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Research Paper

Comparison of the Simple Additive Weighting (SAW) with the Technique for Others Reference by Similarity to Ideal Solution (TOPSIS) methods

Imam Tahyudin[1*], Rahman Rosyidi[1], Ansari Saleh Ahmar[2], Haviluddin[3]

[1]Department of Information System, STMIK AMIKOM Purwokerto, Indonesia
[2]Department of Statistics, Universitas Negeri Makassar, Indonesia
[3] Faculty of Computer Science and Information Technology, Mulawarman University, Indonesia
**Corresponding author E-mail: imam.tahyudin@amikompurwokerto.ac.jp*

Abstract

The purpose of this research is to compare the SAW and TOPSIS methods. This research uses data selection of education scholarship in an Indonesian public school. This research uses data from selection of education scholarship program in an Indonesian public school. The methods usage is SAW and TOPSIS methods. A comparison of the two methods using this data set demonstrates that SAW method was more accurate than TOPSIS method.

Keywords: *SAW; TOPSIS; Scholarship selection.*

1. Introduction

The process of selecting suitable scholarship candidates from a subset of student's applicants and the reporting process is currently performed manually, as such the process generally requires a long time and occasionally mistakes occur. This research tries to solve these problems by application of two Decision Support System (DSS) methods, SAW and TOPSIS.

Previous research by Savitha and Chandrasekar [1], has described the use of SAW and TOPSIS Algorithms applied to Trusted Network Selection using SAW and TOPSIS Algorithms for Heterogeneous Wireless Networks. Their research showed that TOPSIS was more accurate than the SAW method. Other research conducted by Chu et al [2] undertook a "comparison among three analytical methods for knowledge communities' group-decision analysis". They also found that TOPSIS was more accurate than the SAW method. Research by Karami et al [3], explained the utilization and comparison of Multi Attribute Decision Making (MADM) techniques. This study showed that SAW was better than TOPSIS. Next, a research present to determine location in Niger by using Fuzzy TOPSIS. His research performed that Erema is the best location based on positive ideal solution [4]. Afterward, the study of SAW for choosing food was conducted by Adriyendi. His proposed method is compared with weighted product method. The result shows that both of them give the same recommendation which the best choice of food is wheat [5]. The other research is presented by A. Awasthi, et al. They studied fuzzy TOPSIS for determining location of urban distribution center. Their proposed method is used to determine aggregate scores for all potential location [6]. The study of decision making was used by manufacture industry process. They used it for deciding maintenance alternative selection perspective. This research compares four methods of DSS method. The result showed that TOPSIS exhibited the highest potential in maintenance decision analysis [7]. In addition, T. Chen demonstrated the comparison of SAW and TOPSIS based on interval-valued fuzzy set. He discussed on score function and weight constraint. This research gives additional reference for formulating the model of implementation both of SAW method and TOPSIS methods for scholarship selection dataset. His research concluded that both of methods give evident similarities exist ranking based on interval fuzzy set [8].

The remaining topics are arranged as follows: Section 2 describes the proposed methods, SAW and TOPSIS; Section 3 presents the result and discussion, and finally; the conclusion is given in Section 4.

2. Methodology

SAW method is often also known as a term weighted summation method. The basic concept of SAW is to find weighted summation of the performance rating of each alternative on all attributes. The SAW method made the decision matrix normalization process (X). The preference value for each alternative (V*i*) is given as [9]:

$$Vi = \sum_{j=1}^{n} Wj\, rij \qquad (1)$$

Where, V*i* is rank of each alternative, W*j* is weight value of each criterion and R*ij* is value of normalized performance rating. A larger V*i* value indicates that the alternative Ai over elected.

The other method is TOPSIS, a method from the range of techniques collectively referred to as MADM. The steps to involved in this method are calculation of the normalization matrix, calculation of the weighted of normalization matrix, determination of the solution of positive and negative ideal value, determination of the

length of the ideal solution and determination of the length of criteria with the ideal solution 4.

3. Results and Discussion

3.1. SAW Method

The tests on the input / output of a mathematical model calculation where the results are to be applied in a decision support systems needs to be truth tested. The output was appropriate and correct, after one or more variables tested through the process of calculating the mathematical model used.

The results of the calculation results of the system under test is calculation SAW mathematical model for selecting a new student scholarship that exist in the DSS application.

Here are the criteria needed for decision making, based on requirements which have been specified. The predetermined criteria, namely average value of national final grade which called UAN (C1), Average Value of school final grade, UAS (C2), and the average of last report value (C3).

From these criteria, it made an interest rate based on the weight values of criteria that have been determined. The weight of C1 is 60% (UAN Value), C2 is 30% (UAS Value), and C3 is 10% (Report Value). The 3 assessment criteria for each student data record are shown in Table 1.

Table 1: Data Structure

Criteria	Main number candidate of student		
	A1	A2	A3
Average value of UAN	24.07	21.00	5.00
Average value of UAS	7.66	7.26	7.67
Average value of Report	7.5	8.0	7.7

Each student's data record can be formed on the decision matrix X, Table 2 shows the suitability rating of each alternative based on each of the criteria.

Table 2: Rating suitability of each alternative on each criterion

Alterative	Criteria		
	C1	C2	C3
A1	24.07	7.66	7.5
A2	21.00	7.26	8.0
A3	25.00	7.67	7.7

Decision makers assign weights based on the level of importance of each criterion as follows:

Vector Weight: W = [60%, 30%, 10%]

Making the decision matrix X, made of the suitability of the following table:

$$X = \begin{bmatrix} 24.07 & 7.66 & 7.5 \\ 21.00 & 7.26 & 8.0 \\ 25.00 & 7.67 & 7.7 \end{bmatrix}$$

Following this a normalization procedure was applied and the result used for multiplication matrix W * R and summing the results of multiplication to obtain the best alternatives by ranking the greatest value with equation (2) as follows:

V1 = (0.6) (0.96) + (0.3) (1) + (0.1) (0.94) = 0.97

V2 = (0.6) (0.84) + (0.3) (0.95) + (0.1) (1) = 0.889

V3 = (0.6) (1) + (0.3) (1) + (0.1) (0.96) = 0.996

Ranking the results obtained: V1 = 0.97, V2 = 0.889, and V3 = 0.996. The greatest value is alternative V3 which is 0.996.

3.2. TOPSIS Method

Based on calculation in the first steps, the normalization matrix appears as indicated in Table 3.

Table 3: The normalization matrix

	C1	C2	C3
A1	0.6033	0.5871	0.5597
A2	0.5129	0.5565	0.5970
A3	0.6106	0.5879	0.5747

After that, this matrix is crossed with weighted score, giving can be seen in Table 4.

Table 4: The crossed with weighted matrix

	C1	C2	C3
A1	0.3620	0.1761	0.0560
A2	0.3078	0.1669	0.0597
A3	0.3664	0.1764	0.0575

The next step is determining the solution of the ideal positive and negative value. The result is shown in Table 5.

Table 5: The ideal solution matrix

Ideal solution	C1	C2	C3
The solution of ideal positive	0.3664	0.1764	0.0597
The solution of ideal negative	0.3078	0.1669	0.0560

Then, determine the length of each value in the second step with solution ideal positive and negative, Table 6.

Table 6: The length to ideal solution matrix

Length to ideal solution	C1	C2	C3
Length to positive ideal solution	0.0058	0.0594	0.0022
Length to negative ideal solution	0.0550	0.0037	0.0594

The last step is determining the length of each value of alternative with length of solution ideal positive and negative, Table 7.

Table 7: The length of alternatives value

Alternatives	Value
A1	0.9050
A2	0.0591
A3	0.9637

Based on these results, the final result of the SAW method and the TOPSIS method ranks the students in the same order. The first position is the third student candidate. The second is the first student candidate and the last position is the second student candidate. However, the accuracy value of both of the SAW and TOPSIS methods is different. The result by SAW method was more accurate than TOPSIS method. This condition is should be tested in various cases. Using this case as an example, the SAW method is recommended as a method for selecting students for scholarship programs in Indonesian public schools.

4. Conclusion

Based on the description of problems and solutions, it can be concluded that the position alternative that they processed by SAW method and TOPSIS are the same. The final result of the SAW method was more accurate than the TOPSIS method. In future, this research can be tested in other cases and continued to be compared with other method like AHP, ELECTRE and many others.

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