Journal of Computer Networks, Architecture and High Performance Computing
e-ISSN 2655-9102, Volume 2, No. 1, January 2020, pp 211-217
https://iocscience.org/ejournal/index.php/CNAPC

Decision Support System to Determine Applicant Housing Credits With SAW Method on the House Complex of J. City Residence by Capital Property

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Abstract- *J. City Residence provides subsidized housing loans facilities for people who earn below the average. The number of credit applicants with different criteria requires carefulness of the Credit Analyst in making decisions. This problem can be solved by building a Decision Support System (DSS) in determining the provision of subsidized mortgage loans using the Simple Additive Weighting (SAW) method. The criteria used are house condition (cost attribute), income (cost attribute), employment (benefit attribute), credit history (benefit attribute) and marital status (benefit attribute). The process is to normalize the credit applicant value matrix, then multiply the results of the normalization by the weight value. If the result of the calculation is above the credit line is not feasible, then the applicant is declared eligible to receive credit. Application can be used to help to determine the eligibility of consumers in obtaining subsidized housing loans with the SAW method in J. City Residence by Capital Property Housing.*

Keywords: credit, mortgages, Simple Additive Weighting.

1. Introduction

House is every human being basic needs. Increasing number of people causes the need for housing also increases. The increasing need for housing has caused housing prices become more expensive and unaffordable for people with lower middle income. Government provides a solution to this problem by creating a subsidized housing program. A subsidized house is a residence that is not subject to the Value Added Tax (VAT) and has a low interest rate, and is intended for people with lower middle income. J. City Residence is a housing project developed by Capital Property. The company provides subsidized Housing Loans (KPR) facilities for people who earn below the average. In order to obtain a subsidized KPR, the loan applicant must meet several predetermined criteria. To overcome this problem, the company recruits workers in the Credit Analyst section to analyze the eligibility of the applicant in receiving KPR credit, as well as conducting a field survey. The number of credit applicants with different criteria requires carefulness in the Credit Analyst section in making decisions. The problem found in determining the eligibility of granting subsidized housing in J. City Residence by Capital Property is there is no computerized system that can be used to determine the eligibility of consumers in obtaining subsidized housing loans. The results of manual analysis tend to be slow, subjective and prone to manual errors (human error). To overcome this problem, a Decision Support System (DSS) can be built which can provide convenience in analyzing data, assessing the suitability of credit applicants, and assisting in processing credit applicant data. The DSS method used is the Simple Additive Weighting (SAW) method. Determination of consumer credit at the company is based on Credit Analyst assessments, namely the conditions of residence, income, employment, applicant's credit history and marital status.

2. Theory

2.1. Decision Support System

Decision Support System (DSS) is part of a computer-based information system including a knowledge-based system (knowledge management) that is used to support decision making in an organization or company. It can also be said as a computer system that processes data into information to make decisions from specific semi-structured problems (Bahrin, 2016, Page 84)

According to Alter, the Decision Support System (DSS) is an interactive information system that provides information modeling, and manipulating data. The system is used to assist decision making in semitructured situations and unstructured situations, where no one knows how the decision should be made (Kusrini, 2017: 16).

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The decision making process is the stages that must be passed or used to make decisions. These stages are the basic framework, so that each stage can be further developed into several sub-stages (called steps) that are more specific / specific and more operational (Iqbal Hasan, 2018: 22).

2.2. Credit

According to national understanding, Law no. 7 of 1992 concerning banking, credit is the provision of money or bills, based on a loan agreement between the bank and another party that requires the borrower to repay the debt after a certain period of time with the amount of interest, compensation or profit sharing (Zefriyenni and Yuliana, 2017 , Page 73).

According to Sinungan, bad loans are non-current loans that have reached maturity and cannot be settled by the customer concerned. According to Sukardji, bad credit is bad debt. Uncollectible receivables are the number of company claims that exist on customers that cannot be collected for a certain reason (Widyartati, 2016, Pages 48-49).

According to Rivai, the provisions of credit policies need to be determined so that each bank has and applies a good credit policy that (Zefriyenni and Yuliana, 2017, Page 74):

a) Able to oversee the overall credit portfolio and set standards in the process of granting credit individually.
b) Have a standard / measure that contains internal supervision in all stages of the credit process.

2.3. *Simple Additive Weighting* (SAW)

Simple Additive Weighting (SAW) is often also known as the weighted sum method. The basic concept of the SAW method is to find a weighted sum of the performance ratings for each alternative of all attributes. The SAW method requires the decision matrix normalization process (X) to a scale that can be compared with all existing alternative ratings (Bahrin, 2016, Page 84).

The steps in the SAW (Simple Additive Weighting) method are as follows (Diana, 2018: 60):

a) Determine the criteria that will be used as a reference in decision making, C_j, where j = 1, 2, ..., m.
b) Determine the weights for each criterion Wj, where j = 1, 2, ..., m, with notes:
$\sum w_j = 100$
c) Normalizing the decision matrix by conducting a comparison process on all alternative values, the normalization formula is:

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{Max\ x_{ij}}, \text{ if } j = \text{benefit attribute} \\ \dfrac{Min\ x_{ij}}{x_{ij}}, \text{ if } j = \text{cost attribute} \end{cases}$$

Information:
r_{ij} : Normalized performance rating
x_{ij} : Attribute value owned by each criterion
Max x_{ij} : Biggest value of each criterion
Min x_{ij} : Smallest value of each criterion
Benefit : If the biggest value is the best
Cost : If the smallest value is the best

d) Calculate the preference value for each alternative, V_i, given as:

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

Information:
V_i = circuit for each alternative.
W_j = the weight value of each criterion
A greater value of V_i indicates that alternative A_i is more selected compared to other alternatives.

3. Analysis

The problem found in determining the eligibility of granting subsidized housing in J. City Residence by Capital Property is the absence of a computerized system that can be used to determine the eligibility of consumers in obtaining subsidized housing loans. The results of manual analysis tend to be slow, subjective and prone to manual errors (human error).

3.1. Determination of Assessment Criteria

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The criteria for residence (C1) and income (C2) are cost attributes, which means that the higher the value of the criteria, the lower the applicant's value in creditworthiness. Job criteria (C3), credit history (C4) and marital status (C5) are benefit attributes, which means the higher the criterion value, the higher the applicant's value in the credit acceptance eligibility. The value of each criterion can be seen in Table 1 to Table 5.

Table 1.
Value of Residence Criteria (Cost Attribute)

Criteria	Criteria Applicant	Value
C1- Residence Condition (Cost)	Boarding house	20
	Contract house	40
	Home Office / Family / Parents	60
	KPR House	80
	Private Property	100

Table 2.
Value of Income Criteria (Cost Attribute)

Criteria	Criteria Applicant	Value
C2- Income (Cost)	Between Rp. 2,000,000 to Rp. 3,000,000	20
	Between Rp. 3,000,001 to Rp. 4,000,000	40
	Between Rp. 4,000,001 to Rp. 6,000,000	60
	Between Rp. 6,000,001 to Rp. 8,000,000	80
	Above Rp. 8,000,000	100

Table 3.
Value of Employment Criteria (Benefit Attribute)

Criteria	Criteria Applicant	Value
C3 - Occupation (Benefit)	Does not work	0
	Work for one company for less than 6 months	20
	Work for one company for less than 1 year	40
	Work for one company for 1 year	60
	Work for one company for 2 years or more	100

Table 4.
Value of Credit History Criteria (Benefit Attribute)

Criteria	Criteria Applicant	Value
C4 - Credit History (Benefit)	Blacklisted	0
	Credit history is paid off with a lot of arrears	20
	Never credit	40
	Credit history is paid off with little arrears	60
	Credit history is paid off and smooth	100

Table 5.
Value of Marriage Status Criteria (Benefit Attribute)

Criteria	Criteria Applicant	Value
C5 - Marital Status (Benefit)	Single	50
	Married	100

3.2. Weight Determination

The next step is assigning a weight value to each criterion. The higher the value of the weight, the more influential the value of the criteria on the final calculation result (determining the eligibility of credit applications). Criteria weights can be seen in table 6.

Table 6.
Weight Value

Criteria Code	Criteria Name	Weight Value
C1	Residence Condition (Cost)	30
C2	Income (Cost)	30
C3	Occupation (Benefit)	15
C4	Credit History (Benefit)	15
C5	Marital Status (Benefit)	10

3.3. Credit Application Assessment

For example, there are several examples of credit applicants with the following data:

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1. Inadequate value (C1 = 80, C2 = 60, C3 = 40, C4 = 40, C5 = 50)
2. Andy (C1 = 60, C2 = 40, C3 = 60, C4 = 40, C5 = 100)
3. Donny (C1 = 20, C2 = 40, C3 = 60, C4 = 40, C5 = 100)
4. Lius (C1 = 20, C2 = 40, C3 = 100, C4 = 60, C5 = 100)
5. Budi (C1 = 40, C2 = 60, C3 = 100, C4 = 100, C5 = 100)
6. Charlie (C1 = 100, C2 = 80, C3 = 40, C4 = 40, C5 = 50)
7. The most appropriate value (C1 = 20, C2 = 20, C3 = 100, C4 = 100, C5 = 100)

The criteria value of each credit applicant is made into a matrix, as follows:

$$X = \begin{pmatrix} 80 & 60 & 40 & 40 & 50 \\ 60 & 40 & 60 & 40 & 100 \\ 20 & 40 & 60 & 40 & 100 \\ 20 & 40 & 100 & 60 & 100 \\ 40 & 60 & 100 & 100 & 100 \\ 100 & 80 & 40 & 40 & 50 \\ 20 & 20 & 100 & 100 & 100 \end{pmatrix}$$

Normalize the X matrix, so the results of the normalization matrix (R) are:

$$R = \begin{pmatrix} 20/80 & 20/60 & 40/100 & 40/100 & 50/100 \\ 20/60 & 20/40 & 60/100 & 40/100 & 100/100 \\ 20/20 & 20/40 & 60/100 & 40/100 & 100/100 \\ 20/20 & 20/40 & 100/100 & 60/100 & 100/100 \\ 20/40 & 20/60 & 100/100 & 100/100 & 100/100 \\ 20/100 & 20/80 & 40/100 & 40/100 & 50/100 \\ 20/20 & 20/20 & 100/100 & 100/100 & 100/100 \end{pmatrix} = \begin{pmatrix} 0.25 & 0.33 & 0.4 & 0.4 & 0.5 \\ 0.33 & 0.5 & 0.6 & 0.4 & 1 \\ 1 & 0.5 & 0.6 & 0.4 & 1 \\ 1 & 0.5 & 1 & 0.6 & 1 \\ 0.5 & 0.33 & 1 & 1 & 1 \\ 0.2 & 0.25 & 0.4 & 0.4 & 0.5 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

The assessment process is carried out by multiplying operations between the normalization matrix (R) and the weight value (W), as follows:

$$W = \begin{pmatrix} 30 \\ 30 \\ 15 \\ 15 \\ 10 \end{pmatrix}$$

The R and W matrices are carried out by multiplying operations by multiplying rows in the R matrix with the columns in the W matrix.

$V1 = W_{1,1}(R_{1,1}) + W_{2,1}(R_{1,2}) + W_{3,1}(R_{1,3}) + W_{4,1}(R_{1,4}) + W_{5,1}(R_{1,5})$

The results of row multiplication in matrix R and column in matrix W are as follows:

V1 = 30(0.25) + 30(0.33) + 15(0.4) + 15(0.4) + 10(0.5) = 34.5
V2 = 30(0.33) + 30(0.5) + 15(0.6) + 15(0.4) + 10(1) = 50
V3 = 30(1) + 30(0.5) + 15(0.6) + 15(0.4) + 10(1) = 70
V4 = 30(1) + 30(0.5) + 15(1) + 15(0.6) + 10(1) = 79
V5 = 30(0.5) + 30(0.33) + 15(1) + 15(1) + 10(1) = 65
V6 = 30(0.2) + 30(0.25) + 15(0.4) + 15(0.4) + 10(0.5) = 30.5
V7 = 30(1) + 30(1) + 15(1) + 15(1) + 10(1) = 100

The value of the ineligible criteria is between 0 to 34.5, while the value of the eligibility criteria is between 34.6 to 100, so the results of the assessment for credit applicants are as follows:

a) Andy scored 49.9 or was in the range of 34.6-100, so he was declared eligible to receive credit.
b) Donny scored 70 or was in the range of 34.6-100, so he was declared eligible to receive credit.
c) Lius scored 79 or was in the range of 34.6-100, so that he was declared eligible to receive credit.

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d) Budi gets a value of 64.9 or is in the range of 34.6-100, so he is declared eligible to receive credit.
e) Charlie gets a value of 30.5 or is between the values of 0 to 34.5, so it is declared not worthy of credit.

In the example calculation above, the value of eligibility for granting credit applications is in the range of values between 29.5 to 100. This value can change depending on the criteria for an unfit credit entered into the system. Thus, the results of calculating the value of credit worthiness depend on the value of the criteria and the value of the criteria entered by credit analysts with the company's approval. Thus, credit worthiness can be calculated.

4. Result

4.1. System Design

System modeling is done using Unified Modeling Language (UML). One UML diagram that can be used to analyze and model a system is a use case. Figure 1 shows the interaction between the user and the system in the use case diagram.

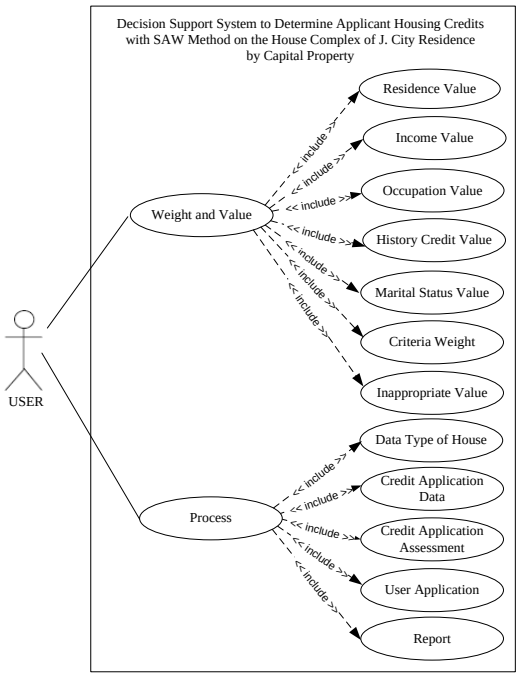


Figure 1. Use Case Diagram of Application

In the Use Case notation, the "include" relationship between use cases, means that use case X uses Y's use case completely. The process that occurs in the application to determine the feasibility of receiving subsidized mortgages can also be illustrated with an activity diagram as shown in Figure 2 Activity diagram illustrates the activity between the user and the system.

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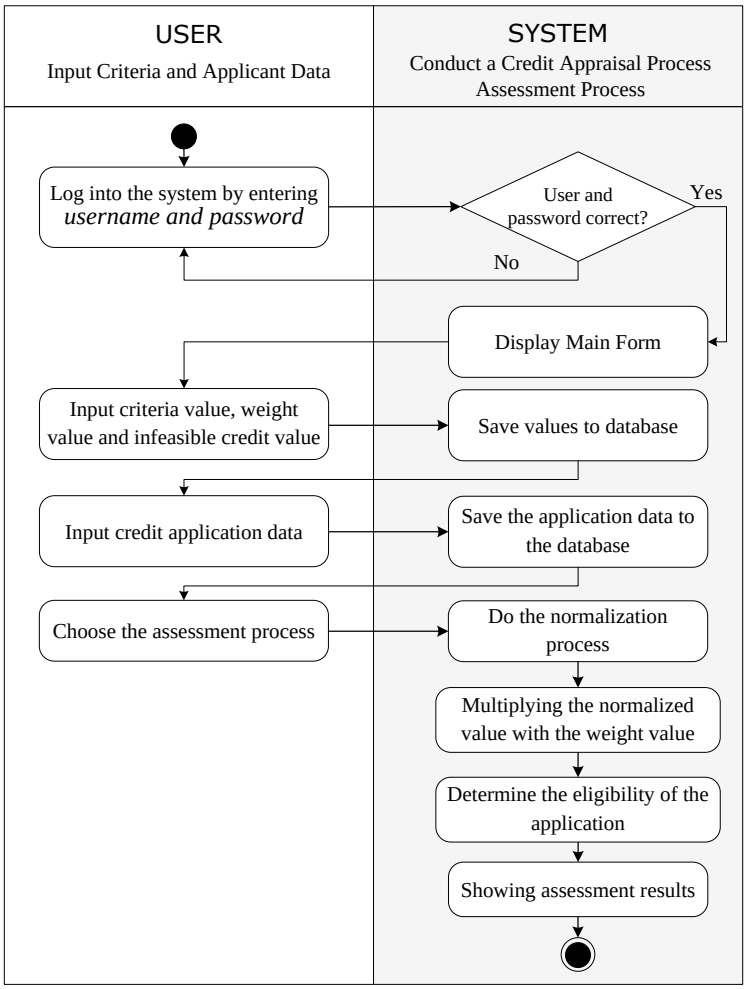


Figure 2. Activity Diagram of the System

4.2. System Strengths and Weaknesses

The decision support system application for determining subsidized housing loan recipients using the SAW method on Housing J. City Residence by Capital Property has the following advantages:

a) The application allows the user to change the value of the criteria and the weighting value of each criterion as well as the criteria deemed unfeasible, so that they can adjust the assessment process according to future needs.
b) The application provides credit application reports and credit application assessment reports so that they can help prepare reports quickly and accurately.
c) The application can display calculation steps in the assessment process, so that it can help understanding of the analysis process carried out.

The application of a decision support system for determining subsidized housing loan recipients using the SAW method on Housing J. City Residence by Capital Property also has the following weaknesses:

a) Application cannot add to the number of criteria in the rating system. The number of evaluation criteria is limited to five criteria.
b) The application can only be run on the Windows operating system and cannot be run online through the website.

5. Conclusion

After completing the design of a decision support system application for determining subsidized housing loan recipients using the Simple Additive Weighting (SAW) method in J. City Residence by Capital Property Housing, a number of things can be concluded as follows:

a) Applications can be used to help determine the eligibility of consumers in obtaining subsidized housing loans with the SAW method in J. City Residence by Capital Property Housing.

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b) The application allows the user (user) to change the value of the criteria and the value of the weight of the criteria and set the value of the criteria deemed inappropriate, so users can adjust the assessment process according to future needs.
c) The application provides credit application reports and credit application assessment reports so that it can help in the rapid preparation of reports and printing reports through printers.
d) The application can display calculation steps in the assessment process, so that it can help understanding the analysis process carried out using the SAW method.

6. References

[1] Bahrin. ***Supporting Decision System for Contracting Staff Selection with Simple Additive Weighting (SAW) Method at Pohuwato Regency Satpol PP Office,*** ILKOM Scientific Journal Volume 8 Number 2, Gorontalo: Ichsan University, 2016.
[2] Sigit, H.T. and Permana, D.H., ***Decision Support System for LCGC Car Selection Using Simple Additive Weighting,*** Banten: Serang Raya University, 2017.
[3] Hidayah, A.K, and Erwadi, Y. ***Decision Support System for the Election of the Chairperson of the Student Executive Board with the Simple Additive Weighting Method.*** Bengkulu: Muhammadiyah University, 2019.
[4] Zefriyenni and Yuliana, I.U. ***Credit Provision Policy on Determining the Amount of Credit (Special Study on Ued-Sp Amanah Sejahtera Sungai Buluh Sub-district, Singingi Hilirk, Kuantan Singingi Regency, Riau Province),*** Padang: Putra Indonesia University, 2017.
[5] Widyartati, P. ***Factors Affecting the Revolving Non-performing Loans in Sendang Mukti BKM Sendangguwo Village, Tembalang District, Semarang City.*** Semarang: STIE Semarang, 2016.
[6] Nuraisah. ***Methods in making decision support systems.*** Jambi: Jambi University, 2016.
[7] Swara and Pebriadi. ***Engineering of Web-Based Cinema Ticket Booking Software.*** Padang: Padang Institute of Technology, 2016.
[8] Dharwiyanti, S. and Wahono, R.S. ***Introduction to the Unified Modeling Language (UML).*** Ilmukomputer.com Public Lecture, 2016.
[9] Putri, N.E. and Azpar, S. ***Integrated Early Childhood Education (PAUD) Data Processing Information System Amalia Syukra Padang.*** Padang: STMIK Indonesia Padang, 2017.
[10] Nahlah and Amiruddin. ***Ms Access Based Library Information System at the Department of Commerce of Ujung Pandang State Polytechnic Commerce.*** Makassar: Unhas Makassar, 2015.
[11] Ir. M. Iqbal Hasan, M.M. ***Highlights of Decision Making Theory,*** Jakarta: Ghalia Indonesia Publisher. 2018.
[12] Dr. Kusrini, M.Kom. ***Concept and Application of Decision Support Systems,*** Yogyakarta: C.v Andi Offset Publisher. 2017.
[13] Diana, S.Sc., M.Kom. ***Decision Support System Method and Application.*** Palembang: Budi Utama Cv Publisher. 2018.

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