

Implementation of the MOORA Method in Motorcycle Loans Decisions

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Abstract—Nowadays, many people need vehicles for their daily activities, so motorcycle loans are an alternative. Motorcycle credit is a credit facility that aims to finance the purchase of motorcycles. In granting motorcycle credit, a system is needed that is able to select customers who are entitled to receive their applications according to predetermined criteria. This study uses a decision support system (DSS) as a problem solver in decision making. A decision support system (DSS) is a system that can provide the ability to solve problems in semi-structured and unstructured situations. One of the DSS methods used to solve decision-making problems This decision is the MOORA method. The MOORA method is a method whose calculations are made as simple as possible.

Keywords: Decision Support Systems; Motorcycle Loans; MOORA Method

1. INTRODUCTION

Repaid at an agreed time. One of the credit activities that many people do is motorcycle loans. Motorcycle credit is an arrangement or loan intended to finance the purchase of a motorcycle, where the source of the loan is the applicant's income. and which can be inherited either personally or as a representative, up to a certain amount. In meeting the need for private vehicles in the community, leasing companies have become the most attractive alternative. Leasing companies can provide bicycle loans motorbike according to the wishes of the community in meeting urgent needs or not.

The large number of credit applications that enter the company makes it ineffective and slow in determining the appropriate customer to receive the application. The criteria in determining the grant of credit are personality, down payment, ability, guarantee, and conditions. With the problems that arise when determining the appropriateness the customer accepts motorcycle loans according to the criteria, a decision support system (SPK) is needed.

Decision support systems are systems designed to support management in making decisions[1]. The decision maker uses one of the SPK methods, namely MOORA. Multi-Objective Optimization on the basic of Ratio Analysis (MOORA) is a multi-purpose system that simultaneously optimizes two or more conflicting attributes [2]. This method is used to solve problems involving complex mathematical calculations[2].

Several previous studies have used the MOORA method to make decisions in order to produce precise and accurate results, including research conducted by Laili Cahyani, Muchamad Arif, and Fitria Ningsih in 2019 concerning the Decision Support System for Selection of Outstanding Students Using the MOORA Method (Case Study of the Faculty Education Sciences, University of Trunojoyo Madura)[3]. The second research was conducted by Ermayanti Astuti and Nidia Enjelita Saragih with the title Support System for the Best School Selection with the MOORA Method[4]. The third research was conducted by Daeng Mhd El faritsi, Darjat Saripurna, and Ita Mariami with the title Decision Support System for Determining Teaching Staff Using the MOORA Method[5]. The fourth research was conducted by Agusta Praba Ristadi Pinem, Henny Indriyawati, and Basworo Ardi Pramono with the title Decision Support System for Determining Spatial-Based Industrial Locations Using the MOORA Method[6].

In this study, the authors used the Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) method, followed by a ranking, namely. choose predetermined criteria, to determine which customer is eligible to get a motorcycle loan. It is expected to provide precise and accurate results and to minimize the work involved in the process of granting motorcycle loans.

2. RESEARCH METHODOLOGY

2.1 Research Stages

The research stages are steps to solve a problem, starting directly with the data collection that will be carried out. In order for the steps taken to produce the best results, below is a Figure 1 of the research stages used.

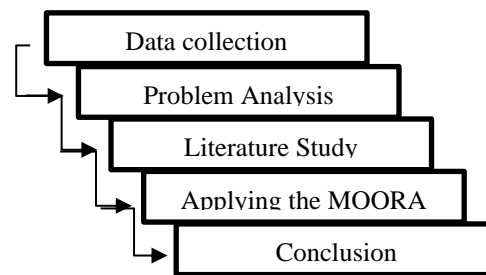


Figure 1. Research Stages

From Figure 1 it can be explained the steps in the research, namely:

- 1) Data collection from the company under investigation.
- 2) Problem Analysis. In analyzing the problem the author looks for what problems arise, the causes of the problems, and what methods can be done.
- 3) Literature Study. In solving problems by tracing sources of writing that have been made before.
- 4) Applying the Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) method.
- 5) Conclusion. The author draw conclusions from all the results of the stages that have been made by the author.

2.2 Motorcycle Loans

Motorcycle credit is a type of consumption credit that is developing in society [7]. In other words, financial institutions are a way for people to get motorcycle loans. Leasing companies are referred to as financial institutions that are able to provide the need for vehicles to the public in urgent or not cases.

2.3 Decision Support System

Decision support systems (DSS) are systems that provide information, modeling and data processing[8]. Decision support systems also provide unique interactive support for the decision-making processes of managers and other business personnel. In decision making there are several types of decisions which are divided into three types, namely structured decisions, unstructured decisions, and semi-structured decisions [8].

2.4 MOORA Method

Multi-Objective Optimization on The Basic of Ratio Analysis (MOORA) is a multi-objective system that has two or more internally conflicting attributes. MOORA optimizes this attribute by applying complex mathematical calculations, so that the desired result is problem solving [9]. This method extracts subjectivity from the evaluation process in the form of weighted criteria with easier-to-understand decision attributes. This method also has great flexibility in using variables [9].

The steps in the MOORA method are as follows [10-17]:

1. Create a Decision Matrix.

The decision matrix is represented as the X_{ij} matrix, where i represents m is the number of alternatives and j represents n is the number of criteria, Equation 1 is the matrix representation of X_{11} decisions.

$$X_{ij} = \begin{bmatrix} X_{11} & X_{12} & \cdot & X_{1n} \\ X_{21} & X_{22} & \cdot & X_{2n} \\ \cdot & \cdot & \cdot & \cdot \\ X_{m1} & X_{m2} & \cdot & X_{mn} \end{bmatrix} \quad (1)$$

2. Normalize Decision Matrix

$$X_{ij}^* = \frac{x_{ij}}{\sqrt{[\sum_j^n x_{ij}^2]}} \quad (2)$$

3. Optimize Attributes

In this stage there are 2 conditions that may occur, each of which has a different calculation. The conditions are as follows:

- a) If it does not have a weight value that belongs to the attribute or criterion in each alternative. Then the formula used is:

$$Y_i^* = \sum_{j=1}^g X_{ij}^* - \sum_{j=g+1}^n X_{ij}^* \quad (3)$$

- b) If it has a weight value on each attribute or criterion in each alternative. Then the formula used is:

$$Y_i^* = \sum_{j=1}^g W_j X_{ij}^* - \sum_{j=g+1}^n W_j X_{ij}^* \quad (4)$$

3. RESULTS AND DISCUSSION

The stages of the process of working on the MOORA method require criteria to be used as material for calculations in the ranking process. These criteria will be used as selection material. The selection process using the MOORA method begins with producing a decision matrix, where the columns in the matrix are expressed as attributes in the form of criteria that have been influenced. The row in the matrix is declared as an alternative that contains the name of a person or object to be compared and chooses the type of benefit criteria (the higher the attribute value, the better) or cost (the lower the attribute value, the better).

3.1 Determination of Criteria, Weights and Alternatives

The leasing company chooses the customer who is entitled to receive the motorcycle loan, namely by fulfilling the 5 criteria used in this study. The following in table 1 is a list of criteria used.

Table 1. Interest Level

Criteria	Criteria	Weight	Criteria Type
C ₁	Administrative documents (KTP, KK, proof of payment of electricity bills for the last 3 months, salary slips for the last 3 months)	0.2	Benefit
C ₂	Marital status (marriage book and passport photo of husband and wife)	0.15	Benefit
C ₃	Down payment	0.2	Benefit
C ₄	Collateral (BPKB, husband and wife approval letter, fiduciary guarantee)	0.2	Benefit
C ₅	Operating revenues	0.25	Benefit

The following table 2 is alternative data used in determining motorcycle credit.

Table 2. Alternative

Alternative	C ₁	C ₂	C ₃	C ₄	C ₅
Annisa Fadillah(A ₁)	KTP, KK	-	3.000.000	BPKB	4.000.000
Reza Wahyuda(A ₂)	KTP, KK, , proof of payment of electricity bills for the last 3 months	marriage book, Pas passport photo of husband and wife	4.000.000	BPKB, husband and wife approval letter	8.000.000
Dinda Lestari(A ₃)	KTP, KK	-	2.000.000	BPKB, fiduciary guarantee	3.000.000
Muhammad Ilham(A ₄)	KTP, KK	-	3.000.000	BPKB, fiduciary guarantee	7.000.000
Sartika(A ₅)	KTP, KK, , proof of payment of electricity bills for the last 3 months	marriage book, passport photo of husband and wife	5.000.000	BPKB, husband and wife approval letter, fiduciary guarantee	7.500.000

After determining the importance weights for the criteria, the following table shows the weighting of each suitability rating by linguistic type.

Table 3. Weight Value C₁, C₄

Description	Weight
Complete (4 documents)	5
Complete enough (2 documents)	3
Incomplete (none)	1

Table 4. Weight Value C₂

Description	Weight
There are	4
none	2

Because C₃ and C₅ already have values, there is no need to give them C₁, C₂, C₃, so that the final compatibility rating data can be seen in table 4 below.

Table 5. Compatibility Rating of Each Alternative

Alternative	C ₁	C ₂	C ₃	C ₄	C ₅
Annisa Fadillah(A ₁)	3	2	3.000.000	1	4.000.000
Reza Wahyuda(A ₂)	3	4	4.000.000	3	8.000.000
Dinda Lestari(A ₃)	3	2	2.000.000	3	3.000.000
Muhammad Ilham(A ₄)	3	2	3.000.000	3	7.000.000
Sartika(A ₅)	3	4	5.000.000	3	7.500.000

3.2 Implementation of MOORA Method

After the required data is complete, such as alternative data, criteria and suitability ratings, then the next step is the process of the MOORA method in choosing the best alternative in determining motorcycle credit. The following are the stages of the MOORA method.

1. Determine the X_{ij} decision matrix obtained from the suitability rating in table 5.

$$X_{ij} = \begin{bmatrix} 3 & 2 & 3.000.000 & 1 & 4.000.000 \\ 3 & 4 & 4.000.000 & 3 & 8.000.000 \\ 3 & 2 & 2.000.000 & 3 & 3.000.000 \\ 3 & 2 & 3.000.000 & 3 & 7.000.000 \\ 3 & 4 & 5.000.000 & 3 & 7.500.000 \end{bmatrix}$$

2. Calculating the decision matrix normalization.

$$X_{11}^* = \frac{3}{\sqrt{3^2 + 3^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{\sqrt{45}} = \frac{3}{6,708} = 0.447$$

$$X_{12}^* = \frac{2}{\sqrt{2^2 + 4^2 + 2^2 + 2^2 + 4^2}} = \frac{2}{\sqrt{44}} = \frac{2}{6,633} = 0.301$$

$$X_{13}^* = \frac{3.000.000}{\sqrt{3.000.000^2 + 4.000.000^2 + 2.000.000^2 + 3.000.000^2 + 5.000.000^2}} \\ = \frac{3.000.000}{\sqrt{63.000.000.000.000}} = \frac{3.000.000}{7.937.253,933} = 0.377$$

$$X_{14}^* = \frac{1}{\sqrt{1^2 + 3^2 + 3^2 + 3^2 + 3^2}} = \frac{1}{\sqrt{37}} = \frac{1}{6,082} = 0.164$$

$$X_{15}^* = \frac{4.000.000}{\sqrt{4.000.000^2 + 8.000.000^2 + 3.000.000^2 + 7.000.000^2 + 7.500.000^2}} \\ = \frac{4.000.000}{\sqrt{194.250.000.000.000}} = \frac{4.000.000}{13.937.359,864} = 0.286$$

$$X_{21}^* = \frac{3}{\sqrt{3^2 + 3^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{\sqrt{45}} = \frac{3}{6,708} = 0.447$$

$$X_{22}^* = \frac{4}{\sqrt{2^2 + 4^2 + 2^2 + 2^2 + 4^2}} = \frac{4}{\sqrt{44}} = \frac{4}{6,633} = 0.603$$

$$X_{23}^* = \frac{4.000.000}{\sqrt{3.000.000^2 + 4.000.000^2 + 2.000.000^2 + 3.000.000^2 + 5.000.000^2}}$$

$$= \frac{4.000.000}{\sqrt{63.000.000.000.000}} = \frac{4.000.000}{7.937.253,933} = 0.503$$

$$X_{24}^* = \frac{3}{\sqrt{1^2 + 3^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{\sqrt{37}} = \frac{3}{6,082} = 0.493$$

$$X_{25}^* = \frac{8.000.000}{\sqrt{4.000.000^2 + 8.000.000^2 + 3.000.000^2 + 7.000.000^2 + 7.500.000^2}}$$

$$= \frac{8.000.000}{\sqrt{194.250.000.000.000}} = \frac{8.000.000}{13.937.359,864} = 0.573$$

$$X_{31}^* = \frac{3}{\sqrt{3^2 + 3^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{\sqrt{45}} = \frac{3}{6,708} = 0.447$$

$$X_{32}^* = \frac{2}{\sqrt{2^2 + 4^2 + 2^2 + 2^2 + 4^2}} = \frac{2}{\sqrt{44}} = \frac{2}{6,633} = 0.301$$

$$X_{33}^* = \frac{2.000.000}{\sqrt{3.000.000^2 + 4.000.000^2 + 2.000.000^2 + 3.000.000^2 + 5.000.000^2}}$$

$$= \frac{2.000.000}{\sqrt{63.000.000.000.000}} = \frac{2.000.000}{7.937.253,933} = 0.251$$

$$X_{34}^* = \frac{3}{\sqrt{1^2 + 3^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{\sqrt{37}} = \frac{3}{6,082} = 0.493$$

$$X_{35}^* = \frac{3.000.000}{\sqrt{4.000.000^2 + 8.000.000^2 + 3.000.000^2 + 7.000.000^2 + 7.500.000^2}}$$

$$= \frac{3.000.000}{\sqrt{194.250.000.000.000}} = \frac{3.000.000}{13.937.359,864} = 0.215$$

$$X_{41}^* = \frac{3}{\sqrt{3^2 + 3^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{\sqrt{45}} = \frac{3}{6,708} = 0.447$$

$$X_{42}^* = \frac{2}{\sqrt{2^2 + 4^2 + 2^2 + 2^2 + 4^2}} = \frac{2}{\sqrt{44}} = \frac{2}{6,633} = 0.301$$

$$X_{43}^* = \frac{3.000.000}{\sqrt{3.000.000^2 + 4.000.000^2 + 2.000.000^2 + 3.000.000^2 + 5.000.000^2}}$$

$$= \frac{3.000.000}{\sqrt{63.000.000.000.000}} = \frac{3.000.000}{7.937.253,933} = 0.377$$

$$X_{44}^* = \frac{3}{\sqrt{1^2 + 3^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{\sqrt{37}} = \frac{3}{6,082} = 0.493$$

$$X_{45}^* = \frac{7.000.000}{\sqrt{4.000.000^2 + 8.000.000^2 + 3.000.000^2 + 7.000.000^2 + 7.500.000^2}}$$

$$= \frac{7.000.000}{\sqrt{194.250.000.000.000}} = \frac{7.000.000}{13.937.359,864} = 0.502$$

$$X_{51}^* = \frac{3}{\sqrt{3^2 + 3^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{\sqrt{45}} = \frac{3}{6,708} = 0.447$$

$$X_{52}^* = \frac{4}{\sqrt{2^2 + 4^2 + 2^2 + 2^2 + 4^2}} = \frac{4}{\sqrt{44}} = \frac{4}{6,633} = 0.603$$

$$X_{53}^* = \frac{5.000.000}{\sqrt{3.000.000^2 + 4.000.000^2 + 2.000.000^2 + 3.000.000^2 + 5.000.000^2}}$$

$$= \frac{5.000.000}{\sqrt{63.000.000.000.000}} = \frac{5.000.000}{7.937.253,933} = 0.629$$

$$X_{54}^* = \frac{3}{\sqrt{1^2 + 3^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{\sqrt{37}} = \frac{3}{6,082} = 0.493$$

$$X_{55}^* = \frac{7.500.000}{\sqrt{4.000.000^2 + 8.000.000^2 + 3.000.000^2 + 7.000.000^2 + 7.500.000^2}}$$

$$= \frac{7.500.000}{\sqrt{194.250.000.000.000}} = \frac{7.500.000}{13.937.359,864} = 0.538$$

$$X_{ij}^* = \begin{bmatrix} 0.447 & 0.301 & 0.377 & 0.164 & 0.286 \\ 0.447 & 0.603 & 0.503 & 0.493 & 0.573 \\ 0.447 & 0.301 & 0.251 & 0.493 & 0.215 \\ 0.447 & 0.301 & 0.377 & 0.493 & 0.502 \\ 0.447 & 0.603 & 0.629 & 0.493 & 0.538 \end{bmatrix}$$

3. Calculating the optimization value

$$Y_1^* = ((0.2 \times 0.447) + (0.15 \times 0.301) + (0.2 \times 0.377) + (0.2 \times 0.164) + (0.25 \times 0.286)) - 0 = 0.314$$

$$Y_2^* = ((0.2 \times 0.447) + (0.15 \times 0.603) + (0.2 \times 0.503) + (0.2 \times 0.493) + (0.25 \times 0.573)) - 0 = 0.552$$

$$Y_3^* = ((0.2 \times 0.447) + (0.15 \times 0.301) + (0.2 \times 0.251) + (0.2 \times 0.493) + (0.25 \times 0.215)) - 0 = 0.337$$

$$Y_4^* = ((0.2 \times 0.447) + (0.15 \times 0.301) + (0.2 \times 0.377) + (0.2 \times 0.493) + (0.25 \times 0.502)) - 0 = 0.434$$

$$Y_5^* = ((0.2 \times 0.447) + (0.15 \times 0.603) + (0.2 \times 0.629) + (0.2 \times 0.493) + (0.25 \times 0.538)) - 0 = 0.538$$

The following are the results of the ranking after being calculated using the MOORA method in table 6 below

Table 6. Ranking of alternatives

Alternative	Mark	Rangking
Annisa Fadillah(A ₁)	0.314	5
Reza Wahyuda(A ₂)	0.552	1
Dinda Lestari(A ₃)	0.337	4
Muhammad Ilham(A ₄)	0.434	3
Sartika(A ₅)	0.538	2

From the normalized attribute values, it can be seen in table 6 that A₂ has the largest value, namely 0.552, so it can be concluded that the 2nd alternative is the best alternative of the five alternatives for candidates who will be given motorcycle loans.

4. CONCLUSION

It can be concluded from the discussion of this article, that the application of the MOORA method in determining the provision of motorcycle loans to customers who apply for motorcycle loans can determine the appropriate and appropriate beneficiary, namely Reza Wahyuda who is the second alternative with a value of 0.552. The MOORA method in selecting the determination of motorcycle credit is carried out by calculating the normalized value of the decision matrix with a weight value to calculate the optimization value of all criteria. The highest value from the calculation results is the most recommended for receiving motorcycle loans. The results of the calculation of the application of the MOORA method form the output of the priority intensity value of the prospective customer where the highest value is appropriate for getting the credit.

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