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Decision support system for the determination of subsided food recipients for family Poor with ahp method on Kelurahan Mangga

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Abstract

In accordance with the regulations that have been determined by the Mangga Village Head Office to obtain Subsidized Food Materials, criteria are needed to determine who will be selected to receive subsidized food. . To assist the determination in determining someone who deserves to receive subsidized food, a decision support system is needed. One method that can be used for Decision Support Systems is to use AHP (Analytical Hierarchy Process). In this study, a case will be raised, namely looking for the best alternative based on predetermined criteria using the AHP (Analytical Hierarchy Process) method to calculate the method in this 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 the one who is entitled to receive subsidized food based on the specified criteria. The research 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. in this case the intended alternative is the one who is entitled to receive subsidized food based on the specified criteria. The research 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. in this case the intended alternative is the one who is entitled to receive subsidized food based on the specified criteria. The research 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.

***Keywords**: Decision Support Systems, Subsidized Foodstuffs, Analytical Hierarchy Process*

1. Introduction

Technology is increasingly becoming a need that must be met, both in the world of education as well as in the business and social world, 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 an area of research, applications and instructions related to computer programmers to do something that in the view of humans is intelligent, in order to help alleviate Human Performance in general, a very intelligent technology has been developed.

The development of a Decision Support System (DSS) or Decision Support System (DSS) was first described in the early 1970s by Michael S. Scott Morton with the term Management Decision System. utilizing certain data and models to solve unstructured problems. Decision support system is part of a computer-based information system that solves this problem. This system can support the decision making of prospective recipients of subsidized food based on predetermined criteria. The way this system works includes all stages of problem-taking, The purpose of this research is to build software that functions as a decision-making tool for determining recipients of subsidized food at the Mangga Village Office, Jalan Tobacco Raya No. 35 Prumnas Simalingkar, Medan City, to determine which ones are entitled to receive and which are not entitled to receive subsidized food, where so far the current system has been ineffective due to the lack of thoroughness of the employees in selecting residents to receive subsidized food with the existing criteria if processed. using a manual system.

In order for the calculation of the decision support system to be more accurate, a method is used, namely the Analytical Hierarchy Process (AHP) method. AHP is a comprehensive decision-making model that takes into account both qualitative and quantitative aspects. This is because the concept is simple and easy to understand, computationally efficient and has the ability to measure the relative performance of decision alternatives. In this method the criteria used in acceptance are only limited to the condition of the house, home status, income, occupation, and number of dependents. With this method, calculations will be obtained in accordance with the appropriate criteria in the distribution of subsidized food, so that the target is not misplaced. And the data used for research is only based on the Mangga Village Office, Medan City. The system to be built uses an application.

2. Method

AHP (Analytic Hierarchy Process) is a general theory of measurement that is used to find the ratio scale, both from discrete and continuous pairwise comparisons. AHP breaks down complex multi-factor or multi-criteria problems into a hierarchy. Hierarchy is defined as a representation of a complex problem in a multi-level structure where the first level is the goal, followed by the level of factors, criteria, sub-criteria, and so on down to the last level of alternatives. With a hierarchy, a complex problem can be broken down into groups which are then arranged into a hierarchical form so that the problem will appear more structured and systematic.

Basically the steps of the AHP method in the form of a flowchart are:

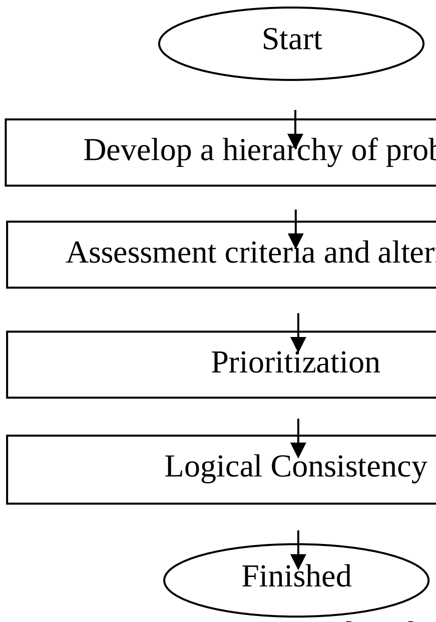

Figure 1. AHP Flowchart

In the case study taken, the author makes some data as an example of calculation:
Alternative:
a. Alexander
b. Renaldi
c. Budiman
d. Andi

Criteria:
a. Home Condition
b. Home Status
c. Income
d. Work
e. The number of dependents

Sub Criteria:
a. Home Condition : Wood, Stone.
b. Home Status : Contract, Own.
c. Income : < 2,000,000, > 2,000,000
d. Work : Entrepreneur, civil servant.
e. The number of dependents : > 2 Persons, < 2 Persons.

1. Assessment criteria and alternatives

Criteria and alternatives were assessed through pairwise comparisons. For many problems, a scale of 1 to 9 is the best scale for expressing opinions. The value and definition of qualitative opinion from the Saaty comparison scale can be seen in Table 3.1 below:

Table 1.
Pairwise Comparison Rating Scale Table

Intensity of Interest	Information
1	Both elements are equally important
3	One element is slightly more important than the other
5	One element is more important than the other
7	One element is clearly more absolutely important than the other elements
9	One element is absolutely important than the other elements
2,4,6,8	The values between the two values of adjacent considerations

Comparisons are made based on the decision maker's policy by assessing the level of importance of one element against another. Pairwise comparison process, starting from the top level of the hierarchy aimed at selecting criteria, for example A, then taking the elements to be compared, for example A1, A2, and A3. Then the arrangement of the elements being compared will look like in the matrix image below:

Table 2.
Example of a pairwise comparison matrix table

	A1	A2	A3
A1	1		

A2		1	
A3			1

To determine the value of the relative importance between elements, a number scale from 1 to 9 is used as shown in Table 2. This assessment is carried out by a decision maker who is an expert in the field of issue being analyzed and has an interest in it.

If an element is compared to itself, it is given a value of 1. If element i is compared to element j, it gets a certain value, then element j compared to element i is the opposite.

In this AHP, alternative assessments can be carried out using the direct method, which is the method used to enter quantitative data. Usually these values come from a previous analysis or from experience and a detailed understanding of the decision problem. If the decision maker has experience or a great understanding of the decision problem at hand, then he can directly enter the weighting of each alternative.

In the case study,
Criteria:
The condition of the house is 5 times more important than the status of the house,
The condition of the house is 5 times more important than the status of the house,
The condition of the house is 5 times more important than income,
Home conditions are 3 times more important than work,
The condition of the house is 3 times more important than the number of dependents,
Home status is as important as income,
Home status is as important as work,
The status of the house is as important as the number of dependents,
Income is as important as work
Income is as important as the number of dependents,
Work is as important as the number of dependents,

Table 3.
Table of Paired Comparison Rating Scale Criteria

Criteria	Home Condition	Home Status	Income	Work	The number of dependents
Home Condition	1	5	5	3	3
Home Status	**1/5=0.2**	1	1	1	1
Income	**1/5=0.2**	**1/1=1**	1	1	1
Work	**1/3=0.333**	**1/1=1**	**1/1=1**	1	1
The number of dependents	**1/3=0.333**	**1/1=1**	**1/1=1**	**1/1=1**	1
Amount	**2.066**	**9**	**9**	**7**	**7**

The sum is the sum of all the numbers in the row above it in one column.

Sub Criteria:

a. Home Condition : Wood is 2 times more important than stone.

b. Home Status : Contracts are 2 times more important than possessions alone.

c. Income : < 2,000,000 million 2 times more important than > 2,000,000 million.

d. Work : Entrepreneurs are 2 times more important than civil servants.

e. The number of dependents : > 2 People 2 times more important than < 2 people.

Table 4.
Table of Paired Comparison Rating Scales Sub Criteria for House Conditions

Home Condition	Wood	Stone
Wood	1	2
Stone	**1/2=0.5**	1
Amount	**1.5**	**3**

Table 5.
Table of Paired Comparison Rating Scales Sub Criteria for Home Status

Home Status	Contract	One's own
Contract	1	2
One's own	**1/2=0.5**	1
Amount	**1.5**	**3**

Table 6.
Table of Paired Comparison Rating Scales for Income Sub-criteria

Income	< 2,000,000	>2,000,000
< 2,000,000	1	2
>2,000,000	**1/2=0.5**	1
Amount	**1.5**	**3**

Table 7.
Table of Paired Comparison Rating Scales for Employment Sub Criteria

Work	entrepreneur	civil servant
entrepreneur	1	2
civil servant	**1/2=0.5**	1
Amount	**1.5**	**3**

Table 8.
Table of Pairwise Comparison Rating Scales Sub CriteriamNumber of Dependents

The number of dependents	>2 People	< 2 People
>2 People	1	2
< 2 People	**1/2=0.5**	1
Amount	**1.5**	**3**

2. Prioritization

For each criterion and alternative, it is necessary to do pairwise comparisons. The relative comparison values are then processed to determine the ranking of alternatives from all alternatives.

Both qualitative criteria, as well as quantitative criteria, can be compared according to a predetermined assessment to produce weights and priorities. The weights or priorities are calculated by manipulating the matrix or by solving mathematical equations.

The considerations for pairwise comparisons are synthesized to obtain overall priorities through the following steps:

a. Square the matrix of pairwise comparisons.
b. Count the number of values for each row, then normalize the matrix.

Table 9.
Criteria Paired Vector Priority Table

Criteria	Home Condition	Home Status	Income	Work	The number of dependents	Number of Rows	Priority Vector Normalization
Home Condition	1/2,066 =0.484	5/9=0.556	5/9=0.556	3/7=0.429	3/7=0.429	2,454	0.491
Home Status	0.2/2.066=0.097	1/9=0.111	1/9=0.111	1/7=0.143	1/7=0.143	0.605	0.121
Income	0.2/2.066=0.097	1/9=0.111	1/9=0.111	1/7=0.143	1/7=0.143	0.605	0.121
Work	0.333/2.066=0.161	1/9=0.111	1/9=0.111	1/7=0.143	1/7=0.143	0.669	0.134
The number of dependents	0.333/2.066=0.161	1/9=0.111	1/9=0.111	1/7=0.143	1/7=0.143	0.669	0.134
Amount	1	1	1	1	1	5,002	1

Priority Vector is the result of the sum of all cells to the left (on the same row) after first dividing by the number below it, then the result of the sum is divided by the number n.

n is obtained from the number of criteria, namely the condition of the house, home status, income, occupation, and number of dependents.

Priority vector =0.491 is obtained from the calculation of
(1/2,066+5/9+5/9+3/7+3/7) * 1/5

Priority vector = 0.121 obtained from the calculation
(0.2/2.066+1/9+1/9+1/7+1/7) *1/5

Priority vector = 0.121 obtained from the calculation
(0.2/2.066+1/9+1/9+1/7+1/7) *1/5
Priority vector= 0.134 obtained from calculation
(0.333/2.066+1/9+1/9+1/7+1/7)*1/5
Priority vector= 0.134 obtained from calculation
(0.333/2.066+1/9+1/9+1/7+1/7)*1/5
Priority Vector shows the weight of each criterion.
Sub Criteria

Table 10.
Paired Priority Vector Table for House Conditions

Home Condition	Wood	Stone	Number of Rows	Priority Vector Normalization	Priority Sub Criteria
Wood	1/1.5=0.667	2/3=0.667	1.334	0.667	1
Stone	0.5/1.5=0.333	1/3=0.333	0.666	0.333	0.449
Amount	1	1	2	1	1,499

Priority vectors:
Priority vector =0.667 is obtained from the calculation of
(1/1.5+2/3) * 1/2
Priority vector =0.333 is obtained from the calculation
(0.5/1.5+1/3) * 1/2
Priority Sub Criteria:
Priority Sub Criteria = 1 obtained from
Priority of Sub Criteria = (Number of Rows + Priority Vector Normalization) / 2
Priority Sub Criteria = (1,334 + 0.667) / 2 = 1

Priority Sub Criteria = 0.449 obtained from
Priority of Sub Criteria = (Number of Rows + Priority Vector Normalization) / 2
Priority Sub Criteria = (0.666 + 0.333) / 2 = 0.449

Table 11.
Paired Priority Vector Table for House Status Sub Criteria

Home Status	contract	One's own	Number of Rows	Priority Vector Normalization	Priority Sub Criteria
contract	1/1.5=0.667	2/3=0.667	1.334	0.667	1
One's own	0.5/1.5=0.333	1/3=0.333	0.666	0.333	0.449
Amount	1	1	2	1	1,499

Priority vectors:
Priority vector =0.667 is obtained from the calculation of
(1/1.5+2/3) * 1/2
Priority vector =0.333 is obtained from the calculation
(0.5/1.5+1/3) * 1/2
Priority Sub Criteria:
Priority Sub Criteria = 1 obtained from
Priority of Sub Criteria = (Number of Rows + Priority Vector Normalization) / 2

Priority Sub Criteria = (1,334 + 0.667) / 2 = 1
Priority Sub Criteria = 0.449 obtained from
Priority of Sub Criteria = (Number of Rows + Priority Vector Normalization) / 2
Priority Sub Criteria = (0.666 + 0.333) / 2 = 0.449

Table 12.
Paired Priority Vector Table for Income Criteria

Income	< 2,000,000	> 2,000,000	Number of Rows	Priority Vector Normalization	Priority Sub Criteria
< 2,000,000	1/1.5=0.667	2/3=0.667	1.334	0.667	1
> 2,000,000	0.5/1.5=0.333	1/3=0.333	0.666	0.333	0.449
Amount	1	1	2	1	1,499

Priority vectors:
Priority vector =0.667 is obtained from the calculation of
(1/1.5+2/3) * 1/2
Priority vector =0.333 is obtained from the calculation
(0.5/1.5+1/3) * 1/2
Priority Sub Criteria:
Priority Sub Criteria = 1 obtained from
Priority of Sub Criteria = (Number of Rows + Priority Vector Normalization) / 2
Priority Sub Criteria = (1,334 + 0.667) / 2 = 1
Priority Sub Criteria = 0.449 obtained from
Priority of Sub Criteria = (Number of Rows + Priority Vector Normalization) / 2
Priority Sub Criteria = (0.666 + 0.333) / 2 = 0.449

Table 13.
Paired Priority Vector Table for Employment Sub Criteria

Work	entrepreneur	civil servant	Number of Rows	Priority Vector Normalization	Priority Sub Criteria
entrepreneur	1/1.5=0.667	2/3=0.667	1.334	0.667	1
civil servant	0.5/1.5=0.333	1/3=0.333	0.666	0.333	0.449
Amount	1	1	2	1	1,499

Priority vectors:
Priority vector =0.667 is obtained from the calculation of
(1/1.5+2/3) * 1/2
Priority vector =0.333 is obtained from the calculation
(0.5/1.5+1/3) * 1/2
Priority Sub Criteria:
Priority Sub Criteria = 1 obtained from
Priority of Sub Criteria = (Number of Rows + Priority Vector Normalization) / 2
Priority Sub Criteria = (1,334 + 0.667) / 2 = 1
Priority Sub Criteria = 0.449 obtained from
Priority of Sub Criteria = (Number of Rows + Priority Vector Normalization) / 2

Priority Sub Criteria = (0.666 + 0.333) / 2 = 0.449

Table 14.
Paired Priority Vector Table Sub Criteria Number of Dependents

The number of dependents	> 2 People	< 2 People	Number of Rows	Priority Vector Normalization	Priority Sub Criteria
> 2 People	1/1.5=0.667	2/3=0.667	1.334	0.667	1
< 2 People	0.5/1.5=0.333	1/3=0.333	0.666	0.333	0.449
Amount	1	1	2	1	1,499

Priority vectors:
Priority vector =0.667 is obtained from the calculation of
(1/1.5+2/3) * 1/2
Priority vector =0.333 is obtained from the calculation
(0.5/1.5+1/3) * 1/2
Priority Sub Criteria:
Priority Sub Criteria = 1 obtained from
Priority of Sub Criteria = (Number of Rows + Priority Vector Normalization) / 2
Priority Sub Criteria = (1,334 + 0.667) / 2 = 1
Priority Sub Criteria = 0.449 obtained from
Priority of Sub Criteria = (Number of Rows + Priority Vector Normalization) / 2
Priority Sub Criteria = (0.666 + 0.333) / 2 = 0.449
In the sub-criteria, the priority of the sub-criteria shows the weight of each sub-criteria.

3. Logical Consistency
All elements are logically grouped and ranked consistently according to a logical criterion.

The weight matrix obtained from the pairwise comparison results must have a cardinal and ordinal relationship. The relationship can be shown as follows (Suryadi & Ramdhani, 1998):

Cardinal relationship : a_{ij}. a_{jk} = aik
Ordinal relationship : A_i> Aj, Aj > Ak then Ai > Ak
The relationship above can be seen from two things as follows:

a. By looking at multiplicative preferences, for example, if grapes are four times tastier than mangoes and mangoes are twice as delicious as bananas, then grapes are eight times tastier than bananas.
b. By looking at transitive preferences, for example, wine is tastier than mango and mango is tastier than banana, so wine is tastier than banana.

In actual conditions there will be some deviations from the relationship, so that the matrix is not perfectly consistent. This happens because of inconsistencies in one's preferences.

Calculation of logical consistency is done by following these steps:

a. Multiply matrices with the corresponding priority.
b. Sum the multiplication results per row.
c. The result of the sum of each row is divided by the respective priority and the results are summed.
d. The result of c divided by the number of elements, will get max.

e. Consistency Index (CI) = (λmax-n) / (n-1)
f. Consistency Ratio = CI/RI, where RI is a random index of consistency. If the consistency ratio 0.1, the results of the calculation of the data can be justified.

List of RI can be seen in Table 3

Table 15.
Random Index Value

Matrix Size	RI value
1.2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49
11	1.51
12	1.48
13	1.56
14	1.57
15	1.59

In the case study:
Criteria:
Principal Eigen Value (λmax) = (1×0.491)+(1×0,121)+(1×0,121)+(1×0,134)+(1×0,134)=1,201.
Calculating Consistency Index (CI) with the formula CI = (λmax-n)/(n-1),
for n = 5
CI= (1,201-5) / (5-1) = -0.760 CI means the weighting is very consistent.
Calculating the Consistency Ratio (CR) is obtained by the formula CR=CI/RI, the value of RI depends on the number of criteria as shown in table 3.16 above.
CR= -0.760 / 1.12 = -0.678
If the results of the CR calculation are less than or equal to 10%, the inconsistency is still acceptable, otherwise if it is greater than 10%, it is unacceptable.
Sub Criteria:
In the sub-criteria, determining the principal eigen value (λmax) is The result of the sum of each row times the priority of the sub criteria
House Condition : Wood, Stone
Principal Eigen Value (λmax) = (1×1)+(1×0.499)=1.5.
Calculating Consistency Index (CI) with the formula CI = (λmax-n)/(n-1),
for n = 2
CI= (1.5-2) / (2-1) = -0.5 CI means the weighting is very consistent.
House Status : Contract, Own
Principal Eigen Value (λmax) = (1×1)+(1×0.499) = 1.5.

Calculating Consistency Index (CI) with the formula CI = (λmax-n)/(n-1),
for n = 2

CI= (1.5-2) / (2-1) = -0.5 CI means the weighting is very consistent.
Earnings: < 2,000,000, > 2,000,000
Principal Eigen Value (λmax) = (1×1)+(1×0.499)=1.5.
Calculating Consistency Index (CI) with the formula CI = (λmax-n)/(n-1), for n = 2
CI= (1.5-2) / (2-1) = -0.5 CI means the weighting is very consistent.
Occupation: Entrepreneur, Civil Servant
Principal Eigen Value (λmax) = (1×1)+(1×0.499)=1.5.
Calculating Consistency Index (CI) with the formula CI = (λmax-n)/(n-1), for n = 2
CI= (1.5-2) / (2-1) = -0.5 CI means the weighting is very consistent.
Number of Dependents : > 2 Persons, < 2 Persons
Principal Eigen Value (λmax) = (1×1)+(1×0.499)=1.5.
Calculating Consistency Index (CI) with the formula CI = (λmax-n)/(n-1), for n = 2
CI= (1.5-2) / (2-1) = -0.5 CI means the weighting is very consistent.

After calculating the weight of the criteria and sub-criteria, a table of weight information can be made as shown in the table below:

Table 16.
Criteria and Sub Criteria Weight Information

Home Condition	Home Status	Income	Work	The number of dependents
0.491	0.121	0.121	0.134	0.134
Wood	Contract	< 2,000,000	entrepreneur	> 2 People
1	1	1	1	1
Stone	One's own	> 2,000,000	civil servant	< 2 People
0.499	0.499	0.499	0.499	0.499

After getting the weights of each character and sub-character, the case studies are selected, along with the completion of the case studies in tabular form.

Table 17.
Determination of Sub Criteria

Alternative name	Home Condition	Home Status	Income	job	Dependent
Alexander	Wood	Contract	< 2,000,000	entrepreneur	> 2 People
Renaldi	Wood	Contract	> 2,000,000	civil servant	< 2 People
Budiman	Stone	One's own	> 2,000,000	civil servant	< 2 People
Andi	Wood	One's own	< 2,000,000	civil servant	> 2 People

Table 18
Alternative Ranking

Alternative name	Home Condition	Home Status	Income	job	Dependent	Total

Alexander	0.491*1	0.121*1	0.121*1	0.134*1	0.134*1	1,001
Renaldi	0.491*1	0.121*1	0.121*0.499	0.134*0.4 99	0.134*0.4 99	0.806
Budiman	0.491*0.4 99	0.121*0.4 99	0.121*0.499	0.134*0.4 99	0.134*0.4 99	0.499
Andi	0.491*1	0.121*0.4 99	0.121*1	0.134*0.4 99	0.134*1	0.873

In Table 3.18 above, we can see that the alternative with the largest total is Alexander (1.001), followed by Andi (0.873) in second place, and Renaldi (0.806) in third position while Budiman (0.499) in fourth.

I. Conclusion

Based on the results of observations that have been made through the implementation and application of the program at the Mangga Village Head Office, Jalan Tobacco No. 35 Prumnas Simalingkar Medan City, it can be concluded as follows:

1. Designing a system for receiving subsidized food for the underprivileged people of Mangga Village effectively and efficiently.
2. Applying methods *Analytical Hierarchy Process (AHP)* on the receipt of subsidized food in Mangga Village.
3. Implementing a decision support system using the method *Analytical Hierarchy Process* (AHP) to determine the poor in receiving Subsidized Foodstuffs.

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