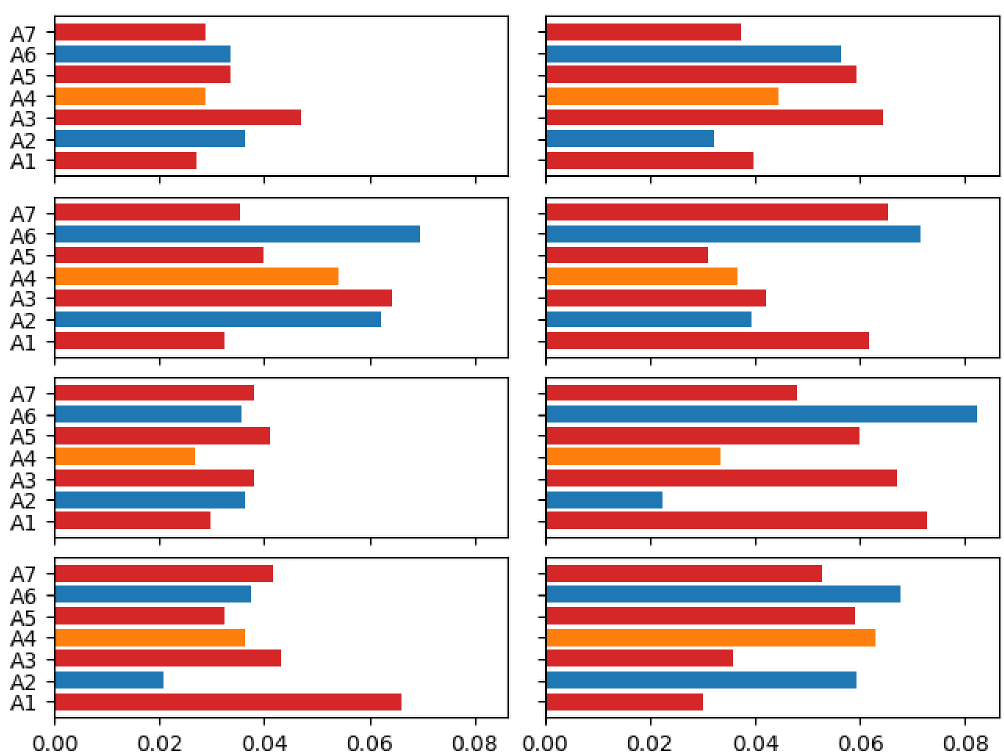

Fig 7. The weighted decision matrix.

In Case 3

We obtain the normalized decision matrix as shown in Fig 8.

The weighted decision matrix as shown in Fig 9.

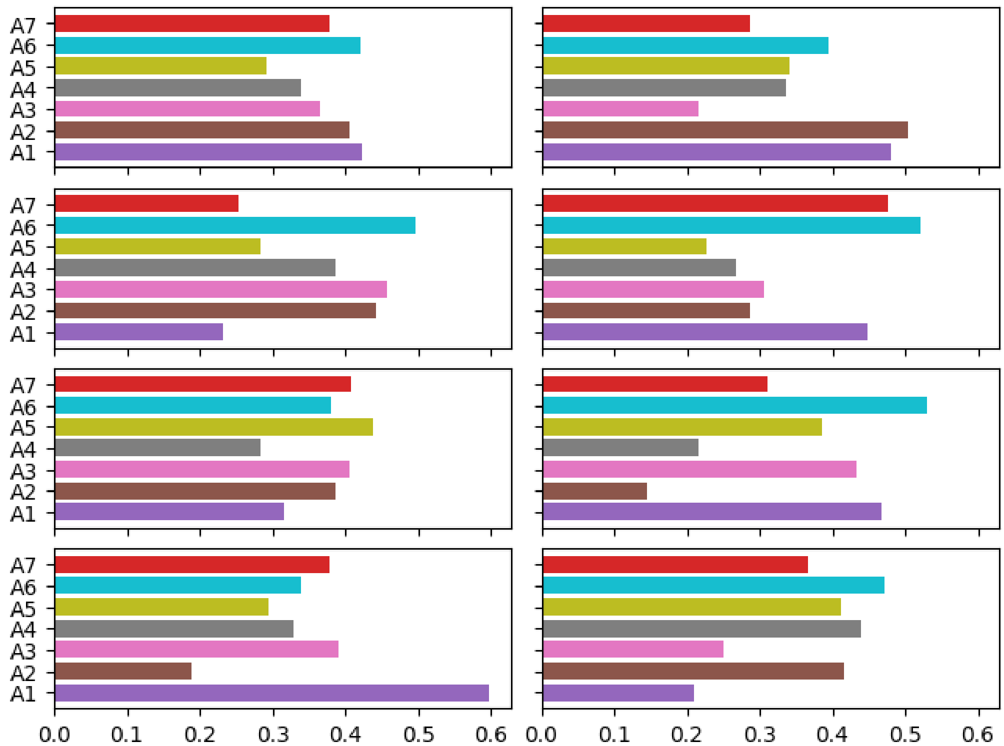

Fig 8. Normalized decision matrix.

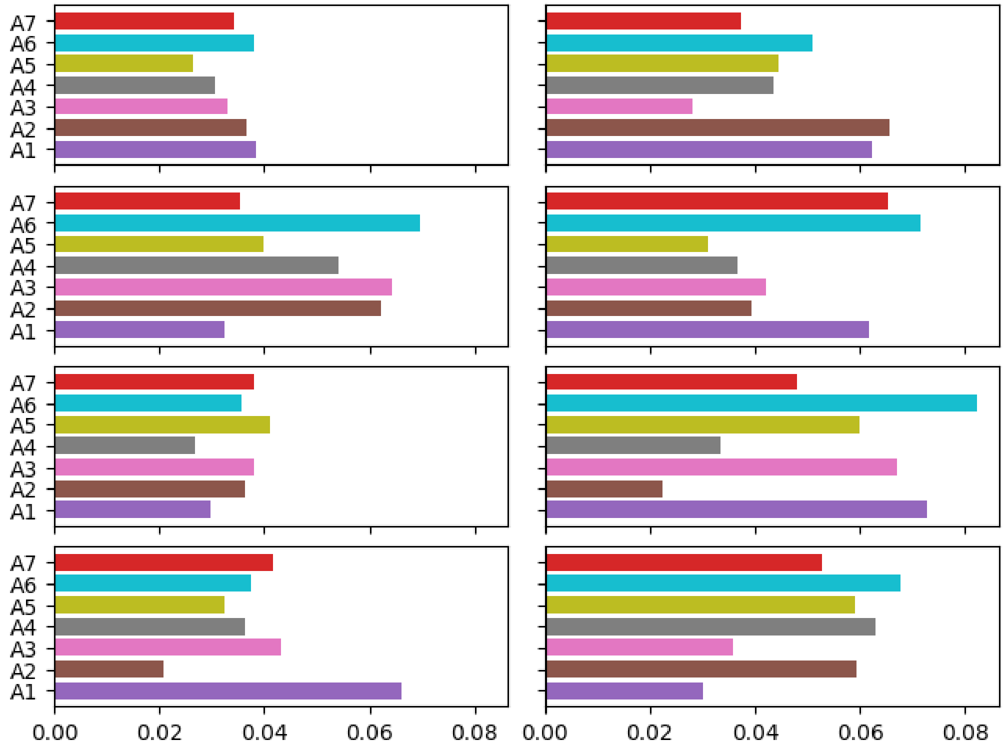

Fig 9. The weighted decision matrix.

In Case 4

We obtain the normalized decision matrix as shown in Fig 10.

The weighted decision matrix as shown in Fig 11.

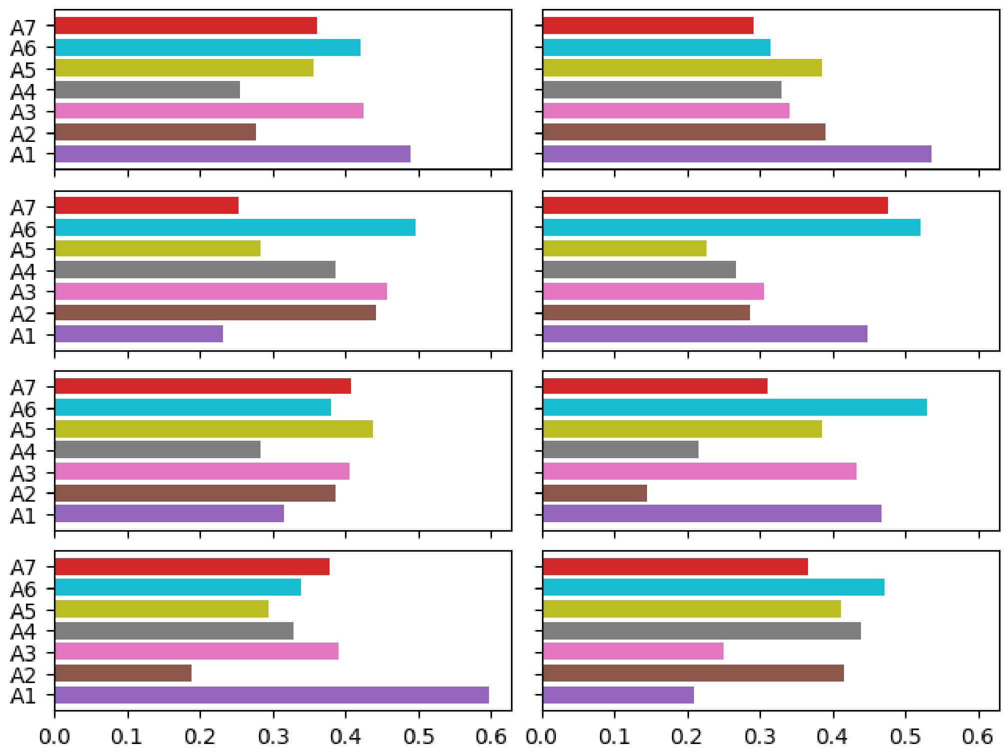

Fig 10. Normalized decision matrix.

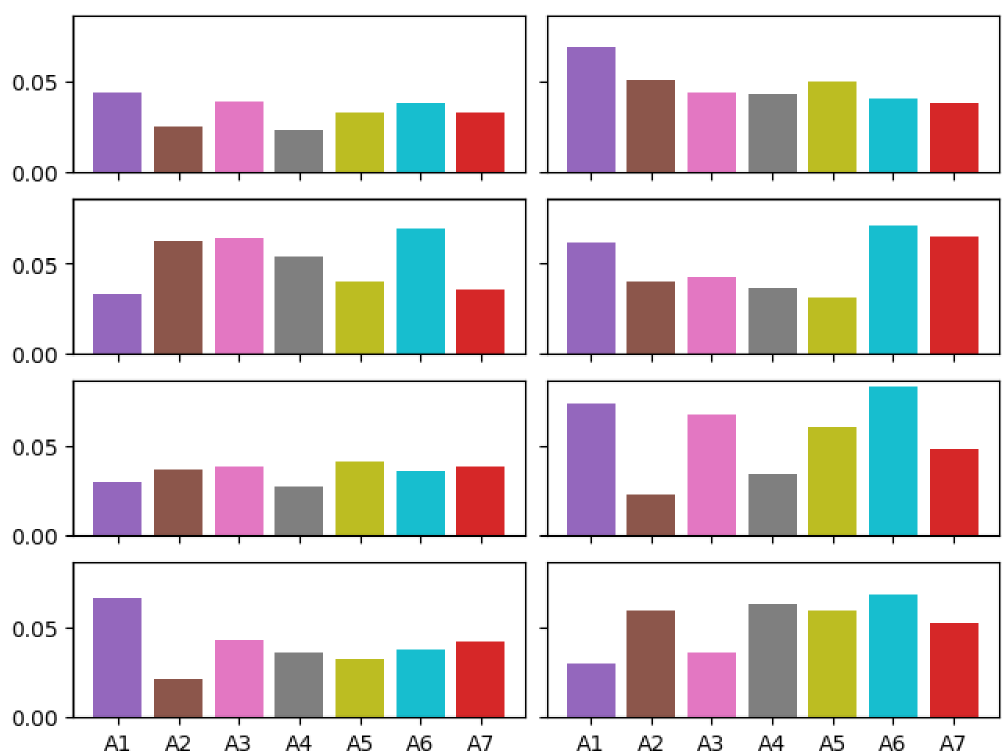

Fig 11. The weighted decision matrix.

Then we compute the rank of the alternatives in each case as shown in Fig 12. We show alternative 6 is the best and alternative 4 is the worst.

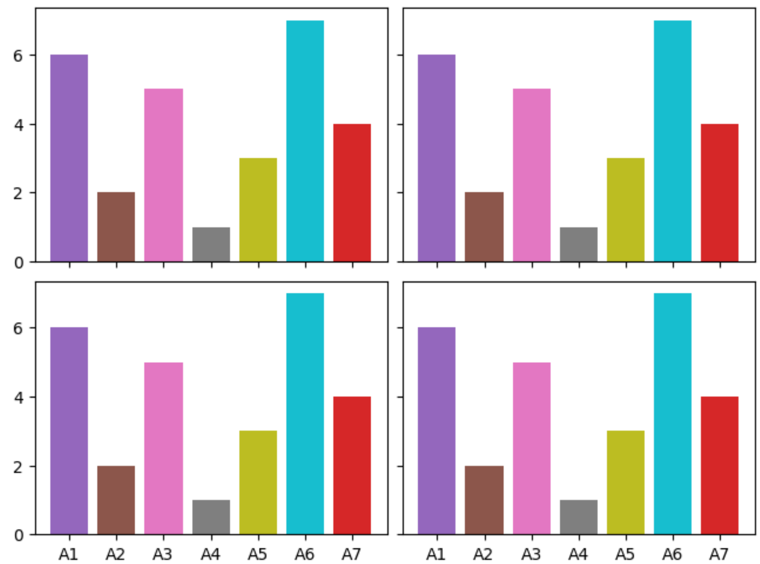

Fig 12. Final ranks of alternatives.

4. Conclusions

The effects of normalizing on the SIWEC-based TOPSIS method are examined in this study, along with the applicability of normalization technique in the TOPSIS method. The findings that have been reached are as follows: (1) Normalization may influence the results, which in turn influences the contribution of attributes to ideal and nonideal solutions. This means that normalization can influence the SIWEC -based TOPSIS method's decision outcome. (2) SuperHyperSoft can affect the decision outcome based on a set of the values in the criteria. (3) SIWEC was used to compute the criteria weights. (4) TOPSIS was used to rank the alternatives. (5) The results show alternative 6 is the best and alternative 4 is the worst.

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