VIKOR analysis in determining creditworthiness

M. Syaifuddin¹, Ganefri², Sukardi², Asyahri Hadi Nasyuha³, Egi Afandi¹
¹Information of System, Information of System, STMIK Triguna Dharma, Medan, Indonesia
²Vocational Technology Education, Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia
³Information of System, Faculty of Information Technology, Universitas Teknologi Digital Indonesia, Yogyakarta, Indonesia

ABSTRACT

Nowadays people are increasingly inclined to buy motorized vehicles because in addition to a light down payment, finance companies also provide convenience for the public in purchasing motorized vehicles. Even though the income level of the people in Indonesia is still relatively low, with a low down payment, the people are not too concerned about it. Honda showrooms carry out various forms of promotion and marketing so that the vehicles they sell get a response from consumers so they want to buy them. However, in fact there are still many forms of promotion that are not appropriate for consumers, so that in the motor vehicle loan process there are often obstacles caused by various factors. This study aims to create an analyst that can later be applied to computer systems, so that it can be said that by testing the system based on existing criteria, it will provide a definite answer in determining the creditworthiness of motorcycles to consumers.

Keywords:
Creditworthiness
Decision support system
VIKOR

1. INTRODUCTION

Nationally, the number of motorized vehicles increases every year, especially motorcycles. Based on data from the Indonesian Motorcycle Industry Association (AISI), the population of motorized vehicles in Indonesia in 2010 reached 50,824,128 units and in 2014 increased to 63,530,160 units or an increase of 25%. Nowadays people are increasingly inclined to buy motorized vehicles because in addition to a light down payment, finance companies also provide convenience for the public in purchasing motorized vehicles [1]. Even though the income level of the people in Indonesia is still relatively low, with a low down payment, the people are not too concerned about it. This is in line with banks that are increasingly active in expanding their products and types of business, one of which is motor vehicle loan financing. Banks in carrying out their activities, have created a new system and competitors in the banking world, not only competitors between banks but also between banks and non-bank financial institutions.

The above conditions are an opportunity for motor vehicle providers to continue to innovate to attract consumers to be interested in buying their motorized vehicles, one of which is the Honda showroom. Honda showrooms carry out various forms of promotion and marketing so that the vehicles they sell get a response from consumers so they want to buy them. Marketing or promotion is a form of business to provide and deliver the right goods and services to the right people at the right time and at the right price with the right promotion and communication. However, in fact there are still many forms of promotion that are not appropriate for consumers, so that in the motor vehicle loan process there are often obstacles caused by various factors. Motor vehicle transactions involve three parties, namely the creditor as the party providing or providing consumer financing. The consumer as the applicant for consumer financing and who
receives financing facilities from creditors. Showroom as the party that sets prices and provides consumer financing goods (motorcycles or cars). The obstacles faced are usually bad credit, the transfer of domicile by the consumer, vehicle damage, loss or other things that result in losses for the dealer. This is of course detrimental to the creditor. For that reason, a system is needed that is able to provide data or solutions for dealers to determine creditworthiness for consumers so that consumers who are given credit are truly appropriate and appropriate. From various research that has been done, it turns out that decision support systems (DSS) are able to overcome these problems.

This study will explain how to use a DSS in determining the creditworthiness of Honda motorcycles for consumers. This DSS has been tested to solve many problems such as determining the best employees, best students, best teachers and so on. In this study, the DSS used will adopt the Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR) method [2]. The VIKOR method itself is one of the multi-criteria decision-making methods or better known as the multi-criteria decision making [3]. Based on various references, the VIKOR method is widely used to resolve situations where decision makers do not have the ability to make choices when the design of a system begins, such as in completing recommendations from multi-criteria cases in determining prospective recipients of routine funding assistance. So that the VIKOR method can be the right solution in determining the recommendation to buy a Honda motorcycle.

2. RESEARCH METHOD

A DSS is a system developed using computers in the decision-making process [4]. A DSS is an information system developed for the purpose of helping management solve immediate problems [5], [6]. DSS are interactive computer-based systems that help decision makers solve unstructured and semi-structured problems using data and models [7], [8]. DSS are interactive information systems that provide information, model data, and manipulate data. This system is used for decision making in semi-structured and unstructured situations [9], [10].

Essentially, DSS is designed to support all stages of decision making, from problem identification, selection of relevant data, determination of approaches to be used in the decision-making process, to evaluation of alternative decisions [11]. DSS are systems that can provide problem-solving and communication skills for problems in semi-structured and unstructured conditions [12], [13]. This system is used to support decision making in semi-structured and unstructured situations where no one knows exactly how to make decisions. DSS is intended to inform, inform, predict, and guide information users to make better decisions [14]–[16].

2.1. VIKOR

VIKOR is better known as a multi-criteria decision-making method, or multi-criteria decision-making (MCDM) [17]. MCDM is used to solve problems with inconsistent and imbalanced criteria. This method focuses on ranking and selecting from a set of alternative, conflicting criteria for making decisions [18], [19] in order to reach a final decision.

In this method, decisions are made on near-ideal solutions and each option is evaluated against all established criteria. VIKOR evaluates alternatives and determines a solution close to the ideal compromise in Shekhovtsov and Salabun [20], Wang et al. [21]. The VIKOR method is very useful in situations where decision makers are unable to make decisions at the beginning of system design [22]. The calculation steps with the VIKOR method are:

a. Perform normalization using [23], [24]:

\[ R_{ij} = \left( \frac{x_{ij}^+ - x_{ij}^-}{x_{ij}^+ - x_{ij}^-} \right) \]  

(1)

b. Calculate the value of \( S \) and \( R \) using [25]:

\[ S_i = \sum_{j=1}^{n} W_j \left( \frac{x_{ij}^+ - x_{ij}^-}{x_{ij}^+ - x_{ij}^-} \right) \]  

(2)

And

\[ R_i = \text{Max } j \left[ W_j \left( \frac{x_{ij}^+ - x_{ij}^-}{x_{ij}^+ - x_{ij}^-} \right) \right] \]  

(3)
Where $W_j$ is the weight of each criterion $j$.

c. Determine the index value

$$Q_i = \left[ \frac{S_i - S^+}{S^+ - S^-} \right] V + \left[ \frac{R_i - R^-}{R^+ - R^-} \right] (1 - V)$$

(4)

Where:

$S^+ = \min S_i$,

$S^+ = \max S_i$ and

$R^- = \min R_j$,

$R^- = \max R_j$ and

$V = 0.5$

d. The ranking result is the result of sorting from $S$, $R$, and $Q$.

e. The best ranked alternative solution based on the minimum $Q$ value becomes the best rank with the conditions.

$$Q(A^{(2)}) - Q(A^{(1)}) = DQ$$

(5)

Where:

$A^2 = \text{alternative with second order in the ranking of } Q$ and

$A^1 = \text{alternative with the best order on the ranking of } Q$ while

$DQ = 1- (m - 1)$, where $m$ is the number of alternatives

Alternative $A^{(1)}$ must be ranked best on $S$ and/or $R$.

3. RESULTS AND ANALYSIS

To obtain material for analysis, observations were made at the Honda showroom. The following are data obtained from observations at the Honda showroom. There is a lot of consumer data recorded in the Honda showroom, but for testing only 10 consumer data are taken randomly. Table 1 is the data to be tested.

After obtaining consumer data for testing. The next stage is to determine the criteria that will be used for testing consumer data. The following are the criteria for determining the eligibility of motorcycle credit to consumers in the Honda showroom. Table 2 is the criteria data to be used.

<table>
<thead>
<tr>
<th>No</th>
<th>Code</th>
<th>Name</th>
<th>Phone</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KM0001</td>
<td>Muhammad Rizaldi</td>
<td>082356473321</td>
<td>Jl. Gatot Subroto No.10 C</td>
</tr>
<tr>
<td>2</td>
<td>KM0002</td>
<td>Rosnawati</td>
<td>081235673241</td>
<td>Jl. Karya Jaya Gg. Karya Muda</td>
</tr>
<tr>
<td>3</td>
<td>KM0003</td>
<td>Fikri Andriansyah</td>
<td>087754322145</td>
<td>Jl. Ledjjan Sudjono</td>
</tr>
<tr>
<td>4</td>
<td>KM0004</td>
<td>Eva Rsnawaty</td>
<td>082365342677</td>
<td>Jl. Karya Muda ujung</td>
</tr>
<tr>
<td>5</td>
<td>KM0005</td>
<td>Jumati</td>
<td>085234612378</td>
<td>Jl. Karya Jaya Gg. Karya Bersama</td>
</tr>
<tr>
<td>6</td>
<td>KM0006</td>
<td>Ptitto Pasaribu</td>
<td>085658004040</td>
<td>Kwala Bekala</td>
</tr>
<tr>
<td>7</td>
<td>KM0007</td>
<td>Anggi Husein Harahap</td>
<td>081269144502</td>
<td>Perunnas Simalingkar</td>
</tr>
<tr>
<td>8</td>
<td>KM0008</td>
<td>Rohdewarni Munte</td>
<td>087754701010</td>
<td>Perunnas Simalingkar</td>
</tr>
<tr>
<td>9</td>
<td>KM0009</td>
<td>Halimah</td>
<td>085296354957</td>
<td>Jl. Karya Jaya Gg. Karya Muda</td>
</tr>
<tr>
<td>10</td>
<td>KM0010</td>
<td>Heru Kurniawan</td>
<td>087751561341</td>
<td>Perunnas Simalingkar</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No</th>
<th>Code</th>
<th>Criteria</th>
<th>Weight ($W_j$)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C1</td>
<td>Income</td>
<td>0.25</td>
<td>Benefit</td>
</tr>
<tr>
<td>2</td>
<td>C2</td>
<td>File equipment</td>
<td>0.25</td>
<td>Benefit</td>
</tr>
<tr>
<td>3</td>
<td>C3</td>
<td>Down payment</td>
<td>0.20</td>
<td>Benefit</td>
</tr>
<tr>
<td>4</td>
<td>C4</td>
<td>Dependent</td>
<td>0.15</td>
<td>Cost</td>
</tr>
<tr>
<td>5</td>
<td>C5</td>
<td>Other expenses</td>
<td>0.15</td>
<td>Cost</td>
</tr>
</tbody>
</table>

After determining the criteria to be used, the next step is normalization. Before normalizing, what must be done is to provide alternative values for each criterion. The goal of normalization is to generate a new decision matrix from consumer data. Table 3 is an alternative assessment for each criterion.
Table 3. Alternative assessment on each criteria

<table>
<thead>
<tr>
<th>No</th>
<th>Code</th>
<th>Alternative Name</th>
<th>Criteria 1</th>
<th>Criteria 2</th>
<th>Criteria 3</th>
<th>Criteria 4</th>
<th>Criteria 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KM0001</td>
<td>Muhammad Rizaldi</td>
<td>70 80 60 70 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>KM0002</td>
<td>Rosmawati</td>
<td>80 70 80 90 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>KM0003</td>
<td>Fiki Andriansyah</td>
<td>90 80 90 70 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>KM0004</td>
<td>Eva Risnowaty</td>
<td>80 70 60 90 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>KM0005</td>
<td>Jumiati</td>
<td>70 70 80 70 70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>KM0006</td>
<td>Pitto Pasaribu</td>
<td>80 70 80 70 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>KM0007</td>
<td>Anggi Husein Harahap</td>
<td>80 70 90 70 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>KM0008</td>
<td>Rohdewami Munte</td>
<td>80 70 80 80 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>KM0009</td>
<td>Halimah</td>
<td>80 80 70 70 90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>KM0010</td>
<td>Heru Kurniawan</td>
<td>90 70 80 80 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Normalize

− Normalize alternative values for each criterion:

\[ R_{ij} = \frac{x_{ij} - x_{j}}{x_{j} - x_{i}} \]  \hspace{1cm} (6)

− Criteria 1 (C1):

\[
R_{11} = \frac{(90-70)}{(90-70)} = 1
\]

\[
R_{21} = \frac{(90-80)}{(90-70)} = 0.5
\]

\[
R_{31} = \frac{(90-90)}{(90-70)} = 0
\]

\[
R_{41} = \frac{(90-80)}{(90-70)} = 0.5
\]

\[
R_{51} = \frac{(90-70)}{(90-70)} = 1
\]

\[
R_{61} = \frac{(90-80)}{(90-80)} = 0.5
\]

\[
R_{71} = \frac{(90-70)}{(90-80)} = 0.5
\]

\[
R_{81} = \frac{(90-70)}{(90-90)} = 0.5
\]

\[
R_{91} = \frac{(90-70)}{(90-90)} = 0.5
\]

\[
R_{101} = \frac{(90-90)}{(90-70)} = 0
\]

− Criteria 2 (C2):

\[
R_{12} = \frac{(80-80)}{(80-70)} = 0
\]

\[
R_{22} = \frac{(80-70)}{(80-70)} = 1
\]

\[
R_{32} = \frac{(80-80)}{(80-70)} = 0
\]

\[
R_{42} = \frac{(80-70)}{(80-70)} = 1
\]

\[
R_{52} = \frac{(80-70)}{(80-70)} = 1
\]

\[
R_{62} = \frac{(80-70)}{(80-80)} = 1
\]

\[
R_{72} = \frac{(80-70)}{(80-70)} = 1
\]

\[
R_{82} = \frac{(80-80)}{(80-70)} = 1
\]

\[
R_{92} = \frac{(80-70)}{(80-70)} = 1
\]

\[
R_{102} = \frac{(80-70)}{(80-70)} = 1
\]

− Criteria 3 (C3):

\[
R_{13} = \frac{(90-60)}{(90-60)} = 1
\]

\[
R_{23} = \frac{(90-60)}{(90-60)} = 0.33
\]

\[
R_{33} = \frac{(90-90)}{(90-60)} = 0
\]

\[
R_{43} = \frac{(90-60)}{(90-60)} = 1
\]

\[
R_{53} = \frac{(90-80)}{(90-60)} = 0.33
\]

\[
R_{63} = \frac{(90-80)}{(90-60)} = 0.33
\]

\[
R_{73} = \frac{(90-90)}{(90-60)} = 0
\]

\[
R_{83} = \frac{(90-80)}{(90-60)} = 0.33
\]

\[
R_{93} = \frac{(90-60)}{(90-60)} = 0.67
\]

\[
R_{103} = \frac{(90-80)}{(90-60)} = 0.33
\]

− Criteria 4 (C4):

\[
R_{14} = \frac{(90-70)}{(90-70)} = 1
\]

\[
R_{24} = \frac{(90-70)}{(90-90)} = 0
\]

\[
R_{34} = \frac{(90-70)}{(90-70)} = 1
\]

\[
R_{44} = \frac{(90-70)}{(90-90)} = 0
\]

\[
R_{54} = \frac{(90-70)}{(90-70)} = 1
\]

\[
R_{64} = \frac{(90-70)}{(90-70)} = 1
\]

\[
R_{74} = \frac{(90-70)}{(90-70)} = 1
\]

\[
R_{84} = \frac{(90-70)}{(90-90)} = 0.5
\]

\[
R_{94} = \frac{(90-70)}{(90-90)} = 1
\]

\[
R_{104} = \frac{(90-90)}{(90-70)} = 0.5
\]

− Criteria 5 (C5):

\[
R_{15} = \frac{(90-60)}{(90-60)} = 1
\]

\[
R_{25} = \frac{(90-60)}{(90-60)} = 0.33
\]

\[
R_{35} = \frac{(90-80)}{(90-80)} = 0.33
\]

\[
R_{45} = \frac{(90-80)}{(90-80)} = 0.33
\]

\[
R_{55} = \frac{(90-70)}{(90-70)} = 0.67
\]

\[
R_{65} = \frac{(90-80)}{(90-80)} = 0.33
\]

\[
R_{75} = \frac{(90-60)}{(90-60)} = 0.33
\]

\[
R_{85} = \frac{(90-60)}{(90-60)} = 0.33
\]

\[
R_{95} = \frac{(90-90)}{(90-60)} = 0
\]

\[
R_{105} = \frac{(90-90)}{(90-60)} = 0.33
\]

From consumer data and criteria data, the normalization stage is carried out. The normalization stage aims to get the matrix value. Table 4 there are values from the normalization results.
After obtaining the normalization value. The next step is to normalize the matrix by multiplying the criteria weights. In Table 5 it can be seen the multiplication between the normalization and the weight of the criteria. After the normalization stage, then the normalization is multiplied by the criterion weight. Then we get the results of normalizing the alternative value matrix. In Table 6 there are the results of the normalization multiplication with alternative values.

### Table 4. Normalization of alternative values

<table>
<thead>
<tr>
<th>No</th>
<th>Alternative Name</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Muhammad Rizaldi</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Rosmawati</td>
<td>0.5</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
</tr>
<tr>
<td>3</td>
<td>Fikri Andriansyah</td>
<td>0</td>
<td>0</td>
<td>0.33</td>
<td>1</td>
<td>0.33</td>
</tr>
<tr>
<td>4</td>
<td>Eva Risnawaty</td>
<td>0.5</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.33</td>
</tr>
<tr>
<td>5</td>
<td>Jumati</td>
<td>1</td>
<td>1</td>
<td>0.33</td>
<td>1</td>
<td>0.67</td>
</tr>
<tr>
<td>6</td>
<td>Pitto Pasaribu</td>
<td>0.5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0.33</td>
</tr>
<tr>
<td>7</td>
<td>Anggi Husein Harahap</td>
<td>0.5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0.33</td>
</tr>
<tr>
<td>8</td>
<td>Rohdewarni Munte</td>
<td>0.5</td>
<td>1</td>
<td>0.33</td>
<td>0.5</td>
<td>0.33</td>
</tr>
<tr>
<td>9</td>
<td>Halimah</td>
<td>0.5</td>
<td>0</td>
<td>0.67</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Heru Kurniawan</td>
<td>0</td>
<td>1</td>
<td>0.33</td>
<td>0.5</td>
<td>0.33</td>
</tr>
</tbody>
</table>

### Table 5. Normalization of alternative value matrix

<table>
<thead>
<tr>
<th>No</th>
<th>Alternative Name</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Muhammad Rizaldi</td>
<td>1</td>
<td>0</td>
<td>0.25</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>2</td>
<td>Rosmawati</td>
<td>0.5</td>
<td>0.25</td>
<td>0.25</td>
<td>0.066</td>
<td>0.15</td>
</tr>
<tr>
<td>3</td>
<td>Fikri Andriansyah</td>
<td>0</td>
<td>0</td>
<td>0.25</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>4</td>
<td>Eva Risnawaty</td>
<td>0.5</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>5</td>
<td>Jumati</td>
<td>1</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>6</td>
<td>Pitto Pasaribu</td>
<td>0.5</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>7</td>
<td>Anggi Husein Harahap</td>
<td>0.5</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>8</td>
<td>Rohdewarni Munte</td>
<td>0.5</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>9</td>
<td>Halimah</td>
<td>0.5</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>10</td>
<td>Heru Kurniawan</td>
<td>0</td>
<td>0</td>
<td>0.25</td>
<td>0.25</td>
<td>0.15</td>
</tr>
</tbody>
</table>

### Table 6. Results of alternative value matrix normalization

<table>
<thead>
<tr>
<th>No</th>
<th>Alternative Name</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Muhammad Rizaldi</td>
<td>0.25</td>
<td>0</td>
<td>0.2</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>2</td>
<td>Rosmawati</td>
<td>0.125</td>
<td>0.25</td>
<td>0.066</td>
<td>0</td>
<td>0.0495</td>
</tr>
<tr>
<td>3</td>
<td>Fikri Andriansyah</td>
<td>0</td>
<td>0</td>
<td>0.2</td>
<td>0.066</td>
<td>0.15</td>
</tr>
<tr>
<td>4</td>
<td>Eva Risnawaty</td>
<td>0.125</td>
<td>0.25</td>
<td>0.2</td>
<td>0</td>
<td>0.0495</td>
</tr>
<tr>
<td>5</td>
<td>Jumati</td>
<td>0.25</td>
<td>0.25</td>
<td>0.066</td>
<td>0.15</td>
<td>0.1005</td>
</tr>
<tr>
<td>6</td>
<td>Pitto Pasaribu</td>
<td>0.125</td>
<td>0.25</td>
<td>0.066</td>
<td>0.15</td>
<td>0.0495</td>
</tr>
<tr>
<td>7</td>
<td>Anggi Husein Harahap</td>
<td>0.125</td>
<td>0.25</td>
<td>0.066</td>
<td>0.15</td>
<td>0.0495</td>
</tr>
<tr>
<td>8</td>
<td>Rohdewarni Munte</td>
<td>0.125</td>
<td>0.25</td>
<td>0.066</td>
<td>0.075</td>
<td>0.0495</td>
</tr>
<tr>
<td>9</td>
<td>Halimah</td>
<td>0.125</td>
<td>0</td>
<td>0.134</td>
<td>0.15</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Heru Kurniawan</td>
<td>0</td>
<td>0</td>
<td>0.25</td>
<td>0.066</td>
<td>0.075</td>
</tr>
</tbody>
</table>

b. Calculation of $S$ and $R$ values

- Finding $S$ value of each option

$$S_j = \sum_{i=1}^{n} W_j \left( \frac{x_{ij} - x_{0j}}{x_{ij} - x_{0j}} \right)$$

$$S(A1) = 0.25 + 0 + 0.2 + 0.15 + 0.15 = 0.75$$
$$S(A2) = 0.125 + 0.25 + 0.066 + 0 + 0.0495 = 0.4905$$
$$S(A3) = 0 + 0 + 0.15 + 0.0495 = 0.1995$$
$$S(A4) = 0.125 + 0.25 + 0.2 + 0 + 0.0495 = 0.6245$$
$$S(A5) = 0.25 + 0.25 + 0.066 + 0.15 + 0.1005 = 0.8165$$
$$S(A6) = 0.125 + 0.25 + 0.066 + 0.15 + 0.0495 = 0.6405$$
$$S(A7) = 0.125 + 0.25 + 0 + 0.15 + 0.0495 = 0.5745$$
$$S(A8) = 0.125 + 0.25 + 0.066 + 0.075 + 0.0495 = 0.5655$$
$$S(A9) = 0.125 + 0 + 0.134 + 0.15 + 0 = 0.409$$
$$S(A10) = 0 + 0.25 + 0.066 + 0.075 + 0.0495 = 0.4405$$

**VIKOR analysis in determining creditworthiness (M. Syaifuddin)**
Finding the $R$ value of each alternative

$$R_i = \text{Max } f \left[ W_j \left( \frac{x_{ij}^+ - x_{il}^-}{x_{ij}^+ - x_{lj}^-} \right) \right] \quad (8)$$

$R(A1) = 0.25$
$R(A2) = 0.25$
$R(A3) = 0.15$
$R(A4) = 0.25$
$R(A5) = 0.25$
$R(A6) = 0.25$
$R(A7) = 0.25$
$R(A8) = 0.25$
$R(A9) = 0.15$
$R(A10) = 0.25$

After the normalization matrix multiplication stage, the next step is to calculate the utility measure ($S$) value. Then the next stage is regrete measure ($R$). Table 7 shows the results of calculating the $S$ and $R$ values from the data for each alternative.

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Value $S$</th>
<th>Value $R$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Muhammad Rizaldi</td>
<td>0.75</td>
<td>0.25</td>
</tr>
<tr>
<td>2</td>
<td>Rosnazwati</td>
<td>0.4095</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>Fikri Andriansyah</td>
<td>0.1995</td>
<td>0.15</td>
</tr>
<tr>
<td>4</td>
<td>Eva Risnawaty</td>
<td>0.6245</td>
<td>0.25</td>
</tr>
<tr>
<td>5</td>
<td>Jumiati</td>
<td>0.8165</td>
<td>0.25</td>
</tr>
<tr>
<td>6</td>
<td>Pitto Pasaribu</td>
<td>0.6405</td>
<td>0.25</td>
</tr>
<tr>
<td>7</td>
<td>Anggi Husein Harahap</td>
<td>0.5745</td>
<td>0.25</td>
</tr>
<tr>
<td>8</td>
<td>Robinedarm Munte</td>
<td>0.5655</td>
<td>0.25</td>
</tr>
<tr>
<td>9</td>
<td>Halimah</td>
<td>0.409</td>
<td>0.15</td>
</tr>
<tr>
<td>10</td>
<td>Heru Kurniawan</td>
<td>0.4405</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Determine the index value

The smallest $Q$ value is the best value. The following is the calculation of the VIKOR value index, which is:

Value $Q1 = \left[ \frac{0.75-0.8165}{0.8165-0.1995} \right] \times 0.5 + \left[ \frac{0.25-0.25}{0.25-0.15} \right] \times (1 - 0.5)$

$= (-0.10778 \times 0.5) + (0 \times 0.5)$

$= -0.05389$

Value $Q2 = \left[ \frac{0.4095-0.8165}{0.8165-0.1995} \right] \times 0.5 + \left[ \frac{0.25-0.25}{0.25-0.15} \right] \times (1 - 0.5)$

$= (-0.52836 \times 0.5) + (0 \times 0.5)$

$= -0.26418$

Value $Q3 = \left[ \frac{0.1995-0.8165}{0.8165-0.1995} \right] \times 0.5 + \left[ \frac{0.15-0.25}{0.25-0.15} \right] \times (1 - 0.5)$

$= (-1 \times 0.5) + (-1 \times 0.5)$

$= -1$

Value $Q4 = \left[ \frac{0.6245-0.8165}{0.8165-0.1995} \right] \times 0.5 + \left[ \frac{0.25-0.25}{0.25-0.15} \right] \times (1 - 0.5)$

$= (-0.31118 \times 0.5) + (0 \times 0.5)$

$= -0.15559$

Value $Q5 = \left[ \frac{0.8165-0.8165}{0.8165-0.1995} \right] \times 0.5 + \left[ \frac{0.25-0.25}{0.25-0.15} \right] \times (1 - 0.5)$

$= (0 \times 0.5) + (0 \times 0.5)$

$= 0$
Value $Q_6 = \frac{[0.6405-0.8165]}{[0.8165-0.1995]} \times 0.5 + \frac{[0.25-0.25]}{[0.25-0.15]} \times (1 - 0.5) = -0.14263$

Value $Q_7 = \frac{[0.5745-0.8165]}{[0.8165-0.1995]} \times 0.5 + \frac{[0.25-0.25]}{[0.25-0.15]} \times (1 - 0.5) = -0.19611$

Value $Q_8 = \frac{[0.5655-0.8165]}{[0.8165-0.1995]} \times 0.5 + \frac{[0.25-0.25]}{[0.25-0.15]} \times (1 - 0.5) = -0.2034$

Value $Q_9 = \frac{[0.409-0.8165]}{[0.8165-0.1995]} \times 0.5 + \frac{[0.15-0.25]}{[0.25-0.15]} \times (1 - 0.5) = -0.83023$

Value $Q_{10} = \frac{[0.4405-0.8165]}{[0.8165-0.1995]} \times 0.5 + \frac{[0.25-0.25]}{[0.25-0.15]} \times (1 - 0.5) = -0.3047$

After calculating the value of the utility measure ($S$) and the increase measure ($R$) value. The next step is to determine the index value ($Q$). From the calculation above, the VIKOR index value can be obtained. In Table 8 it can be seen the value of the VIKOR index.

c. Alternative solutions with the highest score based on the lowest $Q$ value representing the highest score. In addition, the last effort is to deliver motorcycle loans to consumers in Honda showrooms. Based on the Table 8, we have the feasibility results which can be seen in Table 9.

d. The best ranking alternative solution based on the minimum $Q$ value becomes the best ranking. From the results of the calculations that have been done, the minimum value is taken as the best value. Next is to provide motorcycle loans to consumers in the Honda showroom. Table 10 shows the results of consumer eligibility.

<table>
<thead>
<tr>
<th>Table 8. VIKOR index value</th>
<th>Table 9. Ranking of $Q$ values</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Name</td>
</tr>
<tr>
<td>1</td>
<td>Muhammad Rizaldi</td>
</tr>
<tr>
<td>2</td>
<td>Rosmawati</td>
</tr>
<tr>
<td>3</td>
<td>Fikri Andriansyah</td>
</tr>
<tr>
<td>4</td>
<td>Eva Risnawaty</td>
</tr>
<tr>
<td>5</td>
<td>Jumiati</td>
</tr>
<tr>
<td>6</td>
<td>Pittopasaribu</td>
</tr>
<tr>
<td>7</td>
<td>Anggi Husein Harahap</td>
</tr>
<tr>
<td>8</td>
<td>Rohdewarni Munte</td>
</tr>
<tr>
<td>9</td>
<td>Halimah</td>
</tr>
<tr>
<td>10</td>
<td>Heru Kurniawan</td>
</tr>
</tbody>
</table>

Table 10. Results table

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Value</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fikri Andriansyah</td>
<td>-1</td>
<td>Worthy</td>
</tr>
<tr>
<td>2</td>
<td>Halimah</td>
<td>-0.83023</td>
<td>Worthy</td>
</tr>
<tr>
<td>3</td>
<td>Heru Kurniawan</td>
<td>-0.3047</td>
<td>Worthy</td>
</tr>
<tr>
<td>4</td>
<td>Rosmawati</td>
<td>-0.26418</td>
<td>Worthy</td>
</tr>
<tr>
<td>5</td>
<td>Rohdewarni Munte</td>
<td>-0.2034</td>
<td>Worthy</td>
</tr>
<tr>
<td>6</td>
<td>Anggi Husein Harahap</td>
<td>-0.19611</td>
<td>not feasible</td>
</tr>
<tr>
<td>7</td>
<td>Eva Risnawaty</td>
<td>-0.15559</td>
<td>not feasible</td>
</tr>
<tr>
<td>8</td>
<td>Pittopasaribu</td>
<td>-0.14263</td>
<td>not feasible</td>
</tr>
<tr>
<td>9</td>
<td>Muhammad Rizaldi</td>
<td>-0.05389</td>
<td>not feasible</td>
</tr>
<tr>
<td>10</td>
<td>Jumiati</td>
<td>0</td>
<td>not feasible</td>
</tr>
</tbody>
</table>

VIKOR analysis in determining creditworthiness (M. Syaifuddin)
After carrying out all the stages of the VIKOR method, the calculation results are obtained from consumer data that is feasible or not for credit applications. In Table 10, it can be seen that consumers who are eligible to be given motorbike loans at the Honda showroom are ranked 1–5. Meanwhile, rank 6 and so on are declared ineligible to be given motorbike loans at the Honda showroom.

4. CONCLUSION

In analyzing the problem of determining the creditworthiness of motorcycles to consumers at the Honda showroom, namely by determining the criteria that influence in determining the creditworthiness of motorcycles to consumers, then each criterion is given a weight value based on the provisions of the VIKOR method, than the calculation process is carried out by adopting the VIKOR method. In applying the VIKOR method in problem solving to determine the creditworthiness of motorcycles to consumers at the Honda showroom, namely by entering the calculation algorithm into the program source code, than the algorithm that has been entered into the program source code will automatically calculate the process in determining eligibility, motorcycle loans to consumers. The system that has been designed is then implemented by entering the data in accordance with those in the previous chapters, then if the output results are in accordance with the manual data then in this test the system runs well, adds data to the database, updates commands to change data in the database, delete command to delete data in the database.

REFERENCES
VIKOR analysis in determining creditworthiness (M. Syaifuddin)

M. Syaifuddin He received his Doctorate (Doctorate in Vocational Technology Education) at the Faculty of Engineering from Padang State University in 2023. He is a Lecturer in computer science at the Information Systems Study Program, STMIK Triguna Dharma, Medan, Indonesia. Focused research in computer security. He can be contacted at email msyaifuddins@gmail.com.

Ganefri He is Indonesian lecturer, teacher, and engineering academic. He was Chancellor of Padang State University for two terms from 2016 to 2024 and served as Chairman of the Council of Chancellors of Indonesian State Universities for the 2022–2024 period. He can be contacted at email: ganefri1@gmail.com.

Sukardi He is an Indonesian lecturer, teacher, and technical academic. He is a lecturer at the Faculty of Engineering, Padang State University and serves as Head of the Center for Field Experience. The focus of research on electricity. He can be contacted at email: sukardiunp@gmail.com.

Asyahri Hadi Nasyuha He received his Doctorate (Doctorate in Vocational Technology Education) at the Faculty of Engineering from Padang State University in 2020. He is a Lecturer in computer science at the Information Systems Study Program, Universitas Teknologi Digital Indonesia, Yogyakarta, Indonesia. In addition, he has also served as Head of the Quality Assurance Institute at STMIK Triguna Dharma from 2020 to 2022. Since 2019, he has a professional lecturer certification from the Ministry of Research, Technology and Higher Education. In 2021 he was assigned by the Ministry of Education, Culture, Research and Technology as a Lecturer Workload Assessor. He is also one of the reviewers of the SINTA 3 indexed national journal. He has published more than 45 journal papers, 3 written books, and 3 papers in conference proceedings. His research interests are decision support systems, artificial intelligence, data mining. He can be contacted at email: asyahrihadi@gmail.com.

Egi Afandi He earned a Master's degree from Putra Indonesia University Padang in 2019. He is a Lecturer in Computer Science at the Information Systems Study Program, STMIK Triguna Dharma, Medan, Indonesia. He has served as the head of the student affairs division at STMIK Triguna Dharma. His research interests are decision support systems, artificial intelligence, data mining. He can be contacted at email: egi.afandi46@gmail.com.