Application Selection Lending Houses Subsidized by the Method of AHP and SAW

Angelina, Ruth Damayanti Surbakti , Risky Sandi Simamora, Erick Cendana, Delima Sitanggang, Jeffry Banjarnahor, Mardi Turnip

Faculty of Technology and computer science, Universitas Prima Indonesia, Indonesia

Email: marditurnip@unprimdn.ac.id

Abstract. Decision Support System (DSS) is a system that can help somebody in making an accurate decision and precisely. many problems can be solved by using DSS, one of them is the determination of giving a subsidized home loans. Giving loans has a higher risk and can affect the pace of company's development if there's a bad credit. A company needs a DSS to help the credit analysis' team in making decision by the recomendation if the consumer deserves the loan or not. the calculation method that's used in this research is to compare two methods of Analytical Hierarchy Process (AHP) and the Simple Additive Weighting (SAW). The result shows by using SAW method for consumers V4 scored 0,25; while using AHP to consumers A004 scored 0,31.

1. Introduction

In this globalization era, so many developments have taken place, including in the field of information technology. The development of information technology is currently inseparable from the rapid development of computer technology, because computers are media that can provide convenience for humans in completing a job. Information technology is very helpful for companies or agencies in processing work data to get accurate information to determine decisions.

Decision support system (DSS) is a part of the development of information technology in this time. Many government agencies and the private sector utilize this technology to help simplify and sped the time in making a decision [1-12]. In this case, DSS is required in the decision to grant credit loans. Because it is too risky for a loan granted by the bank, so the implementation should consider the precautionary principle and the principles of the lending, so that in the future it doesn't cause problems that make it difficult for the customer or harm the bank due to the return of substandard, doubtful and non-performing loans [5].

Improper credit decisions will result in high bad credit. Bad loans cause losses because funds issued by cooperatives cannot be returned, so it needs to be made a better decision support system, which can help the cooperative in deciding customers who have the good potential to make loan installments [3-5].

In previous research, the manufacturer of a decision support system facilitates the customers and the bank, reducing the risk of loss and saving the time to make a decision of prospective customers credit recipients [3-6]. The results of this research is to facilitate the decision maker to supporting lending decisions to grant subsidized home loans.
2. Research Methodology

In general, a decision support system (DSS) is an attempt to solve the problem by choosing an alternative solution exists. As an Art, DSS is the process of taking a decision on the situation in difference (because of the diversity that is unique). As a science, DSS is an activity that has a method, procedure and specific approach in a systematic, organized and directed.

Analytical Hierarchy Process (AHP) is a decision support models developed by Dr. Thomas L. Saaty. For example, there are n as objects is denoted by (A1, A2, ... An) is to be assessed based on the level of importance between Ai and Aj presented in Pair-wise Comparison matrix [7]. First of all calculate the weighted priority. Value and priority weighting matrix elements can be determined by the following formula : MPij / \sum_{i=1}^{n} MP_{ij} ; The priority value is calculated using the formula: \sum_{j=1}^{n} WP_{ij} / N ; With the caption: MP = matrix comparison and WP = Weight Priority Matrix, i = row, j = columns, n = a lot of criteria or sub-criteria; Repeat steps 3,4, and 5 for all levels of hierarchy; Calculate the eigenvectors of each pairwise comparison matrix which is the weight of each element for the determination of the priority elements at the lowest level of the hierarchy until it reaches the destination; Check the consistency of the hierarchy; Having obtained the value of each criterion, obtaining scoring value can be calculated with the following formula: \sum_{i=1}^{n} P_i * NCI_i ; With the caption: Pi = the value of the priority of the category Ci Ci NCI = value category.

Steps to resolve SAW is as follows: Specify the criteria that will be used as a reference in the decision, namely Ci. Value criteria = value of the fuzzy set based on the input values; The rating determines the suitability of each alternative on each criterion; Make decisions based on criteria matrix (G), the formula used is as follows: rij = \frac{x_{ij}}{Max_{i}x_{ij}} \text{ and } \hat{r}_{ij} = \frac{Min_{x}x_{ij}}{x_{ij}} ; With the caption: rij = Rating normalized performance, Max ij = The maximum value of each row and column, Min ij = minimum value of each row and column, xij = Rows and columns of the matrix; The final results obtained from the ranking process is the summation of the normalized R matrix multiplication with the weight vector in order to obtain the greatest value is selected as the best alternative (Ai) as a solution [8]. The formula for calculating the value of scoring: \sum_{j=1}^{n} w_j r_{ij} ; Where Vi = The final value of the alternative and r_{ij} = normalization matrix.

The first stage of the research is the problem analysis process and then the process of collecting data with 3 methods, namely interviews, observation and literature. For the process of method analysis carried out by the AHP and SAW methods. Furthermore, a comparison process between the two methods is carried out so that it can produce a comparison of methods. Here is a Table 1 pairwise comparison matrix consumer ratings and the average value of the normalization matrix based job.

| Work | A001 | A002 | A003 | A004 | A005 | The average amount of matrix |
|------|------|------|------|------|------|-----------------------------|
| A001 | 0.45 | 0.47 | 0.47 | 0.47 | 0.33 | 0.43                        |
| A002 | 0.14 | 0.16 | 0.20 | 0.33 | 0.20 | 0.20                        |
| A003 | 0.33 | 0.32 | 0.32 | 0.20 | 0.45 | 0.32                        |
| A004 | 0.20 | 0.11 | 0.33 | 0.24 | 0.33 | 0.24                        |
| A005 | 0.33 | 0.19 | 0.09 | 0.30 | 0.22 | 0.22                        |
Below is a Table 2 pairwise comparison matrix consumer ratings based on income and the average value of the normalization matrix income.

**Table 2.** The average value of the normalization matrix by income.

| Income | A001 | A002 | A003 | A004 | A005 | The average amount of matrix |
|--------|------|------|------|------|------|-----------------------------|
| A001   | 0.17 | 0.23 | 0.23 | 0.16 | 0.17 | 0.19                        |
| A002   | 0.05 | 0.07 | 0.07 | 0.09 | 0.05 | 0.06                        |
| A003   | 0.05 | 0.07 | 0.07 | 0.09 | 0.05 | 0.06                        |
| A004   | 0.52 | 0.38 | 0.38 | 0.48 | 0.52 | 0.45                        |
| A005   | 0.17 | 0.23 | 0.23 | 0.16 | 0.17 | 0.19                        |

Below is a Table 3 pairwise comparison matrix consumer ratings and the average value of the normalization matrix Number of Dependents.

**Table 3.** The average value of the normalization matrix based the number of dependents.

| The number of dependents | A001 | A002 | A003 | A004 | A005 | The average amount of matrix |
|--------------------------|------|------|------|------|------|-----------------------------|
| A001                     | 0.15 | 0.04 | 0.27 | 0.33 | 0.17 | 0.19                        |
| A002                     | 0.47 | 0.12 | 0.09 | 0.11 | 0.05 | 0.16                        |
| A003                     | 0.05 | 0.12 | 0.09 | 0.11 | 0.05 | 0.08                        |
| A004                     | 0.15 | 0.36 | 0.27 | 0.33 | 0.52 | 0.32                        |
| A005                     | 0.15 | 0.36 | 0.27 | 0.11 | 0.17 | 0.21                        |

Here is a Table of four pairwise comparison matrix consumer ratings average value of the normalization matrix Advances.

**Table 4.** The average value of Normalization Matrix base on Down payment.

| Down payment | A001 | A002 | A003 | A004 | A005 | The average amount of matrix |
|--------------|------|------|------|------|------|-----------------------------|
| A001         | 0.09 | 0.06 | 0.09 | 0.10 | 0.09 | 0.08                        |
| A002         | 0.27 | 0.20 | 0.27 | 0.17 | 0.27 | 0.23                        |
| A003         | 0.09 | 0.06 | 0.09 | 0.10 | 0.09 | 0.08                        |
| A004         | 0.45 | 0.60 | 0.45 | 0.51 | 0.45 | 0.49                        |
| A005         | 0.09 | 0.06 | 0.09 | 0.10 | 0.09 | 0.08                        |

Below is a Table 5 pairwise comparison matrix consumer ratings and the average value of the normalization matrix BI Checking.

**Table 5.** The average value of Normalization Matrix base on BI Checking.

| BI Checking | A001 | A002 | A003 | A004 | A005 | The average amount of matrix |
|-------------|------|------|------|------|------|-----------------------------|
| A001        | 0.33 | 0.20 | 0.34 | 0.36 | 0.36 | 0.31                        |
Here is a Table of 6 pairwise comparison matrix consumer ratings and the average value of the normalization matrix Documents Completeness record.

Table 6. The average value of Normalization Matrix Completeness of Documents.

| Completeness of Documents | A001 | A002 | A003 | A004 | A005 | The average amount of matrix |
|---------------------------|------|------|------|------|------|-----------------------------|
| A001                      | 0,12 | 0,17 | 0,12 | 0,11 | 0,11 | 0,12                        |
| A002                      | 0,04 | 0,05 | 0,04 | 0,06 | 0,06 | 0,05                        |
| A003                      | 0,12 | 0,17 | 0,12 | 0,11 | 0,11 | 0,12                        |
| A004                      | 0,36 | 0,29 | 0,36 | 0,34 | 0,34 | 0,33                        |
| A005                      | 0,36 | 0,29 | 0,36 | 0,34 | 0,34 | 0,33                        |

Here is a Table of 7 calculation based on weight criteria, consumer ratings.

Table 7. Calculation of Consumer Ratings.

| Criteria                  | A001 | A002 | A003 | A004 | A005 |
|---------------------------|------|------|------|------|------|
| Work                      | 0,43 | 0,20 | 0,32 | 0,24 | 0,22 |
| Income                    | 0,19 | 0,06 | 0,06 | 0,06 | 0,45 |
| The number of dependents  | 0,19 | 0,16 | 0,08 | 0,32 | 0,21 |
| Down payment              | 0,08 | 0,23 | 0,08 | 0,49 | 0,08 |
| BI Checking               | 0,31 | 0,06 | 0,34 | 0,13 | 0,13 |
| The completeness of document | 0,12 | 0,05 | 0,12 | 0,33 | 0,33 |
| Total                     | 1,32 | 0,76 | 1,00 | 1,57 | 1,42 |

In accordance with the calculation based on weighted criteria, consumer ratings produced by the method of AHP, A001 weight value is 1.26; A002 weight value is 0.15; A003 weight value is 0.20; A004 weight value is 0.31; A004 weight value is 0.31; and A005 weight value is 0.28. The largest weight value contained in the A004 with a value of 0.31. Here is a Table of 8 ranking consumer based on the total weight gained.

Table 8. ranking.

| Alternatif | Weight of Criteria | Ranking |
|------------|-------------------|---------|
| A004       | 0,31              | 1       |
| A005       | 0,28              | 2       |
| A001       | 1,26              | 3       |
| A003       | 0,20              | 4       |
| A002       | 0,15              | 5       |

SAW calculation method consists of five weights is very low (SR), low (L), Fair (C), High (H), and very high (ST) as shown in Table 9.
Table 9. Weights.

| Weight          | Value |
|-----------------|-------|
| Very Low (SR)   | 0,00  |
| Low (R)         | 0,25  |
| Enough (C)      | 0,50  |
| Height (T)      | 0,75  |
| Very High (ST)  | 1,00  |

In this study there weight method and criteria needed to determine consumers who deserve credit. The criteria in this study in Table 10 are:

Table 10. Criteria for Research.

| Code | Criteria                      |
|------|-------------------------------|
| C1   | Work                          |
| C2   | Income                        |
| C3   | The number of dependents      |
| C4   | Down payment                  |
| C5   | BI Checking                   |
| C6   | The completeness of document  |

The rating determines the suitability of each alternative on each criterion. The variable value is translated using fuzzy numbers below.

Table 11. Variable Value.

| Nilai | C1   | C2   | C3   | C4   | C5   | C6   |
|-------|------|------|------|------|------|------|
| C = 76-100 | 1,00 | 1    | 1,00 | 1,00 | 1,00 | 1,00 |
| C = 66-75  | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 |
| C = 56-65  | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 |
| C = 46-55  | 0,25 | 0,25 | 0,25 | 0,25 | 0,25 | 0,25 |
| C = 0-45   | 0,00 | 0    | 0,00 | 0,00 | 0,00 | 0,00 |

Table 12. Calculations Rated X on Consumer Data.

| NIK    | Factor | C1   | C2   | C3   | C4   |
|--------|--------|------|------|------|------|
| DS1200131 | $V_1$ | 0,5  | 0,07 | 0,67 | 0,1  |
| DS1200132 | $V_2$ | 1    | 0,1  | 1    | 0,1  |
| DS1200133 | $V_3$ | 0,25 | 0,1  | 0,33 | 0,1  |
| DS1200134 | $V_4$ | 0,05 | 1    | 0,07 | 0,2  |
| DS1200135 | $V_5$ | 0,5  | 0,1  | 0,33 | 1    |

Based on table 12, then can be formed matrix Normalization to Value - The value of X with such data. Make decisions based on criteria matrix (Ci), then normalized matrix based on equations that are tailored to the type attribute (attribute or attributes benefit costs) in order to obtain the normalized matrix.

The process of using weights given by decision makers:

\[ W = [ 0,25 \quad 0,2 \quad 0,15 \quad 0,15 ] \]
So it can be the sum of each consumer factors such as table 13 below:

**Table 13. Results Addition Vaktor.**

| No | Factor | Value of V |
|----|--------|------------|
| 1. | V₁     | 0,37       |
| 2. | V₂     | 0,43       |
| 3  | V₃     | 0,44       |
| 4  | V₄     | 0,25       |
| 5  | V₅     | 0,33       |

From the table above it can be seen that the results of ranking the consumer, V₁ weight value is 0,37; V₂ weight value is 0,43; V₃ weight value is 0,44; V₄ weight value is 0,25; V₅ weight value is 0,33. V₄ is as a consumer who receive home loans.

**Table 14. Ranking of Consumer.**

| No | Factor | Value of V |
|----|--------|------------|
| 1  | V₃     | 0,44       |
| 2  | V₂     | 0,43       |
| 3  | V₁     | 0,37       |
| 4  | V₅     | 0,33       |
| 5  | V₄     | 0,25       |

3. Conclusion

Based on this research, a number of conclusions is that a decision support system SAW method to get a better result than the method of AHP. In accordance with the calculation based on weighted criteria, consumer ratings produced by the method of AHP, A001 weight value is 1.26; A002 weight value is 0.15; A003 weight value is 0.20 ;A004 weight value is 0.31; A004 weight value is 0.31; and A005 weight value is 0.28. The results of ranking the consumer based on SAW method, V₁ weight value is 0,37; V₂ weight value is 0,43; V₃ weight value is 0,44; V₄ weight value is 0,25; V₅ weight value is 0,33. The assessment result using AHP to consumers A004 scored is 0,31; while using SAW method for consumers V₄ scored is 0,25. And decision support system can assist in making lending decisions and minimize home subjective assessment.

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