

Implementation of Simple Additive Weighting For Scholarship Admission Selection

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ABSTRACT

Various types of scholarships are given to students who have achievements both academic and non-academic achievements. Conditions that often occur in the process of awarding scholarships, the assessment is not always decided based on definite considerations and predetermined criteria. Therefore, a decision support system is needed that can assist the scholarship selection team in making effective and efficient decisions. The decision support system to be built applies the Simple Additive Weighting (SAW) method with criteria such as IPS, GPA, Parents' Income, Number of Dependents of parents and Achievement. With the new system, it is expected to help the selection team related to managing applicant data, selection and proposal of scholarship recipients can be done more easily and quickly. After calculation, the highest score of 90.5 was obtained on behalf of Candra K which deserves to be a priority and recommended in receiving scholarships.

Keywords: Scholarship; Decision Support System, SAW

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1. INTRODUCTION

Various factors can support students to study hard so that lectures can be completed on time by holding a degree according to the chosen field of science or major. One of the factors that can support students' enthusiasm for learning is the existence of educational assistance in the form of scholarships. Scholarship is a program contained in an institution with the aim of helping students' education costs in order to continue their studies [1]. This form of assistance is usually given to everyone who has certain criteria for the continuation of the education pursued [2]. Various types of scholarships are given to students who have achievements in both academic and nonacademic achievements. Scholarships given by universities to students come from the government, private parties or from these universities.

Conditions that often occur in the process of providing scholarships to students experience obstacles. This is because the assessment process is not always decided based on definite considerations and predetermined criteria, such as Semester Achievement Index, Compulsive Achievement Index, parents'

income, number of parental dependents, achievements and others. The existence of various criteria can make it difficult for decision makers to determine which students are eligible to receive scholarships.

The process of determining the provision of scholarships to students will be more effective and efficient if using a decision support system. A decision support system is a specific information system aimed at solving a specific problem that must be solved [3]. The existence of a decision support system can help the selection team in the selection process for scholarship recipients so as to speed up the decision-making process based on predetermined criteria. The decision support system to be built applies the Simple Additive Weighting (SAW) method. This method was chosen because it is able to select the best alternative from a number of alternatives, the alternative referred to here is based on the specified criteria. This study was carried out by finding the weight value for each attribute, then carrying out the ranking process from the final assessment results [4]. This method is carried out by normalizing the matrix to a scale that can be considered with the data that has been collected and then making assessment criteria based on these data [5].

Research related to the Simple Additive Weighting (SAW) method has also been carried out before, such as research conducted by Sopian, et al [6] stated that in choosing an internet service package, four criteria were produced, namely connection speed, price, connection quality, and quota. From these criteria, the results of the ranking that have been carried out using the SAW method were found and the results were obtained that Telkomsel had the first rank.

Furthermore, research conducted by Setiawan [4] which states that the selection of prospective student admissions is determined based on 4 (four) criteria, including: report card scores; UN (National Examination) scores; written test; and interview test. The system that is built can be useful for the school as a suggestion in making decisions.

Then research related to the assessment of lecturer performance using the SAW method conducted by Kuswanto, et al [7] which states that the assessment criteria are based on: nilai mahasiswa; kedisiplineran; jenjang akademik; pendidikan; Karya ilmiah. This method was chosen because it is able to select the best alternative from a number of alternatives.

Research conducted by Ramadhan, et al [8], which states that the assessment of scholarship recipients will be right on target because it is based on predetermined criteria and weights, so as to get precise and accurate results and also right on target for students who will receive the scholarship program.

The purpose of this study is to build a decision support system in selecting scholarship acceptance by applying the Simple Additive Weighting (SAW) Method in the selection process. Data on assessment criteria are sourced from observations and interviews with the scholarship selection team. The criteria in the assessment are IPS, GPA, Parents' Income, Number of Dependents of parents and Achievement. With the new system, it is hoped that it can help the selection team related to the management of registrant data, selection and proposal of scholarship recipients can be done more easily and quickly[9].

2. RESEARCH METHODS

The method used in this study is the Simple Additive Weighting (SAW) Method method. The Simple Additive Weighting (SAW) method often also known as the weighted summation method is a method that has the basic concept that the normalized value of the criteria for alternatives must be multiplied by the weight of the criterion[8]. This method is a method used to find optimal alternatives from a number of alternatives with certain criteria [10]. Here are the steps in solving a problem using the Simple Additive Weighting method, namely [11]:

- a. Determine the criteria that will be used as a reference in decision making[12], namely C_i .
- b. Assigns the weight value for each of the criteria as W .
- c. Provide each alternative match rating value on each criterion.
Make a decision matrix based on criteria (C_i), then normalize the matrix based on equations adjusted to the type of attribute (profit attribute or cost attribute) so that a normalized matrix R is obtained[13]

$$R_{ij} = \begin{cases} \frac{X_{ij}}{\text{Max } X_{ij}} & \text{if } j \text{ is the benefit attribute} \\ \frac{\text{Min } X_{ij}}{X_{ij}} & \text{if } j \text{ is the cost attribute} \end{cases} \quad (1)$$

- d. The final result is obtained from the ranking process, namely the addition and multiplication of the normalized matrix R with the weight vector so that the largest value is obtained which is chosen as the best alternative (Ai) as a solution. With the following formula [14]:

$$V_{ij} = \sum_{i=1}^n W_j r_{ij} \quad (2)$$

3. RESULTS AND DISCUSSION

The following are the steps for completing the Simple Additive Weighting (SAW) method:

- a. Determine the criteria that will be used as a reference in decision making. The criteria used in the assessment process were obtained based on observations and interviews with the selection team. The criteria for the assessment process consist of 5 criteria, namely:
 - C1: IPS
 - C2: GPA
 - C3: Parents' Income
 - C4: Number of Parental Dependents
 - C5: Achievements
- b. Provide a weight value for each criterion.
 After determining the criteria for the assessment process, then giving weight to the criteria value. Weighting begins with determining the type of criterion whether benefit or cost and determining the value of the criterion weight. The determination can be seen in table 1 below:

Table 1. Weight Criteria

| Criterion | Information | Kind | Weight |
|-----------|---------------------------------|---------|--------|
| C1 | IPS | Cost | 20 |
| C2 | GPA | Benefit | 30 |
| C3 | Parents' Income | Benefit | 20 |
| C4 | Number of Dependents of parents | Benefit | 20 |
| C5 | Achievement | Cost | 10 |

- c. Provide each alternative match rating value on each criterion
 Next is to give a match rating value to each alternative on each criterion, the alternatives are as follows:

Table 2. Alternative

| Alternative | Student | C1 | C2 | C3 | C4 | C5 |
|-------------|-----------|------|------|-----------|----|---------------|
| A1 | Jovanca | 3.15 | 3.32 | 2.500.000 | 1 | Regency |
| A2 | Candra K | 3.35 | 3.40 | 1.750.000 | 3 | International |
| A3 | Silvia | 3.10 | 3.20 | 1.500.000 | 2 | Province |
| A4 | Ilham | 3.25 | 3.25 | 2.500.000 | 3 | National |
| A5 | Novanda | 3.20 | 3.20 | 1.600.000 | 1 | Regency |
| A6 | Bayu | 3.00 | 3.00 | 1.500.000 | 1 | Regency |
| A7 | Cindy | 3.15 | 3.17 | 2.500.000 | 2 | Province |
| A8 | Nendy | 3.25 | 3.25 | 2.250.000 | 3 | Province |
| A9 | Indri | 3.25 | 3.25 | 2.500.000 | 2 | Regency |
| A10 | Sepidiani | 3.15 | 3.10 | 1.500.000 | 1 | Regency |
| A11 | Febrianto | 3.35 | 3.40 | 2.200.000 | 2 | Province |
| A12 | Pratama | 3.00 | 3.00 | 2.500.000 | 2 | Province |
| A13 | Rahayu | 3.15 | 3.32 | 2.250.000 | 1 | Regency |
| A14 | Budianto | 3.00 | 3.18 | 2.200.000 | 2 | National |

From the alternative data in table 2 above, then analyze the criteria, determine the type of criteria (benefit or cost) and convert if the criteria have crips data.

Analysis results:

- IPS: type of cost criteria. There is no crips data so there is no need to convert values

- GPA: type of benefit criteria. There is no crips data so there is no need to convert values
- Parents' income: types of benefit criteria. There is crips data so it is necessary to convert values
- Number of dependents of parents: type of benefit criteria. There is no crips data so there is no need to convert values
- Achievement: type of cost criteria. There is crips data so it is necessary to convert values

Alternative conversions of parental income and achievement data are as follows:

- a) Parents' Income:
- 0 – 1,000,000 : Point 4
 - 1,000,001 – 2,000,000 : Point 3
 - 2,000,001 – 3,000,000 : Point 2
 - > 3,000,001 : Pointt 1
- b) Achievement:
- Regency : point 1
 - Province : point 2
 - Na tional : point 3
 - Interna tional : point 4

Table 3. Conversion Results

| Alternative | Student | C1 | C2 | C3 | C4 | C5 |
|-------------|-----------|------|------|----|----|----|
| A1 | Jovanca | 3.15 | 3.32 | 2 | 1 | 1 |
| A2 | Candra K | 3.35 | 3.40 | 3 | 3 | 4 |
| A3 | Silvia | 3.10 | 3.20 | 3 | 2 | 2 |
| A4 | Ilham | 3.25 | 3.25 | 2 | 3 | 3 |
| A5 | Novanda | 3.20 | 3.20 | 3 | 1 | 1 |
| A6 | Bayu | 3.00 | 3.00 | 3 | 1 | 1 |
| A7 | Cindy | 3.15 | 3.17 | 2 | 2 | 2 |
| A8 | Nendy | 3.25 | 3.25 | 2 | 3 | 2 |
| A9 | Indri | 3.25 | 3.25 | 2 | 2 | 1 |
| A10 | Sepidiani | 3.15 | 3.10 | 3 | 1 | 1 |
| A11 | Febrianto | 3.35 | 3.40 | 2 | 2 | 2 |
| A12 | Pratama | 3.00 | 3.00 | 2 | 2 | 2 |
| A13 | Rahayu | 3.15 | 3.32 | 2 | 1 | 1 |
| A14 | Budianto | 3.00 | 3.18 | 2 | 2 | 3 |

- d. Next is to make a decision matrix based on criteria, while the decision matrix based on table 3 above, namely:

$$x_{ij} = \begin{bmatrix} 3.15 & 3.32 & 2 & 1 & 1 \\ 3.35 & 3.40 & 3 & 3 & 4 \\ 3.10 & 3.20 & 3 & 2 & 2 \\ 3.25 & 3.25 & 2 & 3 & 3 \\ 3.20 & 3.20 & 3 & 1 & 1 \\ 3.00 & 3.00 & 3 & 1 & 1 \\ 3.15 & 3.17 & 2 & 2 & 2 \\ 3.25 & 3.25 & 2 & 3 & 2 \\ 3.25 & 3.25 & 2 & 2 & 1 \\ 3.15 & 3.10 & 3 & 1 & 1 \\ 3.35 & 3.40 & 2 & 2 & 2 \\ 3.00 & 3.00 & 2 & 2 & 2 \\ 3.15 & 3.32 & 2 & 1 & 1 \\ 3.00 & 3.18 & 2 & 2 & 3 \end{bmatrix}$$

Then normalize the matrix based on equations that are adjusted to the type of criteria, whether included in the benefit criteria or cost criteria. If the type of criterion is a benefit, then the normalization process is carried out by dividing the attribute value by the largest value of all attributes on the criterion. However, if the type of criterion is cost, then the normalization process is carried out by dividing the smallest value of all attributes on the criterion by the attribute value. The following are the calculation results based on predetermined benefit and cost criteria:

C1 : IPS (Cost)

$$r_{11} = \frac{3.00}{3.15} = 0.95$$

$$r_{12} = \frac{3.00}{3.35} = 0.90$$

$$r_{13} = \frac{3.00}{3.10} = 0.97$$

$$r_{14} = \frac{3.00}{3.25} = 0.92$$

$$r_{15} = \frac{3.00}{3.20} = 0.94$$

$$r_{16} = \frac{3.00}{3.00} = 1.00$$

$$r_{17} = \frac{3.10}{3.15} = 0.95$$

$$r_{18} = \frac{3.10}{3.25} = 0.92$$

$$r_{19} = \frac{3.10}{3.25} = 0.92$$

$$r_{110} = \frac{3.10}{3.15} = 0.95$$

$$r_{111} = \frac{3.10}{3.35} = 0.90$$

$$r_{112} = \frac{3.00}{3.00} = 1.00$$

$$r_{113} = \frac{3.10}{3.15} = 0.95$$

$$r_{114} = \frac{3.00}{3.00} = 1.00$$

C2 : GPA (Benefit)

$$r_{11} = \frac{3.32}{3.40} = 0.98$$

$$r_{12} = \frac{3.40}{3.40} = 1.00$$

$$r_{13} = \frac{3.17}{3.40} = 0.93$$

$$r_{14} = \frac{3.25}{3.40} = 0.96$$

$$r_{15} = \frac{3.18}{3.40} = 0.94$$

$$r_{16} = \frac{3.00}{3.40} = 0.88$$

$$r_{17} = \frac{3.17}{3.40} = 0.93$$

$$r_{18} = \frac{3.25}{3.40} = 0.96$$

$$r_{19} = \frac{3.25}{3.40} = 0.96$$

$$r_{110} = \frac{3.10}{3.40} = 0.91$$

$$r_{111} = \frac{3.40}{3.40} = 1.00$$

$$r_{112} = \frac{3.00}{3.40} = 0.88$$

$$r_{113} = \frac{3.32}{3.40} = 0.98$$

$$r_{114} = \frac{3.18}{3.40} = 0.94$$

C3 : Parents' Income (Benefit)

$$r_{11} = \frac{2}{3} = 0.67$$

$$r_{12} = \frac{3}{3} = 1.00$$

$$r_{13} = \frac{3}{3} = 1.00$$

$$r_{14} = \frac{2}{3} = 0.67$$

$$r_{15} = \frac{3}{3} = 1.00$$

$$r_{16} = \frac{3}{3} = 1.00$$

$$r_{17} = \frac{2}{3} = 0.67$$

$$r_{18} = \frac{2}{3} = 0.67$$

$$r_{19} = \frac{2}{3} = 0.67$$

$$r_{110} = \frac{3}{3} = 1.00$$

$$r_{111} = \frac{2}{3} = 0.67$$

$$r_{112} = \frac{2}{3} = 0.67$$

$$r_{113} = \frac{2}{3} = 0.67$$

$$r_{114} = \frac{2}{3} = 0.67$$

C4 : Number of Dependents of parents (Benefit)

$$r_{11} = \frac{1}{3} = 0.33$$

$$r_{12} = \frac{3}{3} = 1.00$$

$$r_{13} = \frac{2}{3} = 0.67$$

$$r_{14} = \frac{3}{3} = 1.00$$

$$r_{15} = \frac{1}{3} = 0.33$$

$$r_{16} = \frac{1}{3} = 0.33$$

$$r_{17} = \frac{2}{3} = 0.67$$

$$r_{18} = \frac{3}{3} = 1.00$$

$$r_{19} = \frac{2}{3} = 0.67$$

$$r_{110} = \frac{1}{3} = 0.33$$

$$r_{111} = \frac{2}{3} = 0.67$$

$$r_{112} = \frac{2}{3} = 0.67$$

$$r_{113} = \frac{1}{3} = 0.33$$

$$r_{114} = \frac{2}{3} = 0.67$$

C5 : Achievement (Benefit)

$$r_{11} = \frac{1}{1} = 1.00$$

$$r_{12} = \frac{1}{4} = 0.25$$

$$r_{13} = \frac{1}{2} = 0.50$$

$$r_{14} = \frac{1}{3} = 0.33$$

$$r_{15} = \frac{1}{1} = 1.00$$

$$r_{16} = \frac{1}{1} = 1.00$$

$$r_{17} = \frac{1}{2} = 0.50$$

$$r_{18} = \frac{1}{2} = 0.50$$

$$r_{19} = \frac{1}{1} = 1.00$$

$$r_{110} = \frac{1}{1} = 1.00$$

$$r_{111} = \frac{1}{2} = 0.50$$

$$r_{112} = \frac{1}{2} = 0.50$$

$$r_{113} = \frac{1}{1} = 1.00$$

$$r_{114} = \frac{1}{3} = 0.33$$

Here's the normalization result matrix

$$x_{ij} = \begin{pmatrix} 0.95 & 0.98 & 0.67 & 0.33 & 1.00 \\ 0.90 & 1.00 & 1.00 & 1.00 & 0.25 \\ 0.97 & 0.93 & 1.00 & 0.67 & 0.50 \\ 0.92 & 0.96 & 0.67 & 1.00 & 0.33 \\ 0.94 & 0.94 & 1.00 & 0.33 & 1.00 \\ 1.00 & 0.88 & 1.00 & 0.33 & 1.00 \\ 0.95 & 0.93 & 0.67 & 0.67 & 0.50 \\ 0.92 & 0.96 & 0.67 & 1.00 & 0.50 \\ 0.92 & 0.96 & 0.67 & 0.67 & 1.00 \\ 0.95 & 0.91 & 1.00 & 0.33 & 1.00 \\ 0.90 & 1.00 & 0.67 & 0.67 & 0.50 \\ 1.00 & 0.88 & 0.67 & 0.67 & 0.50 \\ 0.95 & 0.98 & 0.67 & 0.33 & 1.00 \\ 1.00 & 0.94 & 0.67 & 0.67 & 0.33 \end{pmatrix}$$

- e. The final result is obtained from the ranking process, namely the addition and multiplication of the normalized matrix R with the weight vector so that the largest value is obtained which is chosen as the best alternative (A_i) as a solution

$$V1 = (0.95 \times 20) + (0.98 \times 30) + (0.67 \times 20) + (0.33 \times 20) + (1 \times 10) = 78.4$$

$$V2 = (0.9 \times 20) + (1 \times 30) + (1 \times 20) + (1 \times 20) + (0.25 \times 10) = 90.5$$

$$V3 = (0.97 \times 20) + (0.93 \times 30) + (1 \times 20) + (0.67 \times 20) + (0.5 \times 10) = 85.7$$

$$V4 = (0.92 \times 20) + (0.96 \times 30) + (0.67 \times 20) + (1 \times 20) + (0.33 \times 10) = 83.9$$

$$V5 = (0.94 \times 20) + (0.94 \times 30) + (1 \times 20) + (0.33 \times 20) + (1 \times 10) = 83.6$$

$$V6 = (1 \times 20) + (0.88 \times 30) + (1 \times 20) + (0.33 \times 20) + (1 \times 10) = 83$$

$$V7 = (0.95 \times 20) + (0.93 \times 30) + (0.67 \times 20) + (0.67 \times 20) + (0.5 \times 10) = 78.7$$

$$V8 = (0.92 \times 20) + (0.96 \times 30) + (0.67 \times 20) + (1 \times 20) + (0.5 \times 10) = 85.6$$

$$V9 = (0.92 \times 20) + (0.96 \times 30) + (0.67 \times 20) + (0.67 \times 20) + (1 \times 10) = 84$$

$$V10 = (0.95 \times 20) + (0.91 \times 30) + (1 \times 20) + (0.33 \times 20) + (1 \times 10) = 82.9$$

$$V11 = (0.9 \times 20) + (1 \times 30) + (0.67 \times 20) + (0.67 \times 20) + (0.5 \times 10) = 79.8$$

$$V12 = (1 \times 20) + (0.88 \times 30) + (0.67 \times 20) + (0.67 \times 20) + (0.5 \times 10) = 78.2$$

$$V13 = (0.95 \times 20) + (0.98 \times 30) + (0.67 \times 20) + (0.33 \times 20) + (1 \times 10) = 78.4$$

$$V14 = (1 \times 20) + (0.94 \times 30) + (0.67 \times 20) + (0.67 \times 20) + (0.33 \times 10) = 78.3$$

The final result of the calculation above can be made a table based on the ranking as follows:

Table 4. Ranking

| Alternative | Student | V | Rank |
|-------------|-----------|------|------|
| A1 | Jovanca | 78.4 | 11 |
| A2 | Candra K | 90.5 | 1 |
| A3 | Silvia | 85.7 | 2 |
| A4 | Ilham | 83.9 | 5 |
| A5 | Novanda | 83.6 | 6 |
| A6 | Bayu | 83.0 | 7 |
| A7 | Cindy | 78.7 | 10 |
| A8 | Nendy | 85.6 | 3 |
| A9 | Indri | 84.0 | 4 |
| A10 | Sepidiani | 82.9 | 8 |
| A11 | Febrianto | 79.8 | 9 |
| A12 | Pratama | 78.2 | 14 |
| A13 | Rahayu | 78.4 | 12 |
| A14 | Budianto | 78.3 | 13 |

So from the calculations above, it can be concluded that the recommendation for the selection of scholarship recipients in this study is Candra K because it gets the highest score of 90.5.

4. CONCLUSION

Looking at the results of the calculation above, that the application of the Simple Additive Weighting (SAW) method for scholarship admission selection is based on 5 criteria, namely IPS, GPA, parents' income, number of parental dependents, and achievements. The final result of the assessment obtained the highest preference value of 0.83 on behalf of Candra K. Based on the results of the assessment above, it can be concluded that the system built is said to be successful.

To get better and more accurate results, it is recommended to add other criteria and combine with methods such as TOPSIS so that the final decision will be maximized. The TOPSIS method uses the principle that the chosen alternative should have the closest distance from the positive ideal solution and the longest distance (farthest) from the negative ideal solution from a geometric point of view by using the distance between two points to determine the relative proximity of an alternative.

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