The Selection System of Student Scholarship Based on Simple Additive Weighting and Technique for Order Preference by Similarity to Ideal Solution Method

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Abstract. The scholarship is a financial aid given to candidate student who is eligible. This aid is aimed to help the students to pursue their study. In UTM, the scholarship system awards applied to select the right candidate of college students is still based on the principles of the proximity of the campus party. The scholarship given isn't for the right target. This research implemented a system of determining admission scholarships using the method of SAW and TOPSIS as a solution to support decision makers based on criteria that have been defined, including GPA, income of the parents, the number of dependant of the parents, tuition fees, semester and the involvement in association. The result of some trials had been shows that the average accuracy for five years is 88.4% compared to manual calculations or the equivalent of 6 to 8 days.

Keywords: admissions, scholarships, criteria, methods, SAW, TOPSIS, Accuracy.

1 Introduction

Education plays an important role in the continuity of leadership as well as the development of a country. Through education we produced generations who will be the successor of the nation. According to the Act of National Education System no.20 year of 2003. The purposes of the national education is to develop student potential to become a pious human being who is faitful to to God the Almighty, as well as precious, healthy, have learned, accomplished, creative, independent, and become citizens of a democratic and responsible [1]. The other purpose is to make education important to all citizens and to give each individual their right to acquire education. Therefore, the Government has an obligation to provide or facilitate the implementation of the Act. One of the ways is by providing scholarships for every citizen who needs financial aid to have formal education [2]. A kind of scholarship provided by the government is scholarship for university students. University of Trunojoyo Madura, as one of the state universities in Indonesia, offers scholarships to its students. However, because of some reasons, the scholarship sometimes is not delivered to the right target, for example in Engineering Faculty which has more students compared to the other faculties. In this faculty, based on preliminary observation, the distribution of the government scholarshi is not conducted appropriately. In other word, the scholarship is not given to the right student. One of the aspects that causes it to happen is that the selection process was not conducted based on the the criteria defined by the government. Therefore, an improvement on the selection process for scholarship

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grant is needed. This research aims to build n a system that supports the selection process of the scholarship receiver in order to make the time of the process be more efficient and improve the quality of the decision in determining the grantees.

Some of the methods that have been widely used to support decision making in the determination of the grantee, such as the method of Fuzzy Multiple Attribute Decision Making (Fuzzy MADM), Analytical Hierarchy Process (AHP), the Weighted Product (WP) and ELECTRE [3][4]. Yet, those methods have low average of accuracy. In fact, determinining the scholarship grantees needs many consideration for the selection [5]. Therefore this research applies method of SAW and TOPSIS for decision making. SAW method can distinguish between the criteria of cost and benefit criteria in the process of normalization even though the process of weighting method of SAW is only a modest summing as the results of multiplication with weights; while the method of TOPSIS is used to designate alternatives which have a distance be the closest to the ideal solution, the farthest distance and negative with a negative solution is ideal. The hypothesis is that using the method of SAW and TOPSIS can help select the scholarship recipients more accurately and precisey on target. Besides it also can optimalize the time of the selection process.

2 Methodology

The data used in this research is taken from the data of scholarship applicats in Engineering Faculty of University of Trunojoyo from the last five years, i.e. 2013-2017, based on the defined criteria including GPA, semester, income of the parents, the number of parent dependants, tuition fees, and the achievements in an organization or association. Each criterion has a conversion value twig matches, as displayed in table 1, as well as a weight value preferences, as shown in Table 2.

Table 1. Data Match Rating Criteria.

Criteria's	Values	Values Conversion
GPA	2.75 - 3.00	1
	> 3.00 - 3.25	2
	> 3.25 - 3.50	3
	> 3.50 - 3.75	4
	> 3.75 - 4.00	5
Semester	2nd Semester	1
	3rd Semester	2
	4th Semester	3
	5th Semester	4
Income of parent	> = 2,000,000	1
	1,500,000 - < 2,000,000	2
	1,000,000 - < 1,500,000	3
	500,000 - < 1,000,000	4
	< 500,000	5
The number of parent dependents	0 - 1 person	1
	2 people	2

Criteria's	Values	Values Conversion
	3 people	3
	4 people	4
	5 people or more	5
	< 1,000,000	1
	1,000,000 - < 2,000,000	2
	2,000,000 - < 3,000,000	3
	3,000,000 - < 4,000,000	4
	4,000,000 - < 5,000,000	5
	5,000,000 - < 6,000,000	6
Tuition fees in areas	> = 6,000,000	7
	National Level	5
	Province Level	4
	Regency Level	3
Organization	College Level	2
Achievement	nothing	1

Table 2. Data weighted preferences.

	Criteria	Bobot
C1	GPA	30%
C2	Semester	5%
C3	Income of parent	20%
C4	The number of parent dependant	15%
C5	Tuition fees in areas	20%
C6	Achievement/organization	10%

A Decision Support System (DSS) is utilized to select the scholarship recipients. Decision is defined as an activity choosing a strategy or action based on certain criteria, such as eligibility, variables, and methods that are used to solve problems [6][7]. Several methods can be used to develop a DSS, one of which is SAW and TOPSIS method. SAW method is often known as the weighted sum method. The steps in solving a problem with method SAW are as follows [8]: (1) Determining the criteria that will be used as reference in decision-making, that is C_i, (2) Determining the suitability of each alternative rating on each the criteria, (3) making a decision matrix based on the criteria (C_i) formulated in equations 1. (4) performing normalization based on matrix equations which are tailored to the type of the attribute (attribute attribute or benefit cost), and then the normalized matrix is obtained r. to make normalization of matrix R by using Equation 2. (5) The final results is obtained from any process of ranks, that is the sum of the multiplication of the normalized matrix R with the vector of weights to obtain the greatest value that is chosen as the best alternative (A_i) as a solution, indicated by Equation 3. The method TOPSIS is one of the decision methods with the multicriteria, which was first introduced by Yoon and Hwang (1981). Solving problems using TOPSIS involves the following steps [9]: (1)

Creating a decision normalize matrix, shown in equation 4, (2) making a decision to normalize matrix weighted (y_{ij}) by using Equation 5, (3) Determining the ideal solution matrix of positive and negative ideal solution matrix. The ideal solution can be a notated positive and negative which can be seen in Equations 6 and 7.

$$x = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad (1)$$

$$r_{ij} \begin{cases} \frac{x_{ij}}{max_i x_{ij}} & j\ atribut\ keuntungan \\ \frac{Min_i x_{ij}}{x_{ij}} & j\ atribut\ biaya\ (cost) \end{cases} \quad (2)$$

$$v_i = \sum_{j=1}^{n} w_j \quad r_{ij} \quad (3)$$

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (4)$$

$$y_{ij} = w_i r_{ij} \quad (5)$$

$$A^+ = (y_1^+, y_2^+, \dots \dots, y_n^+) \quad (6)$$

$$A^- = (y_1^-, y_2^-, \dots \dots, y_n^-) \quad (7)$$

3 The results of the tests

Based on data analysis using SAW and TOPSIS method, the result of the first step which is determining the criteria and rating the suitability is used as a reference in decision making, as shown in Table 1. The second step is determining the weighting of each criterion as any preference of Table 2. The third step, making a decision based on criteria matrix, as shown in Table 3 and Figure 1 to show the implementation of criteria, and it retrieves W = {0.3 0.2 0.05;0.1 0.2 0.15}. The fourth step, normalizing matrix Decision- Making R can be seen in Table 4. After normalized matrix R is obtained, the value of the weighted matrix Y is determined by using sorting technique and TOPSIS method to obtain the prospective scholarship recipients based on the V_i obtained starting from the highest value to the lowest one by using Equation 3. The the application of SAW and TOPSIS in the selection process of scholarship recipients show

the following results: (1) The first alternative is V_5 = Ika, (2) The second Alternative is V_2 = Danu, (3) The third Alternative is V_1 = Alviana, (4) Fourth Alternative is V_4 = Fransiska, (5) Alternative fifth is V_3 = Elita.

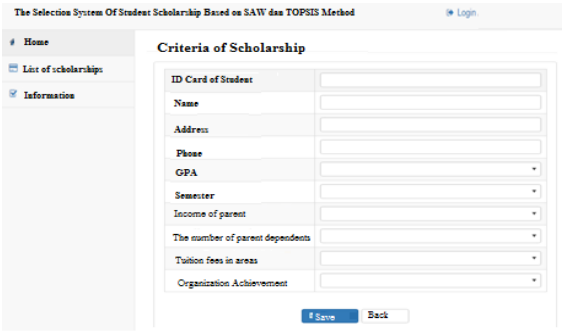

Fig. 1. Implementation of Criteria.

Tabel 3. Alternative of matrix Assessment.

	C1	C2	C3	C4	C5	C6
A1	3,54	4	1,5 million	4	0	nothing
A2	3,48	4	1,2 million	1	3 million	nothing
A3	3,39	4	3 million	1	1,5 million	College level
A4	3,34	4	4,9 million	3	0	nothing
A5	3,51	4	1 million	2	4,2 million	College levelt

Tabel **4.** Matrix Normalization.

	C1	C2	C3	C4	C5	C6
A1	1	1	0.667	1	0.2	0.5
A2	0.75	1	1	0.25	0.8	0.5
A3	0.75	1	0.333	0.25	0.4	1
A4	0.75	1	0.333	0.75	0.2	0.5
A5	1	1	1	0.5	1	1

In this research it is proven that SAW and TOPSIS method can be used to solve the problem of determination of scholarships grantees. Comparing to the result of manual caculation conducted by the campus adminitrator, result of the tests using SAW and TOPSIS seems to be more appropriate. In other word, the results indicate that the recipients are the right target of the scholarship. As the comparison, in each year there is always recipient(s) that does not meet the

criteria (the number of recipients in each year is presented in table 5). In 2013, for example, out of 12 recipients, one student is not appropriate because the student includes in the blacklist of scholarship recipients. While in 2014, there are three recipients who are not qualified due to the fact that those students violated the campus regulation. The other example is that in 2015, there is one of recipient who is not appropriate. Those students never get a scholarship in the previous period so that the backup was made when the candidate quota recipients less than or equal to 12 people. In 2016, the two scholarship recipients are not appropriate; it is because both these students are receiving other scholarships, namely class champion in each class. In the year 2017, the grantee with the method of calculation based on method of TOPSIS and SAW and the results of manual calculation wholly campus. The retrieved value of accuracy for five consecutive years are 92%, 75%, 92%, 83% and 100%. As for the average value of the accuracy of the method of SAW and TOPSIS on a five-year experiment data was 88.4%.

Table 5. Test result Accuracy SAW and TOPSIS Method.

Years	The appropriate data	Inappropriate data	Accuracy
2013	11	1	92%
2014	9	3	75%
2015	11	1	92%
2016	10	2	83%
2017	12	0	100%

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