Decision Support System for Determining Recipients of Subsidized Foodstuffs for Poor Families Using the Simple Addictive Weighting Method

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Abstract

Technology is increasingly becoming a necessity that must be met, both in the world of education and in the world of business and social, especially information technology is used not only as a support but also as a primary need that can be used to provide information quickly. In accordance with what has been determined to obtain Subsidized Food, criteria are needed to determine who will be selected to receive subsidized food. The distribution of subsidized food is distributed to underprivileged or poor citizens. To assist in determining who is eligible to receive subsidized food, a decision support system is needed. One method that can be used for Decision Support Systems is by using *Simple Additive Weighting* (SAW). In this study, a case will be raised, namely finding the best alternative based on predetermined criteria by using the SAW method to calculate the method in the case. This method was chosen because it is able to select the best alternative from a number of alternatives, in this case the intended alternative is those who are entitled to receive subsidized food based on the specified criteria. The study was conducted by finding the weight value for each attribute, then a ranking process was carried out which would determine the optimal alternative, namely the poor. After the study was conducted, the results obtained were that there were 4 alternatives receiving Subsidized Food and the one with the highest value was alternative 5 with the name Yuhel Fentri with a value of 0.875.

Keywords : Decision Support System, Subsidized Food Ingredients, Simple Additive Weighting, Criteria.

1. Introduction

Technology is increasingly becoming a necessity that must be met, both in the world of education and in the world of business and social, especially information technology is used not only as a support but also as a primary need that can be used to provide information quickly. Artificial intelligence is a research area, applications and instructions related to computer programmers to do something that in the human view is intelligent, in order to help ease Human Performance in general, then a very intelligent technology is developed [1].

The development of Decision Support Systems (DSS) was first expressed in the early 1970s by Michael S. Scott Morton with the term Management Decision System. This system is a computer-based system that is intended to help make decisions by utilizing certain data and models to solve various unstructured problems.[2][3]

Decision support systems are part of computer-based information systems that address this problem. This system can support decision-making for potential recipients of subsidized food based on predetermined criteria. The way this system works includes all stages of problem-solving, selecting relevant data and determining the approach used in the decision-making process to problem-solving and solutions[4].

The purpose of this study is to build software that functions as a decision-making tool for determining recipients of subsidized food at the Air Tawar Barat Village Office in Padang City, to determine who is entitled to receive and who is not entitled to receive subsidized food, where so far the system that is running is less effective because of the lack of thoroughness of the employees who select residents in receiving subsidized food with the existing criteria if processed using a manual system. In order for the calculations in this decision support system to be more accurate, a method is used, namely the Simple Additive Weighting (SAW) Method. The basic concept of the SAW method is the weighted summation of the performance value rating for each alternative on all attributes [5]. The Simple Additive Weighting (SAW) method is one of the methods used in the decision-making process. The basic concept of the SAW method is to find the weighted summation of the performance rating for each alternative on all attributes. In this method, the criteria used in acceptance are only limited to the condition of the house, status of the house, income, occupation, and number of dependents [6][7][8]. With this method, calculations will be obtained that are in accordance

with the appropriate criteria in the distribution of subsidized food, so that it is not misdirected. And the data used for the study is only based on the Air Tawar Barat Village Office, Padang City. The system to be built uses an application.

The SAW method can also select the best alternative from a number of existing alternatives. The SAW method also has disadvantages such as, the data to be entered must be precise and correct, so that there are no errors during ranking. Data accuracy is still slightly lacking because the criteria that have been set must be dynamic and have a wide scope [9].

Decision Support System, in general is defined as a system that is able to provide both problem-solving and communication capabilities for semi-structured problems. Specifically , DSS is defined as a system that supports the work of a manager or a group of managers in solving semi-structured problems by providing information or suggestions leading to certain decisions[10][11].

Simple Addaptive Weighting (SAW) The SAW method is often known as the weighted summation method. The basic concept of the SAW (Simple Additive Weighting) method is to find the weighted summation of the performance ratings on each alternative on all attributes [12]. The SAW method can help in making decisions in a case, but the calculation using the SAW method only produces the largest value that will be selected as the best alternative. The calculation will be in accordance with this method if the selected alternative meets the predetermined criteria. This SAW method is more efficient because the time required for the calculation is shorter [13] [14]. The SAW method requires a process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings [15].

2. Research methodology

Research Methodology is a research stage carried out in solving a problem. In collecting data and information for this study, the author applies several research methods including the research framework of this study is shown in Figure 1 .
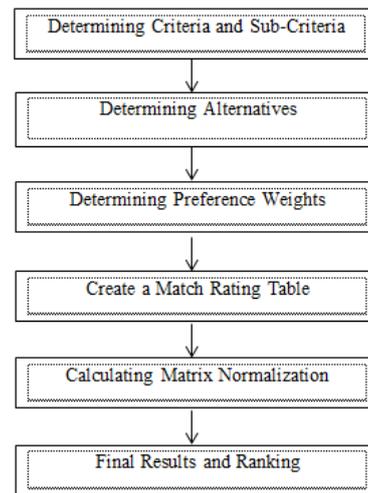

Figure 1. Research Framework

The Simple Additive Weighting (SAW) method is one of the techniques used in multi-criteria decision making. This method is used to evaluate and select alternatives based on a number of given criteria. Here are the steps in the SAW method:

1. Determining Criteria and Sub-Criteria
The criteria used in decision making must be appropriate to the problem at hand and reflect the aspects to be assessed.

2. Determining Alternatives
Identify and detail all alternatives to be evaluated in the context of decision making. Alternatives are choices or solutions that can be chosen to solve a problem or achieve a certain goal.

3. Determining Preference Weights
Setting preference weights is an important step in the Simple Additive Weighting (SAW) method or other multi-criteria decision-making methods. These weights indicate different levels of importance or preference for each criterion in the decision-making process.

4. Creating a Match Rating Table
This table is used to assess the extent to which each alternative meets or is compatible with each criterion.

5. Performing Matrix Normalization
Normalization is done to change the assessment matrix so that all values are on a uniform scale, thus allowing a fair comparison between criteria or alternatives.

6. Calculating Final Grades and Ranking
Alternatives based on the calculated weighting values from the highest to the lowest. The alternative with the highest weighting value will be the best choice according to the specified criteria.

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The Simple Additive Weighting (SAW) method is a problem-solving method that is often referred to as the weighted summation method. The basic principle of this method is to calculate the weighted sum of the performance values of each alternative based on all the attributes considered. SAW requires normalization of the decision matrix (x) into a scale that allows comparison between all existing alternative values [16]. Given the equation in the figure as follows:

$$rij \ (benefit) = \frac{xij}{\max xij}$$

$$rij \ (cost) = \frac{\min xij}{xij}$$

Where:

rij = Normalized performance rating
Max Xij = Maximum value of each row and column
Min Xij = Minimum value of each row and column
Xij = Rows and columns of the matrix
Benefit = if the greatest value is the best
Cost = if the smallest value is the best

Where rij is the normalized performance rating of alternative Ai on attribute Cj ; i = 1,2....m and j = 1,2....n. The preference value for each alternative (Vi) is given in the following figure:

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

Information:

Vi = Preference value
wj = Ranking weight
rij = normalized performance rating

larger Vi value indicates that alternative Ai is more preferred.

3. Results and Discussion

The SAW method calculation can determine the weight value for each attribute which will be continued with a ranking process which will then select the best alternative from a number of existing alternatives, the steps of the SAW method include :

1. Criteria

The initial stage in calculating the SAW method is determining the criteria. In this study, the criteria used in the selection process for recipients of achievement scholarships can be seen in Table 1 below:

Table 1. Criteria Data

No	Criteria Code	Criteria	Category	Weight
1	C1	Income	*Cost*	0.35
2	C2	Number of Dependents	*Benefits*	0.25
3	C3	House	*Cost*	0.15

No	Criteria Code	Criteria	Category	Weight
4	C4	Condition Home Ownership	*Cost*	0.15
5	C5	House Area	*Cost*	0.10

description :

1. Income earned each month.
2. Number of dependents (children) owned.
3. Condition or type of house occupied.
4. Ownership status of the occupied house .
5. Area of the house occupied.

2. Sub Criteria

The next stage is to determine the sub-criteria and their values. In this study, the sub-criteria and values used in the selection process for achievement scholarship recipients can be seen in Table 2 below:

Table 2. Sub Criteria Data

No	Criteria Code	Criteria	Sub Criteria	Mark	Rating
1	C1	Income	>2,000,000	5	Very high
			>1,500,000 to 2,000,000	4	Tall
			>1,000,000 to 1,500,000	3	Currently
			>= 500,000 to 1,000,000	2	Low
			<500,000	1	Very Low
2	C2	Number of Dependents	4 or More Children	5	Very high
			3 Children	4	Tall
			2 Children	3	Currently
			1 Child	2	Low
			No Children	1	Very Low
3	C3	House Condition	Permanent	3	Tall
			Semi Permanent	2	Currently
			Wood	1	Low
4	C4	Home Ownership	One's own	3	Tall
			Contract	2	Currently
			hitchhiking	1	Low
5	C5	House Area	>500 m2	5	Very high
			201 – 500 m2	4	Tall
			101 – 200 m2	3	Currently
			51 – 100 m2	2	Low
			0 – 50 m2	1	Very Low

3. Data Alternative

The next stage in this research is to determine alternative data that will be used in the selection process for subsidized food recipients. At this stage, the selection of alternative data is very important because it will affect the final results of the selection process. The alternative data in question is a number of subsidized food recipient candidates who have met certain requirements and will be assessed based on predetermined criteria.

Table 3. Alternative Data

No	Alternative Code	Alternative	Criteria				
			C1	C2	C3	C4	C5
1	A1	Princess Zulaini	>=500,000 to 1,000,000	1 Child	Wood	hitchhiking	51 – 100 m2
2	A2	Yasril	>2,000,000	2 Children	Permanent	One's own	201 – 500 m2
3	A3	Okrianto	>1,000,000 to 1,500,000	No Children	Wood	hitchhiking	51 – 100 m2
4	A4	Yenhendra	>2,000,000	3 Children	Permanent	One's own	201 – 500 m2
5	A5	Yuhel Fentri	<500,000	1 Child	Wood	hitchhiking	51 – 100 m2
6	A6	Roni Hardison	>1,000,000	1 Child	Semi Permanent	Contract	101 – 200 m2
7	A7	Basni	>1,500,000 to 2,000,000	2 Children	Permanent	Contract	101 – 200 m2
8	A8	Fadhil Indra Gusnam	>1,500,000 to 2,000,000	1 Child	Permanent	Contract	101 – 200 m2
9	A9	jefrialdi	>1,500,000 to 2,000,000	1 Child	Wood	hitchhiking	51 – 100 m2
10	A10	Veni Desrina Djasrul	>2,000,000	1 Child	Wood	One's own	101 – 200 m2

4. Data Conversion Results Alternative

The next step is to determine the conversion results from alternative data. In this study, the results of the conversion of alternative data that has been carried out can be seen in Table 4. following:

Table 4. Alternative Data Conversion Results

No	Alternative Code	Criteria				
		C1	C2	C3	C4	C5
1	A1	2	2	1	1	2
2	A2	5	3	3	3	4
3	A3	3	1	1	1	2
4	A4	5	4	3	3	4
5	A5	1	2	1	1	2
6	A6	3	2	2	2	3
7	A7	4	3	3	2	3
8	A8	4	2	3	2	3
9	A9	4	2	1	1	2
10	A10	5	2	1	3	3

5. Normalization

The next stage is to normalize the matrix based on the results of the alternative data conversion that has been obtained previously to obtain the normalization matrix R. Normalization is carried out according to the criteria of *benefit* and *cost attributes* . The normalization stages for each criterion are:

1. Income (C1)

$$R11 = \frac{Min(2;5;3;5;1;3;4;4;5)}{2} = 0.5$$
$$R21 = \frac{Min(2;5;3;5;1;3;4;4;5)}{5} = 0.2$$
$$R31 = \frac{Min(2;5;3;5;1;3;4;4;5)}{3} = 0.33$$
$$R41 = \frac{Min(2;5;3;5;1;3;4;4;5)}{5} = 0.2$$
$$R51 = \frac{Min(2;5;3;5;1;3;4;4;5)}{1} = 1$$
$$R61 = \frac{Min(2;5;3;5;1;3;4;4;5)}{3} = 0.33$$
$$R71 = \frac{Min(2;5;3;5;1;3;4;4;5)}{4} = 0.25$$
$$R81 = \frac{Min(2;5;3;5;1;3;4;4;5)}{4} = 0.25$$
$$R91 = \frac{Min(2;5;3;5;1;3;4;4;5)}{4} = 0.25$$
$$R101 = \frac{Min(2;5;3;5;1;3;4;4;5)}{5} = 0.2$$

2. Number of Dependents (C2)

$$R12 = \frac{2}{Max(2;3;1;4;2;2;3;2;2;2)} = 0.5$$
$$R22 = \frac{3}{Max(2;3;1;4;2;2;3;2;2;2)} = 0.75$$
$$R32 = \frac{1}{Max(2;3;1;4;2;2;3;2;2;2)} = 0.25$$
$$R42 = \frac{4}{Max(2;3;1;4;2;2;3;2;2;2)} = 1$$
$$R52 = \frac{2}{Max(2;3;1;4;2;2;3;2;2;2)} = 0.5$$
$$R62 = \frac{2}{Max(2;3;1;4;2;2;3;2;2;2)} = 0.5$$
$$R72 = \frac{3}{Max(2;3;1;4;2;2;3;2;2;2)} = 0.75$$
$$R82 = \frac{2}{Max(2;3;1;4;2;2;3;2;2;2)} = 0.5$$
$$R92 = \frac{2}{Max(2;3;1;4;2;2;3;2;2;2)} = 0.5$$
$$R102 = \frac{2}{Max(2;3;1;4;2;2;3;2;2;2)} = 0.5$$

3. House Condition (C3)

$$R13 = \frac{Min(1;3;1;3;1;2;3;3;1;1)}{1} = 1$$
$$R23 = \frac{Min(1;3;1;3;1;2;3;3;1;1)}{3} = 0.33$$
$$R33 = \frac{Min(1;3;1;3;1;2;3;3;1;1)}{1} = 1$$
$$R43 = \frac{Min(1;3;1;3;1;2;3;3;1;1)}{3} = 0.33$$
$$R53 = \frac{Min(1;3;1;3;1;2;3;3;1;1)}{1} = 1$$
$$R63 = \frac{Min(1;3;1;3;1;2;3;3;1;1)}{2} = 0.5$$

$$R73 = \frac{Min(1;3;1;3;1;2;3;3;1;1)}{3} = 0.33$$

$$R83 = \frac{Min(1;3;1;3;1;2;3;3;1;1)}{3} = 0.33$$

$$R93 = \frac{Min(1;3;1;3;1;2;3;3;1;1)}{1} = 1$$

$$R103 = \frac{Min(1;3;1;3;1;2;3;3;1;1)}{1} = 1$$

4. Home Ownership (C4)

$$R14 = \frac{Min(1;3;1;3;1;2;2;2;1;3)}{1} = 1$$

$$R24 = \frac{Min(1;3;1;3;1;2;2;2;1;3)}{3} = 0.33$$

$$R34 = \frac{Min(1;3;1;3;1;2;2;2;1;3)}{1} = 1$$

$$R44 = \frac{Min(1;3;1;3;1;2;2;2;1;3)}{3} = 0.33$$

$$R54 = \frac{Min(1;3;1;3;1;2;2;2;1;3)}{1} = 1$$

$$R64 = \frac{Min(1;3;1;3;1;2;2;2;1;3)}{2} = 0.5$$

$$R74 = \frac{Min(1;3;1;3;1;2;2;2;1;3)}{2} = 0.5$$

$$R84 = \frac{Min(1;3;1;3;1;2;2;2;1;3)}{2} = 0.5$$

$$R94 = \frac{Min(1;3;1;3;1;2;2;2;1;3)}{1} = 1$$

$$R104 = \frac{Min(1;3;1;3;1;2;2;2;1;3)}{3} = 0.33$$

5. House Area (C5)

$$R15 = \frac{Min(2;4;2;4;2;3;3;3;2;3)}{2} = 1$$

$$R25 = \frac{Min(2;4;2;4;2;3;3;3;2;3)}{4} = 0.5$$

$$R35 = \frac{Min(2;4;2;4;2;3;3;3;2;3)}{2} = 1$$

$$R45 = \frac{Min(2;4;2;4;2;3;3;3;2;3)}{4} = 0.5$$

$$R55 = \frac{Min(2;4;2;4;2;3;3;3;2;3)}{2} = 1$$

$$R65 = \frac{Min(2;4;2;4;2;3;3;3;2;3)}{3} = 0.67$$

$$R75 = \frac{Min(2;4;2;4;2;3;3;3;2;3)}{3} = 0.67$$

$$R85 = \frac{Min(2;4;2;4;2;3;3;3;2;3)}{3} = 0.67$$

$$R95 = \frac{Min(2;4;2;4;2;3;3;3;2;3)}{2} = 1$$

$$R105 = \frac{Min(2;4;2;4;2;3;3;3;2;3)}{3} = 0.67$$

From results normalization every criteria the, so obtained mark normalized matrix R, namely :

$$R = \begin{bmatrix} 0.5 & 0.5 & 1 & 1 & 1 \\ 0.2 & 0.75 & 0.33 & 0.33 & 0.5 \\ 0.33 & 0.25 & 1 & 1 & 1 \\ 0.2 & 1 & 0.33 & 0.33 & 0.5 \\ 1 & 0.5 & 1 & 1 & 1 \\ 0.33 & 0.5 & 0.5 & 0.5 & 0.67 \\ 0.25 & 0.75 & 0.33 & 0.5 & 0.67 \\ 0.25 & 0.5 & 0.33 & 0.5 & 0.67 \\ 0.25 & 0.5 & 1 & 1 & 1 \\ 0.2 & 0.5 & 1 & 0.33 & 0.67 \end{bmatrix}$$

6. Ranking

The final stage is to do the ranking using weights. Ranking is done by summing the multiplication of the normalized matrix R with weights to obtain the largest value which is then selected as the best alternative. The results obtained are as follows:

$$V_1 = (0.35 * 0.5) + (0.25 * 0.5) + (0.15 * 1) + (0.15 * 1) + (0.10 * 1) = 0.700$$

$$V_2 = (0.35 * 0.2) + (0.25 * 0.75) + (0.15 * 0.33) + (0.15 * 0.33) + (0.10 * 0.5) = 0.408$$

$$V_3 = (0.35 * 0.33) + (0.25 * 0.25) + (0.15 * 1) + (0.15 * 1) + (0.10 * 1) = 0.579$$

$$V_4 = (0.35 * 0.2) + (0.25 * 1) + (0.15 * 0.33) + (0.15 * 0.33) + (0.10 * 0.5) = 0.470$$

$$V_5 = (0.35 * 1) + (0.25 * 0.5) + (0.15 * 1) + (0.15 * 1) + (0.10 * 1) = 0.875$$

$$V_6 = (0.35 * 0.33) + (0.25 * 0.5) + (0.15 * 0.5) + (0.15 * 0.5) + (0.10 * 0.67) = 0.458$$

$$7_7 = (0.35 * 0.25) + (0.25 * 0.75) + (0.15 * 0.33) + (0.15 * 0.5) + (0.10 * 0.67) = 0.467$$

$$V_8 = (.35 * 0.25) + (0.25 * 0.5) + (0.15 * 0.33) + (0.15 * 0.5) + (0.10 * 0.67) = 0.404$$

$$V_9 = (0.35 * 0.25) + (0.25 * 0.5) + (0.15 * 1) + (0.15 * 1) + (0.10 * 1) = 0.61$$

$$V_{10} = (0.35 * 0.2) + (0.25 * 0.5) + (0.15 * 1) + (0.15 * 0.33) + (0.10 * 0.67) = 0.4$$

After the ranking is done, the ranking results are then entered into the ranking table. The ranking table that has been created can be seen in Table 5 below:

Table 5. Ranking Results

Ranking	Alternative Code	Alternative	Mark	Caption
1	A5	Yuhel Fentri	0.875	Accepted
2	A1	Princess Zulaini	0.700	Accepted
3	A9	jefrialdi	0.613	Accepted
4	A3	Okrianto	0.579	Accepted
5	A4	Yuhendra	0.470	Rejected
6	A7	Basni	0.467	Rejected
7	A10	Veni Desrina Djasrul	0.462	Rejected
8	A6	Roni Hardison	0.458	Rejected
9	A2	Yasril	0.408	Rejected
10	A8	Fadhil Indra Gusnam	0.404	Rejected

Based on the table above, it can be concluded that the highest value of Subsidized Foodstuff recipients is

alternative 5 with the name Yuhel Fentri with a value of 0.875. Furthermore, in positions 2 , 3 and 4 by Alternative 1, Alternative 9 and Alternative 3.

System Implementation

1. *Login* Page View

login page is used to validate data for each *user,* namely admin and village head who want to enter the system by entering *a username* and *password* as shown in Figure 2 below:

Figure 2. Login Page View

2. Dashboard Page View Admin

admin dashboard page displays the *admin dashboard view* after *admin* succeed *login* . Appearance This containing menu And sub menu What only one can seen And accessed by admin like Which seen on Figure 3. following :

Figure 3. Admin Dashboard Page View

3. Data Page View Criteria

The criteria data page displays the criteria data used as criteria in the assessment using the SAW method in this decision support system as seen in Figure 4. following:

Figure 4. Criteria Data Page View

4. Data Page View Alternative

The alternative data page displays the names of potential recipients of subsidized food using the SAW method in this decision support system as seen in Figure 5 below:

Figure 5. Alternative Data Page View

5. Data Page View Evaluation

The assessment data page is the page where you enter the assessment. to alternatives Which There is in accordance with criteria which has been previously determined as seen in Figure 6 below. :

Figure 6. Assessment Data Page View

6. Data Page View Calculation

The calculation data page displays the overall SAW method calculation process against previously determined alternatives and criteria as shown in Figure 7 below:

Figure 7 Calculation Data Page View

7. Result Data Page View End

The final results data page displays the ranking results based on the assessments that have been carried out on the existing alternatives and is used to print the ranking results report as shown in Figure 8 below:

Figure 9. Final Result Data Page View

8. Results Report View End

The final results report is a report that contains the ranking results of the assessment that was carried out previously using... SAW method to find out who receives subsidized food as seen in Figure 10. following :

Figure 10. Final Results Report View

4. Conclusion

Based on the needs analysis, design and implementation of the decision support system for subsidized food recipients at the Air Tawar Barat sub-district office in Padang City using the SAW (Simple Additive Weighting) method, it can be concluded that the existence of a decision support system using the SAW method can help in determining the selection of subsidized food recipients for poor families. Utilizing a decision support system is expected to determine data selection quickly and accurately, and using this decision support system, the progress made to determine subsidized food recipients is right on target.

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