

Poor Family Classification Decision Support System using the Simple Additive Weighting (SAW) Method

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Abstract

Poverty is a problem that continues to be the focus of attention for the government. Poverty has also caused people to be willing to sacrifice anything for their survival. To anticipate this problem, various policies have been adopted by the government to break the chain of poverty. One of them is providing assistance funds to poor families (PKH). This is felt directly by all levels of underprivileged society. One of the efforts of the Koto Ranah Tapan government to eradicate poverty that occurs in Koto Ranah Tapan is to follow the central government program, namely the launch of government financial assistance (PKH). These funds will be distributed to poor residents in Koto Ranah Tapan through the nagari guardian office in Koto Ranah Tapan. However, the distribution of aid funds to poor families is often not on target due to a large level of manual calculation error which makes the aid not on target and also the office of the nagari village of high cliff village has not been able to objectively determine the families who receive the aid. To help determine which families are worthy of receiving poor family assistance funds, a decision support system is needed. With this Decision Support System (DSS), it is hoped that the decision-making process can minimize the occurrence of wrong targets that often arise in the process of selecting poor families who wish to receive aid funds. In this calculation the author uses the Simple Additive Weighting (SAW) method, because this method is suitable for accurate calculations and is very helpful in calculating any data obtained. The results obtained were that Ade Irma Suryani got the highest score with a score of 10.8 and was ranked at the top (Best 1), so she could be considered the best recipient of aid funds.

Keywords: Decision Support Systems, Simple Additive Weighting Method, Criteria, Alternatives, Accurate.

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1. Introduction

In the context of developing countries, poverty is a common thing, including in Indonesia itself, which is one of the developing countries in Southeast Asia. Poverty is a problem that continues to be the focus of attention for the government. Poverty has also caused people to be willing to sacrifice anything for their survival. The poverty that continues to plague them also has an impact on high levels of crime, they carry out these actions for the reason of fulfilling their living needs. (Ripho Delzy Perkasa, 2016). To anticipate this problem, various policies have been adopted by the government to break the chain of poverty that continues to shackle the community so that they can escape the trap of poverty. One of them is providing assistance funds to poor families (PKH). This is felt directly by all levels of underprivileged society.

The Koto Ranah Tapan government is one of the central government's connecting arms in reducing the number of poor people in Koto Ranah Tapan. One of the efforts of the Koto Ranah Tapan government to eradicate poverty that occurs in Koto Ranah Tapan is to follow the central government program, namely the launch of government financial assistance (PKH). These funds will be distributed to poor residents in

Koto Ranah Tapan through the nagari guardian office in Koto Ranah Tapan.

This was done to avoid uneven distribution or distribution that was not on target, this often happens in the field, one of which is at the Wali Nagari Village Office of Tebing Tinggi Tapan Village. The assistance provided by the government (PKH) to poor residents in the Tebing Tinggi Tapan village environment is classified as uneven, where there are still many people who should be entitled, but do not receive the assistance funds because they still use manual methods in collecting data on poor residents, such as filling out forms in paper form. it takes a long time and there is a high level of manual calculation error which makes this assistance not on target. The Kampung Tebing Tinggi Tapan Wali Nagari Office has also not been able to determine the families who will receive the aid objectively.

In line with the development of the times and science, there are many ways that can be used to distribute aid for the poor (PKH) into the hands of citizens on target. One way is to build a decision support system with the decision making method used, namely the simple additive weighting (SAW) method.

Decision Support Systems, or what are usually called Decision Support Systems (DSS), are information

systems that can be used interactively to present information, carry out modeling and process data. The aim is to assist the decision-making process in situations that are not completely structured or unstructured [1][2][3]. Decision Support Systems (DSS) are components of computer-based information systems, which include knowledge-based systems or knowledge management, used to provide support in the decision-making process within an organization or company [4][5][6].

Previous researchers regarding the Employee Recruitment Decision Support System Using the Simple Additive Weighting (SAW) Method found that the alternative with the highest value could be used as consideration data for selection. Alternative A5 (Prospective Employees) has the highest score with a value of 6.03 so it can be used as consideration or supporting data to be selected as an employee at the Muhammadiyah University of Riau Promotion UPT [7]. Other previous research on the Decision Support System for Selecting Smartphones by Applying the Simple Additive Weighting (SAW) Method resulted in a decision support system application for selecting smartphones that can help consumers select smartphones according to their wants and needs based on predetermined criteria. So the 5 alternative values that have the highest value and can be selected are alternative A3 with a value of 77.5, alternative A8 with a value of 74.125, alternative A7 with a value of 73.5, alternative A9 with a value of 68.5, and alternative A6 with a value of 69.1 [8].

computer studies [9], selecting the best employees[10][11], receiving scholarships[12], receiving Covid-19 aid[13], receiving aid for livable housing[14], determining the best students[15], teacher performance assessment[16], and many other studies.

Through the decision support system which will be built using the simple additive weighting method, it is hoped that it will be able to help the party responsible for distributing government financial assistance (PKH) at the Wali Nagari Village Office of Tebing Tinggi Tapan in carrying out more valid and objective calculations for determining poor families which will result in assistance These government funds (PKH) can be distributed evenly and on target.

In various aspects of decision making, including employee performance assessment, supplier selection, or evaluation of investment alternatives, aid recipients, new student admissions, the SAW (Simple Additive Weighting) method is often used to calculate final grades and rankings. SAW method is one of the popular decision analysis techniques, where we give weights to various criteria and calculate the final value based on these weights. Based on the previous explanation, this research aims to classify recipients of aid funds for poor families which can help in decision making, so that the decisions obtained become a

reference in making decisions effectively and efficiently.

2. Research methodology

The research framework is a sequence of activities that will be carried out in a study. The research will be carried out applying the Simple Additive Weighting (SAW) method. The SAW method is used to make it easy to make flexible decisions and is widely used because of its simplicity in responding to needs in decision making, so that decisions can be made effectively and efficiently.

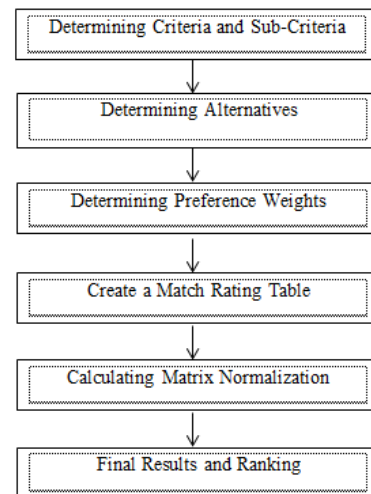


Figure 1. Research Framework

This method is the most well-known method and is widely used by people in dealing with Multiple Attribute Decision Making (MADM) situations. This method requires the decision maker to determine the weight for each attribute. The total score for an alternative is obtained by adding up all the multiplication results between ratings that can be compared across attributes) weights and each attribute. The rating for each attribute has previously gone through a normalization process. The SAW method is known as the term weighted addition. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes. The SAW method requires a process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings. The formula for carrying out this normalization is as follows:

$$r_{ij} = \left\{ \frac{x_{ij}}{\max x_{ij}} \right\} \text{ if } j \text{ is the profit attribute}$$

$$r_{ij} = \left\{ \frac{\min x_{ij}}{x_{ij}} \right\} \text{ if } j \text{ is the cost attribute (cost)}$$

R_{ij} is the normalized performance rating of alternative A_i on attribute C_j ; $i=1, 2, \dots, m$ and $j=1, 2, \dots, n$.

Information:

R_{ij} = normalized performance rating value
 X_{ij} = attribute value for each criterion
 Max_{xij} = largest value of each criterion
 Min_{xij} = smallest value of each criterion
 benefit = if the largest value is the best criterion
 cost = if the smallest value is the best criterion

Where r_{ij} is the normalized performance rating of alternative A_i on attribute C_j ; $i=1,2,...,m$ and $j=1,2,...,n$. The preference value for each alternative (V_i) is given as:

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

Information:

V_i = ranking for each alternative
 w_j = weight value of each criterion
 r_{ij} = normalized performance rating value
 larger V_i value indicates that alternative A_i is more selected.

After the V_i value is obtained, ranking is carried out, so that we can find out the best alternative which will be used as a guide for decision making.

3. Results and Discussion

3.1 Simple Additive Weighting (SAW) Method Calculation

1. Determining Criteria and Sub-Criteria

To solve the problem, criteria and weighting of assessment (selection) criteria are needed in accordance with the criteria that must be met as a condition for receiving aid funds. The criteria used by the nagari guardian's office are as follows:

Code	Criteria	Weight
C1	Income	5
C2	Home Ownership Status	2
C3	Assets owned	3
C4	Water sources	1
C5	The number of dependents	1

Understand the sub-criteria used to measure various aspects of the main criteria. In the sub-criteria table the sub-criteria relate to each main criterion along with its classification and associated values. Sub-criteria are an important component in the assessment process that helps us in giving weight to the alternatives being evaluated. The following is a sub-criteria table containing the assessment variables for each criterion.

Table 2. Sub criteria table

Criteria	Sub Criteria	Classification	Mark
Income	> 2,000,000	Lots	2
	1,500,000 - 2,000,000	Enough	3
	<1,500,000	A little	5
Home Ownership Status	One's own	Low	2
	Rent	Currently	3
	Hitchhiking	Tall	5
Assets owned	> 30,000,000	Lots	2
	10,000,000 - 30,000,000	Currently	3
	< 10,000,000	A little	5
Water sources	PDAM	Low	2
	Water pump	Currently	3
	Well	Tall	5
The number of dependents	> 5 People	Lots	5
	2-5 People	Currently	3
	1 person	A little	2
	No dependents	The least	1

2. Determining Alternatives

Alternatives taken from potential recipients of government assistance can be seen in Table 3 below:

Table 3. Alternative Data on Government Assistance Recipients

Code	Criteria
A1	Abu Bakr
A2	Ade Irma Suryani
A3	Afriadi Nurbi
A4	Afriana Husna
A5	Afrijal

In this study, 5 (five) alternatives (poor families) were used as objects to be assessed. The alternatives used are coded A1 to A5.

3. Determining Preference Weights

Identify the preference weight given to each criterion based on the type of variable, whether it is criteria that provide benefits or criteria that provide costs. This preference weight will be used to calculate the final value and ranking of alternatives. By understanding this preference weight table, we can determine the relative importance of each criterion in decision making, which can be seen in Table 4.

Criteria	Variable Type	Weight
C1	Benefits	5
C2	Benefits	2
C3	Benefits	3
C4	Benefits	1
C5	Cost	1

4. Create a Match Rating Table

The suitability rating table presented below is important information in the evaluation process using the SAW (Simple Additive Weighting) method to calculate the final value and ranking of alternatives. This table lists

the assessment or suitability rating given to each alternative (A1, A2, A3, A4, and A5) based on existing criteria (C1, C2, C3, C4, and C5). Suitability ratings reflect the extent to which each alternative meets or conforms to each criterion. By understanding the suitability rating table, you can proceed to the calculation steps in the SAW method and determine the best alternative based on the assessment that has been given.

Table 5. Suitability Ratings

Alternative	C1	C2	C3	C4	C5
A1	3	3	5	5	3
A2	5	5	3	5	3
A3	2	2	3	5	3
A4	2	2	3	5	3
A5	5	2	3	5	5

5. Perform Matrix Normalization

After determining the criteria that are worth profits and costs and having converted the data, the normalization process can be carried out, and a normalized matrix is obtained

$$R = \begin{bmatrix} 0,6 & 0,6 & 1 & 1 & 1 \\ 1 & 1 & 0,61 & 1 & 1 \\ 0,4 & 0,4 & 0,61 & 1 & 1 \\ 0,4 & 0,4 & 0,61 & 1 & 1 \\ 1 & 0,4 & 0,61 & 0,6 & 1 \end{bmatrix}$$

6. Calculating Final Scores and Rankings

After the normalization results are obtained, the next step is to determine the vector V value.

$$v1 = (5 * 0.6) + (2 * 0.6) + (3 * 1) + (1 * 1) + (1 * 1) = 9.2$$

$$v1 = (5 * 1) + (2 * 1) + (3 * 0.6) + (1 * 1) + (1 * 1) = 10.8$$

$$v1 = (5 * 0.4) + (2 * 0.4) + (3 * 0.6) + (1 * 1) + (1 * 1) = 6.6$$

$$v1 = (5 * 0.4) + (2 * 0.4) + (3 * 0.6) + (1 * 1) + (1 * 1) = 6.6$$

$$v1 = (5 * 1) + (2 * 0.4) + (3 * 0.6) + (1 * 1) + (1 * 0.6) = 9.2$$

Based on the results of these calculations, the final result is obtained , namely the Vector (V) value for determining the best poor family. The final results can be seen from Table 6.

Table 6. Final Results of Ranking

No	Name of recipient of aid funds	Score (V)
1	Abu Bakr	9.2
2	Ade Irma Suryani	10.8
3	Afriadi Nurbi	6.6
4	Afriana Husna	6.6
5	Afriajal	9.2

on the names of recipients of poor family aid funds can be obtained as in table 8.

Table 8. Final Results and Decisions

No	Name of recipient of aid funds	Score (V)	Rank	Decision
1	Ade Irma Suryani	10.8	1	Best 1
2	Abu Bakr	9.2	2	Best 2
3	Afriajal	9.2	3	Best 3
4	Afriadi Nurbi	6.6	4	Best 4
5	Afriana Husna	6.6	5	Best 5

From the table above, it can be seen that the recipient of government aid funds was Ade Irma Suryani who received the highest score (10.8) and was ranked at the top (Best 1), so she can be considered the best recipient of aid funds. Furthermore, Abu Bakar and Afriajal were ranked second and third, respectively with a score of 9.2, while Afriadi Nurbi and Afriana Husna were ranked fourth and fifth with the same score, namely 6.6.

3.2 System Implementation

At this stage the researcher determines the application that is being built on a system. This implementation stage is carried out after going through the planning stage. The purpose of this implementation is to find out to what extent the application in the system can be used.

1. Login Form Display

Here you can see the login form used for system security. In order to enter the decision support system for classifying poor families as a reference for recipients of government aid funds , we must enter a username and password as in Figure 2:

Figure 2. Login Form Display

2. Criteria Page Views

On this page the admin will display the criteria data in the system as in Figure 3.

No	Kode kriteria	Deskripsi	Bobot	Tipe	Aksi
1	C1	Penghasilan	5	keuntungan	Detail Edit
2	C2	Status Kepemilikan Rumah	2	keuntungan	Detail Edit
3	C3	Asat Yang Dimiliki	3	keuntungan	Detail Edit
4	C4	Sumber Air	1	keuntungan	Detail Edit
5	C5	Jumlah Tanggungan	1	biaya	Detail Edit

Figure 3. Criteria page

Perhitungan Nilai Preferensi (V)	
V1	$\times (0.040) + (0.040) + (0.040) + (0.040) + (0.040) = 0.2$
V2	$\times (0.040) + (0.040) + (0.040) + (0.040) + (0.040) = 0.8$
V3	$\times (0.040) + (0.040) + (0.040) + (0.040) + (0.040) = 0.6$
V4	$\times (0.040) + (0.040) + (0.040) + (0.040) + (0.040) = 0.6$
V5	$\times (0.040) + (0.040) + (0.040) + (0.040) + (0.040) = 0.6$

Figure 6. Calculation page

3. Alternative Page Views

On this page the admin will display alternative data in the system as in Figure 4.

No	Kode Alternatif	Alternatif	Aksi
1	K001	ABU BAKAR	Detail Edit
2	K002	ADE IRMA SURYANI	Detail Edit
3	K003	AFRIADI NURDI	Detail Edit
4	K004	AFRIANA HUSNA	Detail Edit
5	K005	AFRIAL	Detail Edit

Figure 4. Alternative Page

4. Assessment Page

On the assessment page, the admin can assign a value in the form of a number to each criterion for each alternative, which value will be processed by the system to obtain calculation results. The assessment page displays in Figure 5.

Alternatif	C1 (Penghasilan)	C2 (Status Kepemilikan Rumah)	C3 (Asat Yang Dimiliki)	C4 (Sumber Air)
K001 (ABU BAKAR)	3	3	5	5
K002 (ADE IRMA SURYANI)	5	5	3	5
K003 (AFRIADI NURDI)	2	2	3	5

Figure 5. Assessment page

5. Calculation Page View

On the calculation page, the admin can see the results of the assessment being processed. Calculation page in Figure 6.

6. Ranking Page

On the ranking page, the admin can see the assessment results which are processed in the form of rankings and the admin can also print the ranking results to be used as a report. Ranking page in Figure 7.

No	Nama	Nilai	Rangkang	Keputusan
1	ADE IRMA SURYANI	0.8	1	BERHAJ KEMERDIA
2	ABU BAKAR	0.2	2	TIDAK BERHAJ KEMERDIA
3	AFRIAL	0.2	3	TIDAK BERHAJ KEMERDIA
4	AFRIADI NURDI	0.6	4	TIDAK BERHAJ KEMERDIA
5	AFRIANA HUSNA	0.6	5	TIDAK BERHAJ KEMERDIA

Figure 18. Ranking page

4. Conclusion _

The decision-making system and calculation method using Simple Additive Weighting (SAW) can help determine which families are entitled to become recipients of Poor Family Assistance Funds (PKH) based on predetermined weights and criteria. The use of a SAW-based decision making system in selecting recipients of aid funds for poor families has the potential to provide a more efficient and objective solution in distributing aid to families in need. The SAW method helps in calculating the final value for each alternative based on certain criteria, thereby enabling a more informed decision.

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