
Implementation of Additive Weighting in Providing in Receiving Bidik Misi Scholarships at the Politeknik Bisnis Indonesia

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Abstract - This research was conducted to design a Decision Support System as a tool for decision makers in distributing the Bidik Misi Scholarship at the Politeknik Bisnis Indonesia. The selection of students who volunteered to become Bidik Misi Scholarship recipients used the Decision Support System (DSS) approach which applied the Simple Additive Weighting (SAW) method so that the decisions of Bidik Misi Scholarship recipients that had been subjective, non-transparent, and immeasurable could be overcome. The Simple Additive Weighting method is carried out by weighting the criteria and sub-criteria for each alternative for all attributes. The SAW method in the process is by normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings. The criteria used in the SAW method in this study consisted of 2 (two) criteria and each of these criteria had Sub Criteria. The first criterion is Parents with Sub Criteria consisting of: Education, Income, The Number of Dependents. The second criterion is Students with Sub Criteria consisting of Age, Academic Potential, KIP Ownership. The output obtained from 5 data samples analyzed in this study obtained first rank NM1 with a value of 0.9, second rank NM3 with a value of 0.77, third rank NM5 with a value of 0.62, fourth rank NM4 with a value of 0.59, fifth rank NM2 with a value of 0.55. Based on the results of the tests conducted, it is concluded that the Bidik Misi Scholarship decision support system using the SAW method can make it easier and very helpful in solving the problems faced by the Politeknik Bisnis Indonesia.

Keywords : DSS; SAW; Bidik Misi

1. Introduction

The Bidik Misi Scholarship is a tuition assistance program for prospective students who are economically disadvantaged but have good academic abilities to pursue higher education. Bidik Misi Scholarship recipients are determined based on certain criteria established by the Ministry of Research, Technology and Higher Education. This scholarship aims to reduce the cost of education for students. (Bisikmisi 2017)

The Politeknik Bisnis Indonesia is a tertiary institution that is mandated by the Central Government through the Directorate General of Higher Education, Ministry of National Education, Republic of Indonesia to manage the Bidik Misi Scholarship Program for prospective students. The implementation of the Bidik Misi Scholarship Program at the Indonesian Business Polytechnic found difficulties in determining the recipients of the Bidik Misi Scholarship. The Indonesian Business Polytechnic grows every year and the number of students applying for the Bidik Misi Scholarship increases. Determination of Bidik Misi scholarship recipients have not used systems and methods that can facilitate decision making, so that the recipients seem to be treated subjectively, as well as the time needed in processing old data.

The Simple Additive Weighting (SAW) method is known as the weighted addition method. The basic concept of the SAW method is to find the number of weighted performance ratings for each alternative on all attributes. (Fricles Ariwisanto Sianturi 2019) This method makes it easy to select weighting factors or attributes. (Supriyanti, Kusriani, and Luthfi 2019) In the SAW method, each attribute is given a weight and the sum of all weights must be 1. (Taufiq and Saputra 2018) Each alternative is assessed in relation to each attribute.

2. Literature Review

2.1. Decision Support System (DSS)

Interactive computer-based systems to assist decision making by utilizing data and models in solving semi-structured and unstructured problems. (Prayogo, Muflikhah, and Wijoyo 2018) (Simarmata et al. 2018) (Rosulastri Purba1 2019) Decision Support System is known as research and management science decision-making operations, the difference is that if the first to solve a problem must be manually calculated iterations to find the minimum, maximum, or optimal value, nowadays, the computer can solve the same problem in time. relatively short. (Prisa Marga Kusumantara, Mashita Kustiyani 2019) (Aisyah 2019)

The characteristics and capabilities of the Decision Support System (DSS) are as follows (Riyanto and Haryanti 2017):

1. Decision Support Systems provide support for decision makers primarily in semistructured and unstructured situations by combining human judgment and computerized information.
2. Providing support for managerial level from executive to manager.
3. Providing support for individual groups, less structured problems require the involvement of several individuals from other departments in the organization.
4. Decision support systems provide support to independent or ongoing decisions.
5. Decision support systems provide support to all phases in the decision-making process of intelligence, design, choice and implementation.
6. Decision support systems support many decision-making processes and styles.
7. Decision support systems are adaptive to time, decision makers must be reactive to deal with changing conditions quickly and change decision support systems must be flexible so that users can add, delete, combine, change and rearrange basic elements.
8. The decision support system is easy to use. Users feel at home when working with systems, such as user friendly, flexibility, high ability to use graphics and language to interact with machines such as using English, it will increase the effectiveness of the decision support system.
9. Decision support systems increase the effectiveness of decision making both in terms of timeliness and quality, not in the cost of making decisions or the cost of using computer time.
10. Decision makers can control the stages of decision-making such as the intelligence, choice and implementation stages and the decision support system is directed to support the decision maker, not replace its position.
11. Allows end users to build their own simple systems. Large systems can be built with the help of information systems specialists.
12. Decision support systems use standard or user-made models to analyze decision states. Modeling capabilities allow experimenting with different strategies under different configurations.

2.2 Simple Additive Weighting (SAW)

SAW is one of the methods used in problem solving. Known as the weighted addition method. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative of all attributes. The SAW method requires a decision matrix normalization process (x) to a scale that can be compared with all available alternative ratings. (Hardita, Utami, and Luthfi 2019) (Rochmawati and Marisa 2018) (Putra, Aryanti, and Hartati 2018)

The stages of the Simple Additive Weighting method, namely:

1. Determine the variables used as a reference in decision making, namely C_i
2. Give the weighted value for each variable as W
3. Give the rating value of the suitability of each alternative on each variable
4. Make a decision matrix based on the variable (C_i), then form a normalized matrix based on an equation that is adjusted to the type of attribute so that a normalized matrix R is obtained.

The formula used to carry out normalization:

$$R_{ij} = \left\{ \begin{array}{l} \frac{X_{ij}}{\text{Max } X_{ij}} \text{ jika } j \text{ adalah atribut keuntungan (benefit)} \\ \frac{\text{Min } X_{ij}}{X_{ij}} \text{ jika } j \text{ adalah atribut keuntungan (cost) } X_{ij} \end{array} \right\} \quad \dots (1)$$

Information:

- R_{ij} = Normalized performance rating of the A_i alternatives on the attribute C_j : $i=1,2,\dots,m$ and $j = 1,2, \dots, n$
- Max X_{ij} = The greatest value of each criterion i
- Min X_{ij} = The smallest value of each criterion i
- X_{ij} = The attribute value that each criterion has
- Benefit = If the greatest value is best
- Cost = If the smallest value is best

The preference value for each alternative (V_i) is given the following formula:

$$V_i = \sum_{j=1}^n W_j r_{ij} \quad \dots (2)$$

Information :

- V_i = Ranking for each alternative
- W_j = Rank weight value (from each alternative)
- R_{ij} = The performance rating value is normalized
- Nilai V_i = the larger one indicates that the alternative A_i is preferred. (Setiadi, Yunita, and Ningsih 2018)(Ismanto and Effendi 2017) (Hermanto and Izzah 2018)(Sri and Tamando Sihotang 2019)(Muhammad, Novi, and Narti 2017)

2.3 Bidik Misi Scholarship Program

The Bidik Misi scholarship program is a tuition assistance program for prospective students who are economically disadvantaged and have good academic potential to pursue higher education. Bidik Misi Scholarship recipients are determined based on certain criteria established by the Ministry of Research, Technology and Higher Education. (Fauzan, Indrasary, and Muthia 2018).

3. METHOD

3.1 Research completion steps

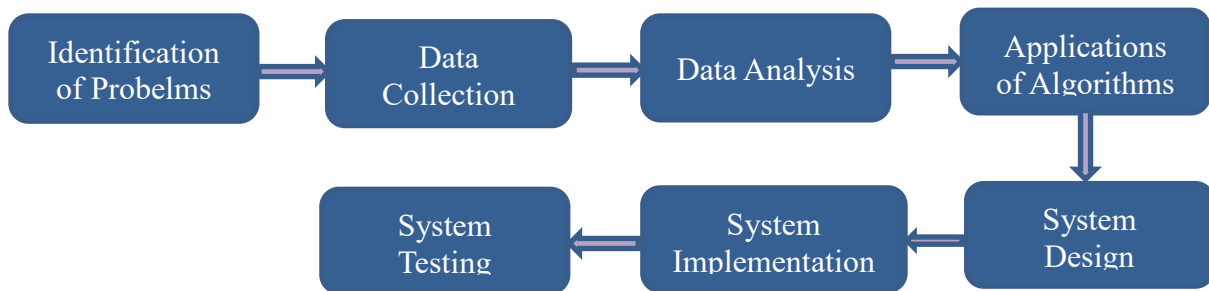


Figure 1. Framework Research

3.2 The following is the use case diagram of the Decision System

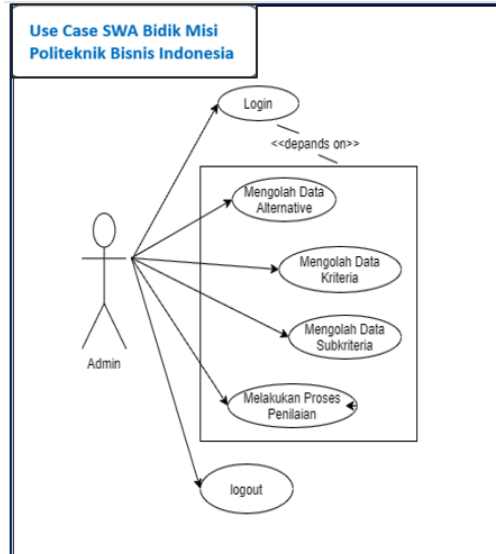


Figure 2. Use Case Diagram

4. RESULT

4.1 Analisis Data dengan metode Simple Additive Weighting (SAW)

1. Determine the criteria that will be used as a reference in making decisions (**C_j**)
 In determining the acceptance of the Bidik Misi Scholarship, 2 criteria are used, namely: parents and students, as well as 6 Sub Criteria, namely: Education, Income, The Number of Dependents, Age, Academic Potential, KIP Ownership.

Table 1
 Criteria and Sub Criteria

Criteria	Sub Criteria	Weight
Parents	Education	20%
	Income	20%
	The Number of Dependents	10%
Students	Age	10%
	Academic Potential	20%
	KIP Ownership	20%

2. Alternative Weights of Each Criterion Fit Rating

Table 2
 Alternative Weights of Each Criterion Fit Rating

Criteria	Sub Criteria	Scale Value	
		Scale	Value
Parents	Education	S3	1
		S2	2
		D-IV & S1	3
		SMA – D-III	4
		SD - SMP	5
	Income	> 4 Milion	1

		3 – 4 Milion	2
		2 – 3 Milion	3
		1 – 2 Milion	4
		< 1 Milion	5
		2 Person	1
		3 Person	2
		4 Person	3
		5 Person	4
		> 6 Person	5
	Age	> 21	1
		< 18	2
		18 - 21	5
		< 75	1
Students	Academic Potential	75,00 – 79,99	2
		80,00 – 84,99	3
		85,00 – 89,99	4
		90,00 – 100,00	5
KIP Ownership	Not Have	1	
	Have	5	

3. Data Analysis

Table 3
Alternative Data

Name	Education	Income	The Number of Dependents	Age	Academic Potential	KIP Ownership
NM1	SD – SMP	1.000.000	3	20	8,5	Have
NM2	D-IV & S1	2.000.000	6	22	8,5	Not Have
NM3	SMA – D-III	2.500.000	2	17	9	Have
NM4	SMA – D-III	1.500.000	3	23	8,5	Not Have
NM5	SMA – D-III	3.000.000	4	17	7,9	Have

4. Alternative Match Ratings

Table 4
Alternative Match Ratings

Name	Parents (C1)				Student (C2)	
	Education	Income	The Number of Dependents	Age	Academic Potential	KIP Ownership
NM1	5	4	2	5	4	5
NM2	3	3	6	1	3	1
NM3	4	3	1	2	5	5
NM4	4	3	3	1	4	1
NM5	4	2	4	2	1	5

5. Decision Matrix X

$$X = \begin{Bmatrix} 5 & 4 & 2 & 5 & 4 & 5 \\ 3 & 3 & 5 & 1 & 3 & 1 \\ 4 & 3 & 1 & 2 & 5 & 5 \\ 4 & 3 & 3 & 1 & 4 & 1 \\ 4 & 2 & 4 & 2 & 1 & 5 \end{Bmatrix}$$

6. Normalize the decision matrix (X) by calculating the normalized performance rating value (R_{ij}) of the alternative (A_i) on the criterion (C_j).

- a. Normalization for Education

$$R_{11} = \frac{5}{\text{Max} \{5,3,4,4,4\}} = \frac{5}{5} = 1$$

$$R_{21} = \frac{3}{\text{Max} \{5,3,4,4,4\}} = \frac{3}{5} = 0,6$$

- b. Normalization for Income

$$R_{12} = \frac{4}{\text{Max} \{4,3,3,3,2\}} = \frac{4}{4} = 1$$

$$R_{22} = \frac{3}{\text{Max} \{4,3,3,3,2\}} = \frac{3}{4} = 0,75$$

- c. Normalization for The Number of Dependents

$$R_{13} = \frac{2}{\text{Max} \{2,5,1,3,4\}} = \frac{2}{5} = 0.4$$

$$R_{23} = \frac{5}{\text{Max} \{2,5,1,3,4\}} = \frac{5}{5} = 1$$

- d. Normalization for Age

$$R_{14} = \frac{5}{\text{Max} \{5,1,2,1,2\}} = \frac{5}{5} = 1$$

$$R_{24} = \frac{1}{\text{Max} \{5,1,2,1,2\}} = \frac{1}{5} = 0,2$$

- e. Normalization for Academic Potential

$$R_{15} = \frac{4}{\text{Max} \{4,3,5,4,1\}} = \frac{4}{5} = 0,8$$

$$R_{25} = \frac{3}{\text{Max} \{4,3,5,4,1\}} = \frac{3}{5} = 0,6$$

- f. Normalization for KIP Ownership

$$R_{16} = \frac{5}{\text{Max} \{5,1,5,1,5\}} = \frac{5}{5} = 1$$

$$R_{26} = \frac{1}{\text{Max} \{5,1,5,1,5\}} = \frac{1}{5} = 0,2$$

Normalized matrix from above data analysis

$$R = \begin{pmatrix} 1 & 1 & 0.4 & 1 & 0.8 & 1 \\ 0.6 & 0.75 & 1 & 0.2 & 0.6 & 0.2 \\ 0.8 & 0.75 & 0.2 & 0.4 & 1 & 1 \\ 0.8 & 0.75 & 0.6 & 0.2 & 0.8 & 0.2 \\ 0.8 & 0.5 & 0.8 & 0.4 & 0.2 & 1 \end{pmatrix}$$

7. Determine the Final Preference Value (V_i)

$$V_1 = (0.2*1) + (0.2*1) + (0.1*0.4) + (0.1*1) + (0.2*0.8) + (0.2*1) = 0,9$$

$$V_2 = (0.2*0.6) + (0.2*0.75) + (0.1*1) + (0.1*0.2) + (0.2*0.6) + (0.2*0.2) = 0,55$$

$$V_3 = (0.2*0.8) + (0.2*0.75) + (0.1*0.2) + (0.1*0.4) + (0.2*1) + (0.2*1) = 0,77$$

$$V_4 = (0.2*0.8) + (0.2*0.75) + (0.1*0.6) + (0.1*0.2) + (0.2*0.8) + (0.2*0.2) = 0,59$$

$$V_5 = (0.2*0.8) + (0.2*0.5) + (0.1*0.8) + (0.1*0.4) + (0.2*0.2) + (0.2*1) = 0,62$$

From the results of the analysis above, the final preference value of each alternative is obtained.

Table 5
Preference Values (V)

Name	Preference Values
MN1	0,9
MN2	0,55
MN3	0,77
MN4	0,59
MN5	0,62

8. Create a Rank

The ranking for each alternative is determined based on the final preference value obtained by the alternative by sorting the preference value downward from the highest preference value to the lowest preference value.

Table 6
Rating Alternative

Name	Preference Values	Rating
MN1	0,9	1
MN3	0,77	2
MN5	0,62	3
MN4	0,59	4
MN2	0,55	5

9. Testing With the System

- a. Alternative Assessment With Systems

IMPLEMENTASI METODE SAW (SIMPLE ADDITIVE WEIGHTING) DALAM SISTEM PENDUKUNG KEPUTUSAN PENERIMA BEASISWA BIDIKMISI DI POLITEKNIK BISNIS INDONESIA										
[HOME] [Kriteria] [Sub Kriteria] [Klasifikasi] [Mahasiswa] [Bobot SAW] [Nilai Kriteria] [Hasil] [Logout]										
Nilai Kriteria Alternatif										
No.	N I M	NAMA mahasiswa	ORANGTUA			MAHASISWA			AKSI	
			PENDIDIKAN	PENGHASILAN KOTOR	JUMLAH TANGGUNGAN	USIA	POTENSI AKADEMIK	KEPEMILIKAN KIP		
1	1900001	Vivin Irmayanti	SD - SMP	1 jt - 2 jt	3 orang	18-21	85.00 - 89.99	Memiliki	Edit	Hapus
2	1900002	andana sakti siregar	DIPLOMA4 - S1	2 jt - 3 jt	>6 orang	>21	80.00 - 84.99	Tidak Memiliki	Edit	Hapus
3	1900003	Dian Marta	SMA - DIPLOMA3	2 jt - 3 jt	2 orang	<18	90.00 - 100	Memiliki	Edit	Hapus
4	1900004	Marini Silalahi	SMA - DIPLOMA3	2 jt - 3 jt	4 orang	>21	85.00 - 89.99	Tidak Memiliki	Edit	Hapus
5	1900005	Haries Raja Guk-guk	SMA - DIPLOMA3	3jt - 4jt	5 orang	<18	<75	Memiliki	Edit	Hapus

Figure 3. Alternativa Appraisal

b. Preference Value With System

Name	Parents (C1)			Student (C2)			Result
	Education	Income	The Number of Dependents	Age	Academic Potential	KIP Ownership	
NM1	0.2	0.2	0.04	0.1	0.16	0.2	0.9
NM2	0.12	0.15	0.1	0.02	0.12	0.04	0.55
NM3	0.16	0.15	0.02	0.04	0.2	0.2	0.77
NM4	0.16	0.15	0.06	0.02	0.16	0.04	0.59
NM5	0.16	0.1	0.08	0.04	0.04	0.2	0.62

Figure 4. Preference Value

5. Discussions

From the results of the tests conducted, it shows that the Bidik Misi Scholarship Decision Making System is designed to operate properly and correctly according to the results of manual calculations.

Table 7
 Conculation Analysis

Name	Calculation of Seniors	System Calculation	Evaluastion
NM1	0.9	0.9	Appropriate
MN3	0.77	0.77	Appropriate
NM5	0.62	0.62	Appropriate
NM4	0.59	0.59	Appropriate
NM2	0.55	0.55	Appropriate

6. Conclusion

The Bidik Misi Scholarship Decision Support System using the SAW method can help the Politeknik Bisnis Indonesia Pematangsiantar. From the results of the research conducted using 5 data samples, it was obtained that the first rank was NM1 with a value of 0.9, the second rank was NM3 with a value of 0.77, the third rank was NM5 with a value of 0.62, the fourth rank was NM4 with a value of 0.59, the fifth rank was NM2 with a value of 0.55. Based on the results of the tests conducted, it is concluded that the Bidik Misi Scholarship decision support system using the SAW method can make it easier and very helpful in solving the problems faced by the Politeknik Bisnis Indonesia

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