Implementation of Simple Additive Weighting to Decide a Fund Proposal

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Abstract

One of Indonesian micro financial services is Baitul Maal Wat Tamwil (BMT) provides services such as savings, financing and zakat activities. Financing service determines qualifying status based on consideration of customer files before carried out in company discussions. This decision support system aims to provide officers to decide whether or not to admit funding. The research used Simple Additive Weighting (SAW) by finding the prejudiced sum of the performance ratings for each alternative from all criteria. The method used 7 criteria including income, outstanding loans, amount of financing, collateral, nature/environment, track record of financing and monthly expenses. Customers were declared acceptable if they had a preference value above the minimum limit of 16.1. The BMT officer can adjust the minimum limit value according to customer performance. To develop the system used the waterfall method and to verify system performance used a black box test which shows the results that the system works according to its function and the validity test results obtained 100% accurate. It means the system is ready and suitable for use. The existence of this decision support system is able to assist officers in making decisions to qualify for financing objectively.
Keywords: decision support system, customer, financing, SAW

1. Introduction

Economic activities continue to develop with the aim of meeting the needs and increasing welfare of the community. Many financial institutions play a role in helping to facilitate and improve the economy of Indonesian society. Baitul Maal Wat Tamwil (BMT) is a sharia financial institution that helps low-income people to obtain micro financing [1]. The activities of Baitul Maal are developing productive businesses and investments in increasing the value of the economic activities of small and medium-sized entrepreneurs by encouraging savings activities and supporting financing activities [2].

BMT Sejahtera Mandiri is an institution that was founded in March 2015 and functions to support the economy of the community in Giriwoyo District and its surroundings. The services available at BMT are in the form of savings, financing and zakat infaq activities. Financing, as a service that is in demand, is widely used by customers for business capital needs, purchasing motor vehicles, electronic equipment and school or hospital payment needs. Before receiving financing, customers need to submit a financing application by completing the specified requirements at the BMT office. Then the officers will conduct a survey of the surrounding environment regarding the behavior and character of customers. After all the data is obtained, the officer will make a decision on whether to qualify for conventional financing, namely by team discussion based on consideration of the existing files.

There are 67 customers who submitted applications for financing in February 2023. 53 of them were selected and decided to receive the financial program. In making decisions, BMT is required to be wise and thorough in order to minimize the occurrence of bad credit. Many previous customers were supposed to delay their payment credits. To avoid this

ailment, a decision support system is needed to determine customer financing approval decisions.

Decision support systems (DSS) is an interactive system that provides information, modeling and data manipulation that is used to help solve structured and unstructured problems. DSS can assist decision making and improve data processing. The DSS method used in this customer financing approval decision-making system is the Simple Additive Weighting (SAW). The SAW method, often known as the weighted addition method, has the advantage of being able to carry out assessments more precisely because it is based on predetermined criteria values and preference weights. The selection of the best alternative from existing alternatives is obtained from the ranking after weighting each attribute [3].

A case study of Surabaya wedding organizer selection, SAW is relatively relevant to be implemented compared to Weighted Product (WP) in the selection with a hamming distance value of 78% compared to a value of 80% [4]. Another research on determining road repair priorities in Rembang Regency, found a sensitivity test value for SAW 5.95% compared to the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method of 0.038% [5]. The sensitivity test selects the method that has a greater sensitive value so that the SAW method is selected as the relevant method. Other research on the comparison between SAW and WP in the decision support system for receiving direct cash assistance government programs showed that SAW is more recommended because the level of conformity between system calculations and manual calculations shows 0% error, whereas in WP there was a slight difference between the results of system calculations and manual calculations [6]. SAW was implemented in research on the creditworthiness of loans at BMT [8] with the criteria of photocopies of Family Cards, Resident Identity Cards, electricity bills, Land and Building Tax, and guaranteed land/building certificates. Meanwhile, in research on determining prospective financing members for BMT Bina Usaha Mandiri Indonesia [9], the criteria used in the research are the applicant's age, collateral, income and housing status.

Based on the problems described previously, a decision support system for customer financing approval using the SAW method is needed. The aim of this research is to assist BMT officers in deciding whether to provide or reject financing proposed by customers. It is hoped that this system will make it easier for officers to make decisions objectively and more efficiently.

2. Method

In the implementation process, a decision support system requires a flowchart. Figure 1 shows a flowchart whose stages start from inputting customer data, determining the weight of the criteria, then inputting sub-criteria data and their values, and then carrying out an alternative assessment process for each criterion. The system will create a decision matrix which is followed by normalizing the decision matrix R and producing a preference value for each alternative which is then obtained by the SAW calculation.

Table 1. Criteria and Attributes

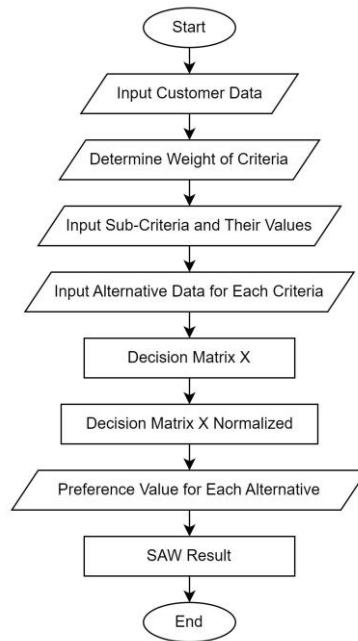|	Criteria	Attribute
C1	Income	Benefit
C2	Guarantee	Benefit
C3	The loan has not been paid off	Cost
C4	Amount of financing	Cost
C5	Behaviour or Environment	Benefit
C6	Track record of financing	Benefit
C7	Expenses per month	Cost

Figure 1 *Flowchart DSS of* SAW.

After determining the criteria and attributes, weighting is required for each criterion based on the level of importance of the weight. Shown in Table 2 are the values of the weighted importance levels starting from 1-5 with levels from lower to higher.

Table 2. Importance level of weight.

Value	Detail
1	Lowest
2	Low
3	Medium
4	High
5	Highest

Based on the level of weight values that have been determined in Table 2, each criterion is then weighted. Each criterion is given based on Table 2. The income criterion is given a weight of 3, collateral is given a weight of 4, outstanding loans are given a weight of 2, the amount of financing is given a weight of 5, the nature or environment is given a weight of 3, track record of financing is given a weight of 3, and monthly expenditure is given a weight of 3. Data on the criteria weighting values can be seen in Table 3.

Table 3. The weighted Value of Criteria.

Criteria	Weight
Income	4
Guarantee	4
The loan has not been paid off	2
Amount of financing	5
Behavior or Environment	3
Track record of financing	3
Expenses per month	3

The criteria that have been determined require sub-criteria, which give details of each criterion provided more specific scales. Based on Table 4, the criteria for income are taken from a scale of less than 1 million until a scale of above 4 million Rupiah, Guarantee criteria is ranging from account officer to certificate, Amount of outstanding loans taken from an income scale of 500 thousand until above 6 million, amount of financing taken from a financing scale of 5 million until 30 million, behavior criteria is ranging from

unrecommended to good, track record is ranging from bad credit to good credit, while monthly expenses are taken on a scale of less than 1 million until above 4 million.

Table 4. Criteria, Sub-criteria, and their Weight.

Criteria	Sub-criteria	Weight
Income (C1)	Income ≤ 1.000.000	1
	Income 1.100.000 - 2.000.000	2
	Income 2.100.000 - 3.000.000	3
	Income 3.100.000 - 4.000.000	4
	Income ≥ 4.000.000	5
Guarantee(C2)	*Account Officer*	1
	Diploma certificate	2
	Vehicle owner certificate	3
	Land/building certificate	4
The loan has not been paid off (C3)	Unpaid loan ≤ 500.000	1
	Unpaid loan 500.000 - 2.000.000	2
	Unpaid loan 2.100.000 - 3.500.000	3
	Unpaid loan 3.500.000 - 5.000.000	4
	Unpaid loan ≥ 5.000.000	5
Amount of financing (C4)	Amount ≤ 5.000.000	1
	Amount 5.100.000 - 10.000.000	2
	Amount 10.100.000 - 15.000.000	3
	Amount 15.100.000 - 20.000.000	4
	Amount 21.100.000 - 30.000.000	5
Behavior or Environment (C5)	Unrecommended	1
	Poor behavior	2
	Medium	3
	Good behavior	4
Track record of financing (C6)	Bad Credit	1
	Other dependent credit	2
	Never before	3
	Smooth credit	4
Expenses per month (C7)	Expenses per month ≤ 1.000.000	1
	Expenses per month 1.100.000 - 2.000.000	2
	Expenses per month 2.100.000 - 3.000.000	3
	Expenses per month 3.100.000 - 4.000.000	4
	Expenses per month ≥ 4.000.000	5

3. Result and Discussion

The customer data that has been obtained will then be calculated. The steps for calculating a decision support system using the Simple Additive Weighting (SAW) method are as follows.

1. The first step is to perform alternative suitability ratings. The next alternative will be given a suitability rating for each customary criterion in Table 1. The results of the alternative suitability rating value for each criterion can be seen in Table 5

Table 5. Alternative Suitability Rating Value for Each Criterion.

Alt	Criteria						
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
A1	2.1 - 3jt	Sertif	< 500 K	20.1-30M	Good	Never before	< 1 M
A2	2.1 - 3jt	Sertif	2.1 -4 M	5.1 -10M	Good	Dependent	< 1 M
A3	3.1 -4 jt	AO	500-2 M	< 5M	Good	Dependent	1.1-2M
A4	> 4 Jt	AO	< 500 K	20.1-30 M	Good	Never before	1.1-2M

Alt	Criteria						
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
A5	> 4 Jt	Sertif	< 500 K	15.1-20 M	Good	Never before	1.1-2M
A6	3.1 -4 jt	Sertif	< 500 K	5.1 -10M	Good	Never before	1.1-2M
A7	2.1 - 3jt	Sertif	4.1- 6 M	10.1-15M	Good	Dependent	< 1M
A8	> 4 Jt	Sertif	< 500 K	20.1-30M	Good	Smooth	1.1-2M
A9	1.1 -2 Jt	AO	< 500 K	< 5M	Good	Dependent	< 1M
A10	3.1 -4 jt	Sertif	< 500 K	5.1 -10M	Good	Never before	1.1-2M
A11	1.1 -2 Jt	Sertif	< 500 K	5.1 -10M	Good	Never before	< 1M
A12	2.1 - 3Jt	Sertif	> 6 M	20.1-30M	Poor	Bad Credit	1.1-2M
A13	1.1 -2Jt	Sertif	< 500 K	< 5M	Good	Dependent	< 1M
A14	2.1 - 3jt	Sertif	< 500 K	5.1 -10M	Good	Dependent	1.1-2M
A15	2.1 - 3jt	Sertif	< 500 K	20.1-30M	Good	Never before	1.1-2M

2. The second step is to create a decision matrix (X) based on criteria (Ci). The data in Table 5 will be converted into a decision matrix (X) according to each criterion. The decision matrix is displayed in Table 6.

3. The third step is to normalize the matrix (R). After obtaining the decision matrix, the next step is to normalize the matrix (R). The decision matrix (X) that has been created will be normalized into a matrix as in Table 7, based on the type of attribute (Benefit or Cost). The formula used for Benefit attributes is $r_{ij} = \frac{Xij}{max\ Xij}$; while the Cost attribute is $r_{ij=} \frac{Min\ Xij}{Xij}$. The results of the normalization matrix calculation (R) for all existing alternatives can be seen in Table 7.

4. The fourth step is to rank or find the preference value obtained from the sum of the results of multiplying the normalized matrix (R) in Table 7 with the weights in Table 3. The formula equation for finding the preference value is $v_i = \sum_{j=1}^{n} W_j\ r_{ij}$. Overall data on preference values for all alternatives is displayed in Table 8.

5. The fifth step is to determine whether the customer will qualify for financing based on the preference value given by the minimum qualifying limit as in Table 9. This minimum limit is used to determine whether the customer will qualify for financing. If the preference value is smaller than the minimum limit then the decision status will be rejected, while the preference value is greater than the minimum limit then the status will be accepted.

Table 6. Decision Matrix (X).

Alt	Criteria						
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
A1	3	4	1	5	4	3	1
A2	3	4	3	2	4	2	1
A3	4	1	2	1	4	2	2
A4	5	1	1	5	4	3	2
A5	5	4	1	4	4	3	2
A6	4	4	1	2	4	3	2
A7	3	4	4	3	4	2	1
A8	5	4	1	5	4	4	2
A9	2	1	1	1	4	2	1

Alt	Criteria						
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
A10	4	4	1	2	4	3	2
A11	2	4	1	2	4	3	1
A12	3	4	5	5	2	1	2
A13	2	4	1	1	4	2	1
A14	3	4	1	2	4	2	2
A15	3	4	1	5	4	3	2

Table 7. Normalized Matrix (R).

Alt	Criteria						
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
A1	0.60	1.00	1.00	0.20	1.00	0.75	1.00
A2	0.60	1.00	0.33	0.50	1.00	0.50	1.00
A3	0.80	0.25	0.50	1.00	1.00	0.50	0.50
A4	1.00	0.25	1.00	0.20	1.00	0.75	0.50
A5	1.00	1.00	1.00	0.25	1.00	0.75	0.50
A6	0.80	1.00	1.00	0.50	1.00	0.75	0.50
A7	0.60	1.00	0.25	0.33	1.00	0.50	1.00
A8	1.00	1.00	1.00	0.20	1.00	1.00	0.50
A9	0.40	0.25	1.00	1.00	1.00	0.50	1.00
A10	0.80	1.00	1.00	0.50	1.00	0.75	0.50
A11	0.40	1.00	1.00	0.50	1.00	0.75	1.00
A12	0.60	1.00	0.20	0.20	0.50	0.25	0.50
A13	0.40	1.00	1.00	1.00	1.00	0.50	1.00
A14	0.60	1.00	1.00	0.50	1.00	0.50	0.50
A15	0.60	1.00	1.00	0.20	1.00	0.75	0.50

Table 8. Preference Value

Alternative	Preference Value
A1	17.65
A2	17.07
A3	16.20
A4	14.75
A5	18.00
A6	18.45
A7	16.07
A8	18.50
A9	17.10
A10	18.45
A11	18.35
A12	11.55
A13	20.10
A14	16.90
A15	16.15

Table 9. The limit of minimum criteria.

Criteria	Value	Weight	Limit of Preference Value
Income per month	1.1 - 2 M	4	
Guarantee	Account officer	4	
The loan has not been paid off	500 K - 2 M	2	
Amount of financing	< 5 M	5	16,1
Behavior or Environment	Good	3	
Track record of financing	Other dependent credit	3	
Expenses per month	< 1 M	3	

The preference values obtained in Table 8 are then compared with the preference value limits from Table 9 to offer a decision whether accepted or rejected status. The decision result is that there are two alternative data which were rejected due to lower preference value than the limit. Table 10 shows the decision results from the system. The results of customer financing can be changed according to the minimum preference value limit. If there is a change in the minimum limit agreed by BMT, then the decision results will be adjusted accordingly.

4. Conclusion

DSS for qualifying customer financing using the Simple Additive Weighting (SAW) method has several features which include dashboards, customers, criteria, sub-criteria, assessment and matrix values and decision results. Based on manual and system calculations, the results obtained were 13 customers with accepted status and 2 customers with rejected status. Black box testing shows valid results that prove that the system features work according to their function. Meanwhile, the validity test obtained 100% accuracy of results between the manual and the system, which proves that this system is suitable for use. So, it can be concluded that the system has achieved the research objective, namely assisting officers in making decisions to accept or reject customer financing objectively.

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