AUTOMATION OF CREDIT APPROVAL ELIGIBILITY USING THE SIMPLE ADDITIVE WEIGHTING METHOD AT FINANCIAL INSTITUTIONS

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Article Info :	ABSTRACT
	Cooperatives as financial institutions engaged in has an important role in providing a source of financing for its members. The credit approval eligibility process in cooperatives is often done manually, which can take a long time, is prone to human error and subjectivity in decision making. and subjectivity factors in decision making. The method used method used in this research is the Simple Additive Weighting (SAW) method that is applied in automating the feasibility of credit approval in cooperatives. The criteria used in this research are income, age, credit history, occupation, number of dependents. This method is used with the aim of providing decisions that are more consistent, objective, transparent, and the time it takes is shorter. The result of this study is that customer A gets the highest score of 0.82, so that the customer is declared the most deserving prospective debtor to get credit approval at the cooperative. The results show that the application of the SAW method in the automation of credit approval eligibility has succeeded in increasing time efficiency in the credit approval eligibility assessment process so that it can handle more credit cases efficiently, besides that this method is able to minimize human error, and is able to eliminate the subjectivity factor in decision making. This can increase customer confidence in supporting transparent cooperative operations

1. INTRODUCTION

Technology has become the main driver in the transformation of various sectors including financial institutions. The application of technology in financial institutions brings significant changes to the way of working and efficiency in operations (Owusu Kwateng, Agyei and Amanor, 2019). Recently, financial institutions such as cooperatives, banks, credit service providers have adopted various technological innovations to meet the needs of the growing market. Financial process automation is one of the technological contributions in the financial sector (Jena *et al.*, 2024; Mohsen, Hamdan and Shoaib, 2024; Yao, 2024). By implementing an automation system, it can optimize the approval of loan applications with an annual growth of 14% (Lee *et al.*, 2024). Technology is able to change service interactions between financial institutions and customers.

The financial institution used in this study is a cooperative. Cooperatives are financial institutions engaged in financial services such as savings and loan cooperatives. Cooperatives are business entities incorporated under the principles of kinship and mutual cooperation which aim to meet the economic, social and cultural needs of their members(Ningsih, Suprapti and Fibrianti,

2019; McKillop *et al.*, 2020; Otaokpukpu, Nwankwo and Uneze, 2024). Credit approval eligibility is an important process in the operations of financial institutions (Maldonado, Peters and Weber, 2020). This process not only helps customers who need funding, but also impacts the viability and balance of the financial institution. In conducting creditworthiness, financial institutions consider various criteria such as credit history, income, customer character and ability to pay (Jargalsaikhan *et al.*, 2019), all of these criteria need to be considered carefully, thoroughly and carefully. However, the current obstacle is that the manual process in creditworthiness often takes a long time, is prone to human error, often the subjectivity factor in decision making causes the decision obtained is not in accordance with accurate data. With financial technology, it can increase profitability, increase cost efficiency, increase innovation, and control risks for financial institutions (Lee *et al.*, 2021; Wang, Xiuping and Zhang, 2021; Liao, 2023). The manual process of credit approval in financial institutions often leads to inefficiencies, errors, and subjectivity in decision-making.

To overcome these problems, in this research, the author introduces a system that automates the credit approval eligibility process by utilizing the Simple Additive Weighting (SAW) method. By applying the SAW method into a computerized system, the system is able to process data automatically and quickly so as to speed up the time needed to assess creditworthiness, so that the cooperative can handle more credit cases in a short time (Chaki, 2022). In addition, the computerized system will work based on data and mathematical calculations rather than on the intuition/subjective of employees, so that the decisions made are more consistent, accurate, fair and transparent. The integration of automation ensures faster, more accurate and objective assessments, thus improving overall operational efficiency.

2.   METHOD

The Simple Additive Weighting (SAW) method can be integrated into computerized systems to support multi-criteria decision making. The SAW method is used in multi-criteria decision making to evaluate software development projects, overcoming ambiguity and uncertainty in judgment (Büyüközkan and Göçer, 2021). Based on previous research, the SAW method can be used to compare criteria with one another to determine the selection of the most popular majors at universities (Rusidah, Risdianti and Susanto, 2023). This research implements the Simple Additive Weighting (SAW) method in the process of automating credit approval eligibility. The SAW method is one of the methods for multi-criteria decision making in various fields. This method combines various criteria to determine the best alternative (Villalba, Sánchez-Garrido and Yepes, 2024).

The author chose to use the SAW method in this research because the SAW method uses mathematical formulas that are not complicated and easy to implement. The SAW method is often called the weighted sum method (Panessai *et al.*, 2019), where the method determines the best choice based on certain criteria. The SAW method is implemented by calculating the sum of the values of each alternative after the normalization and weighting process. The stages of this research consist of several stages, namely:

1. Literature study, conducted to understand the research topic by reviewing the SAW method, studying previous research that discusses similar topics to this research, then reviewing journals related to criteria relevant to this research.

2. The author identifies problems that arise in the credit approval eligibility process at Annajah Islamic Cooperative.

3. Data collection. The data used in this study were collected through interviews with the management of the Annajah Islamic Cooperative. The author collects real data from financial institutions which include income, age, credit history, occupation, number of dependents. After that the author determines the weight of each criterion.

4. The implementation of the SAW method is applied to the decision-making system for the automation of the feasibility of the credit approval process, starting with normalizing the value of criteria, giving the weight of each criterion, calculating the preference value of weight and normalization, the results will provide a ranking of credit applicants based on the highest to lowest preference value.

3.   RESULTS AND ANALYSIS

The basic concept of the SAW method is to calculate the weighted sum of each alternative from all attributes. The SAW method is one of the simplest and most popular multi-attribute fuzzy methods (Rusidah, Risdianti and Susanto, 2023). The following is a hierarchy of determining customers who deserve credit approval at Annajah Islamic Cooperative.
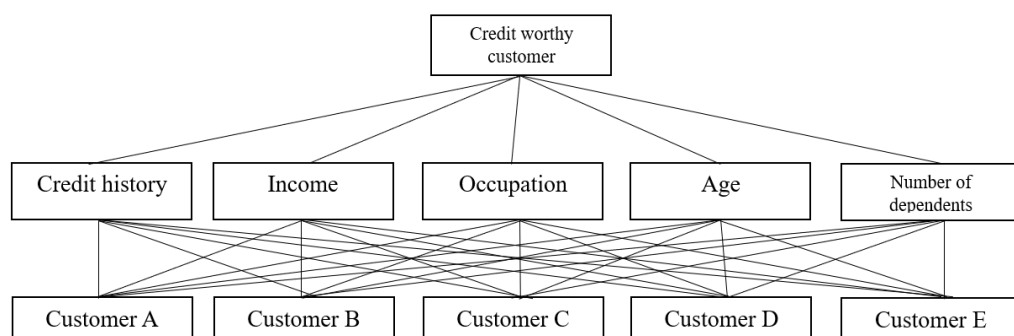

Figure 1. Credit Approval Eligibility Hierarchy

To implement the SAW method into a decision support system, the author divides it into 4 stages of the completion process, namely:

3.1. Determination of Criteria

Determination of criteria will be the basis for the decision-making process. This method involves the weights and criteria needed to assess the eligibility of customers who have the highest potential for credit. The weights used in determining the most potential customers, namely:

C1 = credit history (very high)

C2 = income (high)

C3 = Job (moderate)

C4 = Age (sufficient)

C5 = Number of dependents (sufficient)

All of criteria above are used as a reference to determine the most potential customers to get credit approval from the cooperative. The weighting of each criterion is as follows:

Table 1. Weight of each criteria

No	Criteria	Weight
1	Credit history	0.30
2	Income	0.25

3	Employment	0.2
4	Age	0.15
5	Number of dependents	0.10

In this study, the alternative data used can be seen in table 2 below:

Table 2. Alternative customer data

No	Alternative	Credit history (C1)	Income (C2)	Employment (C3)	Age (C4)	Number of dependents (C5)
1	Customer A	9	7.500.000	Private	30	2
2	Customer B	8	6.700.000	Private	28	1
3	Customer C	8	5.500.000	Private	25	1
4	Customer D	7	8.000.000	Private	38	3
5	Customer E	0	9.000.000	Civil Servant	45	4

From the table above, there are 5 customers who are potential alternatives for credit approval eligibility at Annajah Islamic Cooperative. Credit history describes the credit score/assessment of each customer. A score of 9 indicates an excellent credit history, a score of 8 indicates a fairly good credit history (there are records of slight problems but they can still be accounted for), a score of 7 indicates a fairly reasonable credit history (there may be delays in payment but still in the reasonable category), while 0 has a very bad credit history or even no credit history at all. The income range used as potential customers has an income of 5,500,000 - 9,000,000 with the types of private jobs and civil servants. The age range used as an alternative potential customer is between 25 - 45 with the number of family dependents 1 - 4 people.

3.2. Determination of suitability rating

The next stage is to determine the suitability value for each alternative on each criterion, which can be seen in table 3 below:

Table 3. Alternative suitability rating

No	Alternative	(C1)	(C2)	(C3)	(C4)	(C5)
1	A1	5	4	4	4	4
2	A2	4	3	3	4	4
3	A3	4	3	3	3	4
4	A4	4	4	4	5	3
5	A5	0	5	5	5	2

3.3. Making a decision matrix

Making a decision matrix (X) is formed from a table of match ratings for each alternative on each criterion. The decision matrix (X) formed can be seen below:

$$X = \begin{bmatrix} 5 & 4 & 4 & 4 & 4 \\ 4 & 3 & 3 & 4 & 4 \\ 4 & 3 & 3 & 3 & 4 \\ 4 & 4 & 4 & 5 & 3 \\ 0 & 5 & 5 & 5 & 2 \end{bmatrix}$$

The calculation of the normalization value for each alternative is continued using the following formula:

$$r_{ij} = \frac{x_{ij}}{\max x_{ij}}$$

(1) If j is a benefit attribute

$$r_{ij} = \frac{\min x_{ij}}{x_{ij}}$$

(2) If j is a cost attribute

The results of the calculation for each alternatif is as follows:

Credit History (C1) :

$$r_{11} = \frac{5}{\max \{5;4;4;4;0\}} = \frac{5}{5} = 1,00$$

$$r_{21} = \frac{4}{\max \{5;4;4;4;0\}} = \frac{4}{5} = 0,80$$

$$r_{31} = \frac{4}{\max \{5;4;4;4;0\}} = \frac{4}{5} = 0,80$$

$$r_{41} = \frac{4}{\max \{5;4;4;4;0\}} = \frac{4}{5} = 0,80$$

$$r_{51} = \frac{0}{\max \{5;4;4;4;0\}} = \frac{0}{5} = 0,00$$

Income criteria (C2):

$$r_{11} = \frac{4}{\max \{4;3;3;4;5\}} = \frac{4}{5} = 0,80$$

$$r_{21} = \frac{3}{\max \{4;3;3;4;5\}} = \frac{3}{5} = 0,60$$

$$r_{31} = \frac{4}{\max \{4;3;3;4;5\}} = \frac{3}{5} = 0,60$$

$$r_{41} = \frac{4}{\max \{4;3;3;4;5\}} = \frac{4}{5} = 0,80$$

$$r_{51} = \frac{5}{\max \{4;3;3;4;5\}} = \frac{5}{5} = 1,00$$

Employment (C3):

$$r_{11} = \frac{4}{\max \{4;3;3;4;5\}} = \frac{4}{5} = 0,80$$

$$r_{21} = \frac{3}{\max \{4;3;3;4;5\}} = \frac{3}{5} = 0,60$$

$$r_{31} = \frac{4}{\max \{4;3;3;4;5\}} = \frac{3}{5} = 0,60$$

$$r_{41} = \frac{4}{\max \{4;3;3;4;5\}} = \frac{4}{5} = 0,80$$

$$r_{51} = \frac{5}{\max \{4;3;3;4;5\}} = \frac{5}{5} = 1,00$$

Age (C4):

$$r_{11} = \frac{\min \{4;4;3;5;5\}}{4} = \frac{3}{4} = 0,75$$

$$r_{21} = \frac{\min \{4;4;3;5;5\}}{4} = \frac{3}{4} = 0,75$$

$$r_{31} = \frac{\min \{4;4;3;5;5\}}{3} = \frac{3}{3} = 1,00$$

$$r_{41} = \frac{\min \{4;4;3;5;5\}}{5} = \frac{3}{5} = 0,60$$

$$r_{51} = \frac{\min \{4;4;3;5;5\}}{5} = \frac{3}{5} = 0,60$$

Number of dependents (C5):

$$r_{11} = \frac{\min \{4;4;4;3;2\}}{4} = \frac{2}{4} = 0,50$$

$$r_{21} = \frac{\min \{4;4;4;3;2\}}{4} = \frac{2}{4} = 0,50$$

$$r_{31} = \frac{\min \{4;4;4;3;2\}}{4} = \frac{2}{4} = 0,50$$

$$r_{41} = \frac{\min \{4;4;4;3;2\}}{3} = \frac{2}{3} = 0,67$$

$$r_{51} = \frac{\min \{4;4;4;3;2\}}{2} = \frac{3}{2} = 1,00$$

Furthermore, the results of the normalization process are arranged in the form of a normalization matrix. The results of the normalization matrix in this study can be seen below:

$$\begin{bmatrix} 1,00 & 0,80 & 0,80 & 0,75 & 0,50 \\ 0,80 & 0,60 & 0,60 & 0,75 & 0,50 \\ 0,80 & 0,60 & 0,60 & 1,00 & 0,50 \\ 0,80 & 0,80 & 0,80 & 0,60 & 0,67 \\ 0 & 1,00 & 1,00 & 0,60 & 1,00 \end{bmatrix}$$

3.4. Ranking

The last step involves calculating the preference value (Vi) obtained by summing the product of each element in the normalized matrix row (R) with the preference weight (W). the weights used in this calculation are as follows:

W = [0.30   0.25   0.20   0.15   0.10)]

The formula used is as follows:

$$V_i \sum_{j=1}^{n} w_j\, r_{ij}$$

(3)

One of the calculation results from the formula above, namely:

$$V1 = (0,30 \times 1,00) + (0,25 \times 0,80) + (0,20 \times 0,80) + (0,15 \times 0,75) + (0,10 \times 0,50)$$
$$= 0,30 + 0,20 + 0,16 + 0,11 + 0,05$$
$$= 0,82$$

From the ranking results above, it can be concluded that the most potential customer alternatives in the cooperative can be identified by ranking the highest to lowest V values. The ranking results can be seen in table 4 below:

Table 4. Customer ranking results

No	Alternative	Final Result		Ranking
1	Customer A	0,82	0,30	1
2	Customer B	0,67	0,25	3
3	Customer C	0,66	0,20	4
4	Customer D	0,76	0,15	2
5	Customer E	0,64	0,10	5
	Total	**3,55**	**1,00**	

From the ranking results table above, the largest value is obtained by V1, namely customer A with a value of 0.82. So it can be concluded that customer A is the most potential/worthy customer to get credit approval from the cooperative based on calculations using the SAW method.

4.   CONCLUSION

Based on this research, it can be concluded that automation in credit decision making using a computer system integrated with the Simple Additive Weighting (SAW) method enables a more efficient and objective assessment process. In this process, customer data such as credit history, income, and employment status are collected and processed automatically. The SAW method is then used to calculate a creditworthiness score by assigning weights to each relevant criteria, integrating data in real-time, and producing consistent, accurate, and transparent decisions, while reducing errors and subjectivity in the process. This automation not only improves operational efficiency but also fosters greater customer trust and confidence in the credit approval process.

From the results of calculations using SAW, customer A with the highest value of 0.82 is declared the most feasible customer to get credit approval. This shows that the SAW method is able to support cooperatives in handling more credit cases, able to increase time efficiency in the assessment process, minimize the potential for human error, and eliminate subjectivity in decision making. So that this can increase operational efficiency and customer confidence in the cooperative. For future researchers, they can develop a computerized decision support system based on the SAW method for cooperative credit approval which includes data integration, automation of calculations using the SAW method, an attractive and user friendly user interface, as well as a report.

5.   DECLARATION OF COMPETING INTEREST

We declare that we have no conflict of interest.

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