Implementation of Simple Additive Weighting in Providing Micro Business Loans at Bank Mandiri Pematangsiantar

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ABSTRACT

Banks are institutions and institutions that are organizations and institutions in Indonesia and have an important role in the sustainability of the Indonesian economy. Bank Mandiri is one of the banks that provides micro business credit facilities to the business world. The higher the public's interest in getting micro business credit, the banks need software to help determine who is entitled to credit. In order to produce a proper feasibility analysis, a method of decision-making in overcoming these problems is needed so that determining who is entitled to receive credit is not too long and efficient in reducing credit risk. Problems arise in the decision-making process for granting micro-business loans, namely the inaccuracy of micro-business credit recipients. The above problems can be resolved by building a Decision Support System which can assist decision makers in assessing and selecting micro business loans using variables: Income, Collateral, Loan Limit, Installments, Length of Business, Number of Dependents. The system built by applying the Simple Additive Weighting method is known as the method of adding weight. The Simple Additive Weighting method requires a decision matrix normalization process to a scale that can be compared with all available alternative ratings. This will be a reference in ranking and consider the advantages and disadvantages of applying for a credit loan in order to find the desired candidate. From the test results using 10 data samples, it was obtained that the first rank was received credit on behalf of A5 with a value of 9.33, and the last rank was on behalf of A6 with a value of 6.4. and very helpful in solving problems faced by Bank Mandiri Pematangsiantar.

Keywords: Decision Support System, Simple Additive Weighting, Credit

INTRODUCTION

The Indonesian economy is divided into 3 (three) groups of business entities, namely: State-Owned Enterprises (BUMN), Cooperatives, and Private-Owned Enterprises (BUMS). Of the three national economic groups, the government hopes to develop into mutually supportive and integrated components in the national economic system. Problems that are often faced in the business world are lack of capital, partnerships and start-ups. By relying on your own capital, it will be difficult to get a higher income and will grow for a long time (N, Zuraidah, and Sartika 2019)

Banks are institutions and institutions that are organizations and institutions in Indonesia and have an important role in the sustainability of the Indonesian economy. Bank customers or debtors are the top priority in the banking world because they are the fuel for financing in a bank.(Yuliana 2014)(Turuis et al. 2017)

Bank Mandiri is one of the banks that provides micro business credit facilities to the business world. With the increasing interest of the community in obtaining micro business credit, banks experience difficulties in processing and analyzing the feasibility of providing micro business credit by considering several criteria that must be met and this takes a long time which can result in large losses. In overcoming this problem, a method is needed that can assist decision makers in determining who is entitled to receive micro business credit.

The development of technology and science in today's digital era is very significant, especially in the field of computer technology. Computer technology greatly influences human life as well as in terms of data analysis and decision making.(Sonang, Purba, and Siregar 2020) Decision making that is supported by computer technology using certain techniques makes the decision making process more efficient, effective, measurable and objective. Many techniques can be used in decision making, one of which is the Simple Additive Weighting (SAW) method. This method can solve the problem of selecting alternatives in a structured manner by involving multi criteria.

The Simple Additive Weighting (SAW) method is known as the method of adding weight. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes. (Fauzan,

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Indrasary, and Muthia 2018)(Ismanto and Effendi 2017) The SAW method requires a decision matrix normalization process (X) to a scale that can be compared with all available alternative ratings. This will be a reference in ranking and take into account the advantages and disadvantages of applying for a credit loan, so that you get the best candidate you want..

LITERATURE REVIEW

Decision Support System (DSS)

Interactive computer-based systems to assist decision making by utilizing data and models in solving semi-structured and unstructured problems.(Purbal and Sihotang 2019)(Puspa 2019)(Prayogo, Muflikhah, and Wijoyo 2018) 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. (Setiawan 2017)(Resti 2017)

The criteria or characteristics of a Decision Support System are:
1. Many choices or alternatives
2. There are conditions
3. Follow a pattern or model of behavior, whether structured or unstructured
4. Many inputs or variables
5. There are risk factors
6. It takes speed, accuracy, and accuracy. (Windarto 2017)(Riyanto and Haryanti 2017)

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 Ci
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 (Ci), 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:

$$R_{ij} = \begin{cases} \dfrac{x_{ij}}{Max\,x_{ij}} & jika\ j\ adalah\ atribut\ keuntungan\ (benefit) \\[2ex] \dfrac{Min\,x_{ij}}{x_{ij}} & jika\ j\ adalah\ atribut\ keuntungan\ (cost)\ X_{ij} \end{cases} \qquad \dots (\,1\,)$$

Information:
Rij   = Normalized performance rating of the Ai alternatives on the attribute Cj : $i=1,2,...,m$ and $j = 1,2, ..., n$
Max Xij = The greatest value of each criterion i
Min Xij = The smallest value of each criterion i
Xij   = 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 (Vi) is given the following formula:

$$V_I = \sum_{J=1}^{n} W_J \, r_{ij}$$

... (2)

Information :
Vi   =   Ranking for each alternative
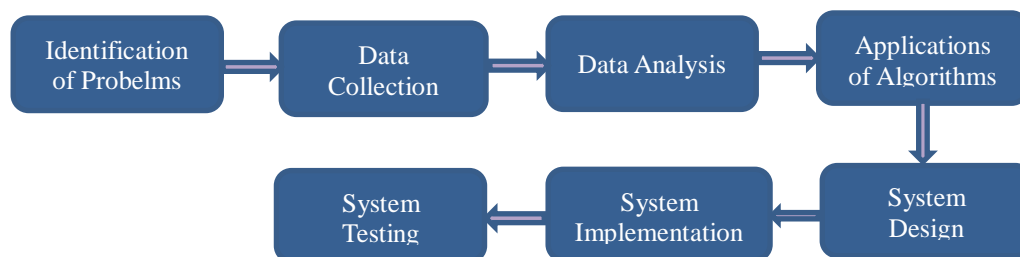Wj   =   Rank weight value (from each alternative)
Rij   =   The performance rating value is normalized
Nilai Vi   =   the larger one indicates that the alternative Ai is preferred. (Setiadi, Yunita, and Ningsih 2018)(Frieyadie 2016)(Sri and Tamando Sihotang 2019)
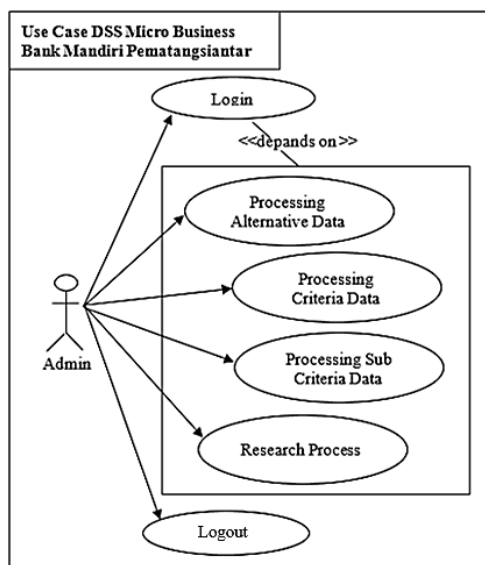
METHOD

Research completion steps

Figure 1. Framework Research

The following is the use case diagram of the Decision System

Figure 2. Use Case Diagram

RESULT

Determine The Weight of Each Variabel

The variables used in determining which debtors are entitled to receive credit loans include 6 criteria, namely: Income, Collateral, Loan Limit, Installments, Length of Business, The Numbes of Dependents.

Table 1
List Variabel

Variabels Code	Variabels	Variabels Weigths	Variabels Type
C1	Income	20%	Benefit
C2	Collateral	20%	Benefit
C3	Loan Limit	20%	Benefit
C4	Installments	20%	Benefit
C5	Length of Business	10%	Benefit
C6	The Numbers of Dependents	10%	Cost

The value of the Income sub criterion (C1)

Table 2
Weigthing Income (C1)

Values Range	Weigthing	Values
< Rp. 2.000.000	Very Low	1
Rp.2.000.000 - < Rp. 4.000.000	Low	2
Rp. 4.000.000 - < Rp. 6.000.000	Enough	3
Rp. 6.000.000 - < Rp. 8.000.000	High	4
> Rp.8.000.000	Very High	5

The value of the Collateral sub criterion (C2)

Table 3
Weighting Collateral (C2)

Values Range	Weigthing	Values
<.Rp. 10.000.000	Very Low	1
Rp. 10.000.000 - < Rp. 20.000.000	Low	2
Rp. 20.000.000 - < Rp. 30.000.000	Enough	3
Rp. 30.000.000 - < Rp. 40.000.000	High	4
> Rp. 40.000.000	Very High	5

The value of the Loan Limit sub criterion (C3)

Table 4
Weights Loan Limit (C3)

Values Range	Weigthing	Values
<.Rp. 5.000.000	Very Low	1
Rp. 5.000.000 - < Rp. 15.000.000	Low	2
Rp. 15.000.000 - < Rp. 25.000.000	Enough	3
Rp. 25.000.000 - < Rp. 35.000.000	High	4
> Rp. 35.000.000	Very High	5

The value of the Installments sub criterion (C4)

Table 5
Weights Installments (C4)

Values Range	Weigthing	Values
12 Month	Very Low	1
18 Month	Low	2
24 Month	Enough	3
30 Month	High	4
36 Month	Very High	5

The value of the Length of Business sub criterion (C5)

Table 6
Weight Length of Business (C5)

Values Range	Weigthing	Values
<2 Year	Very Low	1
2 s/d 3 Year	Low	2
3 s/d 4 Year	Enough	3
4 s/d 5 Year	High	4
> 5 Year	Very High	5

The value of the Numbers of Dependents sub criterion (C6)

Table 7
Weight Numbers of Dependents (C6)

Values Range	Weigthing	Values
0	Very Low	1
1 Person	Low	2
2 Person	Enough	3
3 Person	High	4
> 4 Person	Very High	5

Calculation Using the SAW Method

1. Alternative Data

Table 8
Alternative Data

No	Name	C1	C2	C3	C4	C5	C6
1.	A1	Rp 4.000.000 - Rp 6.000.000	Rp 20.000.000 -Rp 30.000.000	Rp 15.000.000 - Rp 25.000.00	36 month	> 5 year	2 person
2.	A2	Rp 2.000.000 - Rp 4.000.000	Rp > 40.000.000	Rp 15.000.000 - Rp 25.000.00	36 month	> 5 year	2 person
3.	A3	Rp 6.000.000 - Rp 8.000.000	Rp > 40.000.000	Rp 15.000.000 - Rp 25.000.00	36 month	2 - 3 year	2 person
4.	A4	Rp 2.000.000 - Rp 4.000.000	Rp 30.000.000 -Rp 40.000.000	Rp 5.000.000 – Rp 15.000.000	36 month	> 5 year	2 person
5.	A5	Rp 6.000.000 - Rp 8.000.000	> Rp 40.000.000	Rp 25.000.000 -Rp 35.000.000	36 month	> 5 year	2 person
6.	A6	Rp 2.000.000 - Rp 4.000.000	> Rp 40.000.000	Rp 5.000.000 – Rp 15.000.000	24 month	< 2 year	0
7.	A7	Rp 4.000.000 - Rp 6.000.000	> Rp 40.000.000	Rp 25.000.000 - Rp 35.000.000	36 month	3 – 4 year	3 person
8.	A8	Rp 4.000.000 - Rp 6.000.000	> Rp 40.000.000	Rp 15.000.000 - Rp 25.000.000	36 month	> 5 year	2 person
9.	A9	> Rp 40.000.000	Rp 25.000.000 - Rp 35.000.000	Rp 25.000.000 - Rp 35.000.000	36 month	3 - 4 year	2 person
10.	A10	Rp 2.000.000 - Rp 4.000.000	> Rp 40.000.000	Rp 5.000.000 - Rp 15.000.000	24 month	4 - 5 year	1 person

2. Alternative Match Ratings

Table 9
Alternative Match Ratings

Alternative	Variabel					
	C1	C2	C3	C4	C5	C6
A1	3	3	3	5	5	3
A2	2	5	3	5	5	3
A3	4	5	3	5	2	3
A4	2	4	2	5	5	3
A5	4	5	4	5	5	3
A6	2	5	2	3	1	1
A7	3	5	4	5	3	4
A8	3	5	3	5	5	3
A9	3	5	4	5	3	3
A10	2	5	2	3	4	2

3. Decision Matrix X

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

4. X matrix normalization to calculate the value of each criterion based on predetermined criteria

    a. A1

$$r11 = \frac{X11}{Max11} \qquad r11 = \frac{3}{4} = 0.75$$

$$r12 = \frac{X12}{Max12} \qquad r12 = \frac{3}{5} = 0.60$$

$$r13 = \frac{X13}{Max13} \qquad r13 = \frac{3}{4} = 0.75$$

$$r14 = \frac{X14}{Max14} \qquad r14 = \frac{5}{5} = 1.00$$

$$r15 = \frac{X15}{Max15} \qquad r15 = \frac{5}{5} = 1.00$$

$$r16 = \frac{Min16}{X16} \qquad r16 = \frac{1}{3} = 0.33$$

    b. A2

$$r21 = \frac{X21}{Max21} \qquad r21 = \frac{2}{4} = 0.50$$

$$r22 = \frac{X21}{Max21} \qquad r22 = \frac{5}{5} = 1.00$$

$$r23 = \frac{X23}{Max23} \qquad r23 = \frac{3}{4} = 0.75$$

$$r24 = \frac{X24}{Max24} \qquad r24 = \frac{5}{5} = 1.00$$

$$r25 = \frac{X25}{Max25} \qquad r25 = \frac{5}{5} = 1.00$$

$$r26 = \frac{Min26}{X26} \qquad r36 = \frac{1}{3} = 0.33$$

From the results of the above calculations, the matrix is normalized

Table 10
Matrix is Normalized

Name	C1	C2	C3	C4	C5	C6
A1	0.75	0.60	0.75	1.00	1.00	0.33
A2	0.50	1.00	0.75	1.00	1.00	0.33
A3	1.00	1.00	0.75	1.00	0.40	0.33
A4	0.50	0.80	0.50	1.00	1.00	0.33
A5	1.00	1.00	1.00	1.00	1.00	0.33
A6	0.50	1.00	0.50	0.60	0.20	1.00
A7	0.75	1.00	1.00	1.00	0.60	0.25
A8	0.75	1.00	0.75	1.00	1.00	0.33
A9	0.75	1.00	1.00	1.00	0.60	0.33
A10	0.50	1.00	0.50	0.60	0.80	0.50

5. Multiply the matrix W X R and add the product to get the best alternative
V1= (2.0,75) + (2.0,60) + (2.0,75) + (2.1) + (1.1) + (1.0,33) = 7,53
V2= (2.0,50) + (2.1) + (2.0,75) + (2.1) + (1.1) + (1.0,33) = 7,83

Table 11
Alternative Rankings

No	Name	Reference Values
1.	A5	9,33
2.	A9	8.43
3.	A7	8.35
4.	A8	8.33
5.	A3	8,23
6.	A2	7.83
7.	A1	7.53
8.	A4	6.93
9.	A10	6.50
10.	A6	6.40

From the above calculations, it can be seen that the first member eligible for credit is A5 with a score of 9.33, second is A9 with a score of 8.43, third is A7 with a value of 8.35, fourth is A8 with a value of 8.33, fifth is A3 with a value of 8.23, sixth is A2 with a value of 7.83, the seventh is A1 with a value of 7.51, the eighth is A4 with a value of 6.93, the ninth is A10 with a value of 6.50, and the last one is A6 with a value of 6.40. The Chart of Preference Value Sorting can be seen in Figure 3.
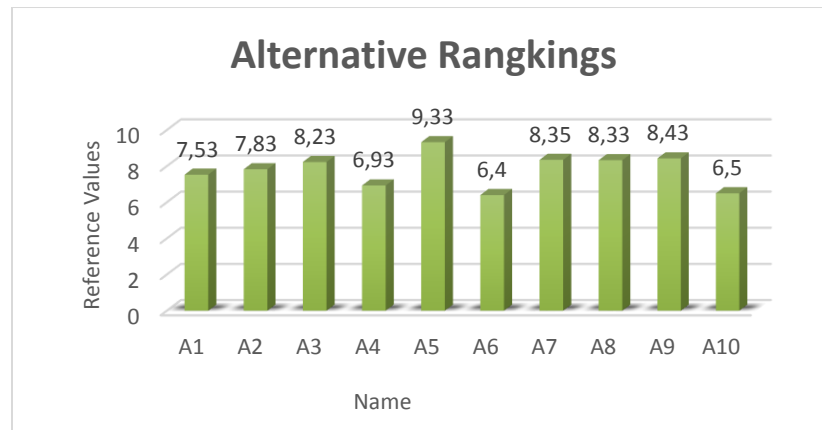
Figure 3. Alternative Rangkings

Test Results with the system that is built

NIK	NAME	VALUES
1107010812930001	Muhammad	7.53
1272020109670001	Wargini	7.83
1272020306700001	Marwan	8.23
1272021204630001	Usman	6.93
1272021406670004	Suparmen	9.33
1272022004920002	Ari Afriandi Batubara	6.4
1272022409710001	Dendi Junaidi	8.35
1272022502700001	Adek Lubis	8.33
1272023112600027	Ediwirman	8.43
1272024111720003	Hariani	6.5

Figure 4. Test Results with the system that is built

DISCUSSIONS

System testing is done either by manual calculation or using a decision support system that is built using a sample of data 10, the same results are obtained, this indicates that the system built is in accordance with the SAW method. Decision support systems built can provide better, timely, and efficient information. This system can help the management of Bank Mandiri Pematangsiantar in solving problems faced in providing micro-business loans.

Table 12
Calculation Analysis

Nama	Calculation of Seniors	System Calculation	Evaluastion
A1	7.53	7.53	Appropriate
A2	7.83	7.83	Appropriate
A3	8.23	8.23	Appropriate
A4	6.93	6.93	Appropriate
A5	9.33	9.33	Appropriate
A6	6.4	6.4	Appropriate
A7	8.35	8.35	Appropriate
A8	8.33	8.33	Appropriate
A9	8.43	8.43	Appropriate
A10	6.5	6.5	Appropriate

CONCLUSION

The decision support system for providing micro-business loans that has been built using the SAW method can help Bank Mandiri Pematangsiantar in providing recommendations and solutions according to the needs of Bank Mandiri Pematangsiantar. From the test conducted using 10 data samples, the first rank was in the name of A5 with a value of 9.33, the second was in the name of A9 with a value of 8.23, the third was in the name of A7 with a value of 8.35, fourth was in the name of A8 with a value of 8.33, the fifth was in the name of A3 with a value 8.23, the sixth is in the name of A2 with a value of 7.83, the seventh is in the name of A1 with a value of 7.53, the eight is in the name of A4 with a value of 6.93, the ninth is in the name of A10 with a value of 6.5, and the tenth is on behalf of A6 with a value of 6.4. The decision support system for creditworthiness with the SAW method can make it easier and very helpful in solving problems faced by Bank Mandiri Pematangsiantar in determining creditworthiness.

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