

# Decision Support System for Purchase of Used Cars using Electre Method

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**Abstract** - This study aims to build a decision support system that can help facilitate the selection of the right used car for potential buyers. To be able to buy a used car that suits the needs and funds owned by consumers, buyers must consider the many criteria and factors of each used car which consists of various brands that exist today. This study uses the ELECTRE (Elimination and Choice Translation Reality) method. The criteria in the comparison used in this decision support system are documents, cylinder volume, year of production and car price. The ELECTRE method is used in conditions where alternatives that do not meet the criteria are eliminated, and suitable alternatives can be generated. Of the 8 samples of used cars studied, the best recommendation was Ayla (A4) with a total aggregate of 4 and an alternative that was not recommended was Agya (A3) with a total aggregate of 0.

**Keywords:** Decision Making System, Used Car, Electre, Criteria, Alternative.

## 1. Introduction

Along with the times that demand to always be fast in all things, it cannot be denied that indirectly transportation has become the necessity of life for everyone. The car is one of the means of transportation needed at this time. When someone has the desire to buy a car, the question is whether to buy a new car or a used car. To buy a used car requires carefulness in choosing a car that is still in good condition and quality because not all used cars have decreased in quality. The criteria used as the basis for choosing a used car include documents, year of production, cylinder volume, and price. The problem that often occurs when someone buys a used car is that buyers often feel disappointed because the car purchased does not meet the criteria needed by the buyer. This is due to the lack of information obtained by potential buyers. To solve this problem, a decision support system was created using the ELECTRE (Elimination and Choice Translation Reality) method where each criterion would be compared so that the buyer would receive recommendations from this system according to the criteria he had chosen. This method can be used to determine whether the car to be purchased is suitable or not with the required qualifications. This is because the ELECTRE method is able to provide the best alternative to the car according to the needs of the buyer.

## 2. Literature Review

### 2.1. Decision Support System

Decision support systems are interactive information systems that provide modeling information and manipulate system data that are used for decision making in semi-structured and unstructured situations where no one is certain about how decisions should be made (Yuliarifin, 2019). DSS is usually built or used for decision making. DSS applications use a CBIS (computer based information system) that is flexible and interactive and can be adapted and developed to support solutions to specific management problems that are not structured. DSS applications using data provide an easy user interface and can incorporate decision-making thinking. DSS is more intended to support management in doing analytical work in less structured situations and with clear criteria. DSS is not intended to automate decision making but provides an interactive tool that enables decision-makers to perform various analyzes using the available models. The goals of a decision support system are: Decision support systems are interactive information systems that provide modeling information and manipulate system data that are used for decision making in semi-structured and unstructured situations where no one is certain about how decisions should be made (Yuliarifin, 2019). DSS is usually built or used for decision making. DSS applications use a CBIS (computer based information system) that is flexible and interactive and can be adapted and developed to support solutions to specific management problems that are not structured. DSS applications using data provide an easy user interface and can incorporate decision-making thinking. DSS is more intended to support management in doing analytical work in less structured situations and with clear criteria. DSS is not intended to automate decision making but provides an interactive tool



$$v_{ij} = \begin{bmatrix} v_{11} & v_{12} & v_{13} & \dots & v_{1n} \\ v_{21} & v_{22} & v_{23} & \dots & v_{2n} \\ \vdots & \vdots & \vdots & \dots & \vdots \\ v_{m1} & v_{m2} & v_{m3} & \dots & v_{mn} \end{bmatrix} \quad (6)$$

4. Determine the set of Concordance and Discordance

The concordance set  $\{C_{kl}\}$  states that the computation of the weight criterion of  $A_k$  is possibly better than that of  $A_l$ .

$$C_{kl} = \{j | V_{kj} \geq V_{lj}\} \quad (7)$$

Description :

$C_{kl}$  = Row concordance value column k l

k,l = 1, 2, ..., m      k ≠ l

j = 1, 2, ..., n

The set of discordance  $\{D_{kl}\}$  is written as follows:

$$D_{kl} = \{j | V_{kj} \leq V_{lj}\} \quad (8)$$

Description:

$D_{kl}$  = row concordance value column k l

k,l = 1, 2, ..., m

k ≠ l

j = 1, 2, ..., n

5. Calculate Matrix Concordance and Discordance

To calculate or determine the concordance matrix is to increase the weight contained in the concordance matrix.

$$C_{kl} = \sum_{j \in C_{kl}} W_j \quad (9)$$

To determine the discordance matrix is to divide the maximum difference between the criteria entered into the discordance set with the highest difference between the values that exist in all criteria.

$$D_{kl} = \frac{\max\{|V_{kj} - V_{lj}|\} | j \in C_{kl}}{\max\{|V_{kj} - V_{lj}|\} | v_j} \quad (10)$$

Matrix D is also the result of m x m and does not take the values of column l and row k, array d as follows:

$$d_{ij} = \begin{bmatrix} - & d_{12} & \dots & d_{1n} \\ d_{21} & - & \dots & d_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ d_{m1} & d_{m2} & \dots & - \end{bmatrix} \quad (11)$$

6. Determining Dominant Concordance Matrix and Dominant Discordance This array can form the upper threshold value (threshold) C. The formula can produce the value c.

$$c = \frac{\sum_{k=1}^m \sum_{l=1}^m C_{kl}}{m(m-1)} \quad (12)$$

The alternative  $A_k$  can have a chance to dominate  $A_l$  if the concordance index  $C_{kl}$  exceeds the upper threshold value C with  $C_{kl} \geq c$  and the dominant concordance matrix element F is defined as:

$$f_{kl} = \begin{cases} 1, & \text{jika } C_{kl} \geq c \\ 0, & \text{jika } C_{kl} < c \end{cases} \quad (13)$$

The same is done for the dominant matrix of discordance matrix G with a threshold value of D. The following formula can give a value of D.

$$d = \frac{\sum_{k=1}^m \sum_{l=1}^m d_{kl}}{m(m-1)} \quad (14)$$

Matriks Element *discorden* dominan G defined as :

$$g_{kl} = \begin{cases} 1, & \text{jika } d_{kl} \geq d \\ 0, & \text{jika } d_{kl} < d \end{cases} \quad (15)$$

7. Determine *Aggregate Dominance Matrix*

Model E as the dominant total matrix is a matrix where each element is multiplied between the matrix F and the element equation G.

$$e_{kl} = f_{kl} * g_{kl} \quad (16)$$

8. Elimination of Less Favorable Alternatives



In this section, the elimination of alternatives that have a value of 1 at least in the aggregated dominant matrix is carried out. The result of this elimination is the alternative with the highest value of 1 in the aggregate dominance matrix.

#### 4. Result

##### 1. Manual calculation methods ELECTRE

In this study, 4 used car samples were used, namely Innova (A1), Terios (A2), Agya (A3), Ayla (A4), Calya (A5), Xenia (A6), Yaris (A7) dan Mobilio (A8) as an alternative to manual calculation with ELECTRE method. Rating matches each alternative on each criterion, rated with one to five, namely :

- |              |               |
|--------------|---------------|
| 1 = Very Bad | 4 = Good      |
| 2 = Bad      | 5 = Very Good |
| 3 = Enough   |               |

The following are the criteria that can be chosen by the user

**Table 1 Document Criteria Preference Value (C1)**

Nilai	Keterangan
1	Masa STNK <= 1 tahun
2	Masa STNK >1 tahun dan <=2 tahun
3	Masa STNK >2 tahun dan <=3 tahun
4	Masa STNK >3 tahun dan <=4 tahun
5	Masa STNK >4 tahun

**Table 3 Value Preference Criteria Cylinder Volume (C3)**

Nilai	Keterangan
1	<=1000 cc
2	>1000 cc dan <=1500 cc
3	>1500 cc dan <=2000 cc
4	>2000 cc dan <=2500 cc
5	>2500 cc

**Table 2 Preference Value Criteria for Production Year (C2)**

Nilai	Keterangan
1	<=2000
2	>2000 dan <=2005
3	>2005 dan <=2010
4	>2010 dan <=2015
5	>2015

**Table 4 Value Preference Criteria Price (C4)**

Nilai	Keterangan
1	>Rp. 500.000.000
2	<=Rp. 500.000.000 dan >Rp. 300.000.000
3	<= Rp. 300.000.000 dan >Rp. 150.000.000
4	<= Rp. 150.000.000 dan >Rp. 100.000.000
5	<=Rp. 100.000.000

The criterion importance level (preference weight) is also assessed by one to five, namely:

- |              |                |
|--------------|----------------|
| 1 = Very Low | 4 = Hight      |
| 2 = Low      | 5 = Very Hight |
| 3 = Enough   |                |

In this study, decision makers give preference weights as follows:

- |                                      |                                     |
|--------------------------------------|-------------------------------------|
| a. Document Criteria (C1) = 5        | c. Cylinder Volume Criteria(C3) = 3 |
| b. Production Year Criteria (C2) = 4 | d. Price Criteria(C4) = 4           |

With the result that W = 5, 4, 3, 4

The next steps are as follows:

##### 1. Determine the Decision Matrix

**Table 5 Decision Matrix**

Alternative	Criteria			
	C1	C2	C3	C4
A1	1	3	3	4
A2	2	4	2	4
A3	4	5	2	4
A4	3	5	2	5
A5	2	5	2	4
A6	2	5	2	4
A7	1	4	2	4
A8	1	5	2	4

$$X = \begin{bmatrix} 1 & 3 & 3 & 4 \\ 2 & 4 & 2 & 4 \\ 4 & 5 & 2 & 4 \\ 3 & 5 & 2 & 5 \\ 2 & 5 & 2 & 4 \\ 2 & 5 & 2 & 4 \\ 1 & 4 & 2 & 4 \\ 1 & 5 & 2 & 4 \end{bmatrix}$$

2. Normalization of the Decision Matrix

$$R_{11} = \frac{1}{\sqrt{1^2 + 2^2 + 4^2 + 3^2 + 2^2 + 2^2 + 1^2 + 1^2}} = \frac{1}{\sqrt{40}} = \frac{1}{6,3246} = 0,1581$$

$$R_{21} = \frac{2}{\sqrt{1^2 + 2^2 + 4^2 + 3^2 + 2^2 + 2^2 + 1^2 + 1^2}} = \frac{2}{\sqrt{40}} = \frac{2}{6,3246} = 0,3162$$

$$R_{31} = \frac{4}{\sqrt{1^2 + 2^2 + 4^2 + 3^2 + 2^2 + 2^2 + 1^2 + 1^2}} = \frac{4}{\sqrt{40}} = \frac{4}{6,3246} = 0,6325$$

$$R_{41} = \frac{3}{\sqrt{1^2 + 2^2 + 4^2 + 3^2 + 2^2 + 2^2 + 1^2 + 1^2}} = \frac{3}{\sqrt{40}} = \frac{3}{6,3246} = 0,4743$$

$$R_{51} = \frac{2}{\sqrt{1^2 + 2^2 + 4^2 + 3^2 + 2^2 + 2^2 + 1^2 + 1^2}} = \frac{2}{\sqrt{40}} = \frac{2}{6,3246} = 0,3162$$

$$R_{61} = \frac{2}{\sqrt{1^2 + 2^2 + 4^2 + 3^2 + 2^2 + 2^2 + 1^2 + 1^2}} = \frac{2}{\sqrt{40}} = \frac{2}{6,3246} = 0,3162$$

$$R_{71} = \frac{1}{\sqrt{1^2 + 2^2 + 4^2 + 3^2 + 2^2 + 2^2 + 1^2 + 1^2}} = \frac{1}{\sqrt{40}} = \frac{1}{6,3246} = 0,1581$$

$$R_{81} = \frac{1}{\sqrt{1^2 + 2^2 + 4^2 + 3^2 + 2^2 + 2^2 + 1^2 + 1^2}} = \frac{1}{\sqrt{40}} = \frac{1}{6,3246} = 0,1581$$

$$R_{12} = \frac{3}{\sqrt{3^2 + 4^2 + 5^2 + 5^2 + 5^2 + 5^2 + 4^2 + 5^2}} = \frac{3}{\sqrt{166}} = \frac{3}{12,8841} = 0,2328$$

$$R_{22} = \frac{4}{\sqrt{3^2 + 4^2 + 5^2 + 5^2 + 5^2 + 5^2 + 4^2 + 5^2}} = \frac{4}{\sqrt{166}} = \frac{4}{12,8841} = 0,3105$$

$$R_{32} = \frac{5}{\sqrt{3^2 + 4^2 + 5^2 + 5^2 + 5^2 + 5^2 + 4^2 + 5^2}} = \frac{5}{\sqrt{166}} = \frac{5}{12,8841} = 0,3881$$

$$R_{42} = \frac{5}{\sqrt{3^2 + 4^2 + 5^2 + 5^2 + 5^2 + 5^2 + 4^2 + 5^2}} = \frac{5}{\sqrt{166}} = \frac{5}{12,8841} = 0,3881$$

$$R_{52} = \frac{5}{\sqrt{3^2 + 4^2 + 5^2 + 5^2 + 5^2 + 5^2 + 4^2 + 5^2}} = \frac{5}{\sqrt{166}} = \frac{5}{12,8841} = 0,3881$$

$$R_{62} = \frac{4}{\sqrt{3^2 + 4^2 + 5^2 + 5^2 + 5^2 + 5^2 + 4^2 + 5^2}} = \frac{4}{\sqrt{166}} = \frac{4}{12,8841} = 0,3105$$

$$R_{72} = \frac{3}{\sqrt{3^2 + 4^2 + 5^2 + 5^2 + 5^2 + 5^2 + 4^2 + 5^2}} = \frac{3}{\sqrt{166}} = \frac{3}{12,8841} = 0,2328$$

$$R_{82} = \frac{3}{\sqrt{3^2 + 4^2 + 5^2 + 5^2 + 5^2 + 5^2 + 4^2 + 5^2}} = \frac{3}{\sqrt{166}} = \frac{3}{12,8841} = 0,2328$$

$$R_{13} = \frac{3}{\sqrt{3^2 + 2^2 + 2^2 + 1^2 + 2^2 + 2^2 + 2^2 + 2^2}} = \frac{3}{\sqrt{34}} = \frac{3}{5,8301} = 0,5145$$

$$R_{23} = \frac{2}{\sqrt{3^2 + 2^2 + 2^2 + 1^2 + 2^2 + 2^2 + 2^2 + 2^2}} = \frac{2}{\sqrt{34}} = \frac{2}{5,8301} = 0,3430$$

$$R_{33} = \frac{2}{\sqrt{3^2 + 2^2 + 2^2 + 1^2 + 2^2 + 2^2 + 2^2 + 2^2}} = \frac{2}{\sqrt{34}} = \frac{2}{5,8301} = 0,3430$$

$$R_{43} = \frac{1}{\sqrt{3^2 + 2^2 + 2^2 + 1^2 + 2^2 + 2^2 + 2^2 + 2^2}} = \frac{1}{\sqrt{34}} = \frac{1}{5,8301} = 0,1715$$

$$R_{53} = \frac{2}{\sqrt{3^2 + 2^2 + 2^2 + 1^2 + 2^2 + 2^2 + 2^2 + 2^2}} = \frac{2}{\sqrt{34}} = \frac{2}{5,8301} = 0,3430$$

$$R_{63} = \frac{2}{\sqrt{3^2 + 2^2 + 2^2 + 1^2 + 2^2 + 2^2 + 2^2 + 2^2}} = \frac{2}{\sqrt{34}} = \frac{2}{5,8301} = 0,3430$$

$$R_{73} = \frac{2}{\sqrt{3^2 + 2^2 + 2^2 + 1^2 + 2^2 + 2^2 + 2^2 + 2^2}} = \frac{2}{\sqrt{34}} = \frac{2}{5,8301} = 0,3430$$

$$R_{83} = \frac{2}{\sqrt{3^2 + 2^2 + 2^2 + 1^2 + 2^2 + 2^2 + 2^2 + 2^2}} = \frac{2}{\sqrt{34}} = \frac{2}{5,8301} = 0,3430$$

$$R_{14} = \frac{4}{\sqrt{4^2 + 4^2 + 4^2 + 5^2 + 4^2 + 4^2 + 4^2 + 4^2}} = \frac{4}{\sqrt{137}} = \frac{4}{11,7046} = 0,3417$$

$$R_{24} = \frac{4}{\sqrt{4^2 + 4^2 + 4^2 + 5^2 + 4^2 + 4^2 + 4^2 + 4^2}} = \frac{4}{\sqrt{137}} = \frac{4}{11,7046} = 0,3417$$

$$R_{34} = \frac{4}{\sqrt{4^2 + 4^2 + 4^2 + 5^2 + 4^2 + 4^2 + 4^2 + 4^2}} = \frac{4}{\sqrt{137}} = \frac{4}{11,7046} = 0,3417$$

$$R_{44} = \frac{5}{\sqrt{4^2 + 4^2 + 4^2 + 5^2 + 4^2 + 4^2 + 4^2 + 4^2}} = \frac{5}{\sqrt{137}} = \frac{5}{11,7046} = 0,4272$$

$$R_{54} = \frac{4}{\sqrt{4^2 + 4^2 + 4^2 + 5^2 + 4^2 + 4^2 + 4^2 + 4^2}} = \frac{4}{\sqrt{137}} = \frac{4}{11,7046} = 0,3417$$

$$R_{64} = \frac{4}{\sqrt{4^2 + 4^2 + 4^2 + 5^2 + 4^2 + 4^2 + 4^2 + 4^2}} = \frac{4}{\sqrt{137}} = \frac{4}{11,7046} = 0,3417$$

$$R_{74} = \frac{4}{\sqrt{4^2 + 4^2 + 4^2 + 5^2 + 4^2 + 4^2 + 4^2 + 4^2}} = \frac{4}{\sqrt{137}} = \frac{4}{11,7046} = 0,3417$$

$$R_{84} = \frac{4}{\sqrt{4^2 + 4^2 + 4^2 + 5^2 + 4^2 + 4^2 + 4^2 + 4^2}} = \frac{4}{\sqrt{137}} = \frac{4}{11,7046} = 0,3417$$

So that the normalized R matrix is obtained:

**Table 6 Normalization Results**

Alternative	Criteria			
	C1	C2	C3	C4
A1	0,1581	0,2328	0,5145	0,3417
A2	0,3162	0,3105	0,3430	0,3417
A3	0,6325	0,3881	0,3430	0,3417
A4	0,4743	0,3881	0,1715	0,4272
A5	0,3162	0,3881	0,3430	0,3417
A6	0,3162	0,3881	0,3430	0,3417
A7	0,1581	0,3105	0,3430	0,3417
A8	0,1581	0,3881	0,3430	0,3417

3. Determine the weighting of the Normalized Matrix



$$R = \begin{bmatrix} 0,1581 & 0,2328 & 0,5145 & 0,3417 \\ 0,3162 & 0,3105 & 0,3430 & 0,3417 \\ 0,6325 & 0,3881 & 0,3430 & 0,3417 \\ 0,4743 & 0,3881 & 0,1715 & 0,4272 \\ 0,3162 & 0,3881 & 0,3430 & 0,3417 \\ 0,3162 & 0,3881 & 0,3430 & 0,3417 \\ 0,1581 & 0,3105 & 0,3430 & 0,3417 \\ 0,1581 & 0,3881 & 0,3430 & 0,3417 \end{bmatrix} \times W = \begin{matrix} \text{So that the matrix V is obtained:} \\ V = \begin{bmatrix} 0,7906 & 0,9314 & 1,5435 & 1,3670 \\ 1,5811 & 1,2418 & 1,0290 & 1,3670 \\ 3,1623 & 1,5523 & 1,0290 & 1,3670 \\ 2,3717 & 1,5523 & 0,5145 & 1,7087 \\ 1,5811 & 1,5523 & 1,0290 & 1,3670 \\ 1,5811 & 1,5523 & 1,0290 & 1,3670 \\ 0,7906 & 1,2418 & 1,0290 & 1,3670 \\ 2,7906 & 1,5523 & 1,0290 & 1,3670 \end{bmatrix} \end{matrix}$$

4. Determine the set *Concordance* and *Discordance*

a. *Concordance*

- $C_{12} = \{j, V_{1j} \geq V_{2j}\} = \{3, 4\}$
- $C_{13} = \{j, V_{1j} \geq V_{3j}\} = \{3, 4\}$
- $C_{14} = \{j, V_{1j} \geq V_{4j}\} = \{3, 4\}$
- $C_{15} = \{j, V_{1j} \geq V_{5j}\} = \{3, 4\}$
- $C_{16} = \{j, V_{1j} \geq V_{6j}\} = \{3, 4\}$
- $C_{17} = \{j, V_{1j} \geq V_{7j}\} = \{1, 3, 4\}$
- $C_{18} = \{j, V_{1j} \geq V_{8j}\} = \{1, 3, 4\}$
- $C_{21} = \{j, V_{2j} \geq V_{1j}\} = \{1, 2, 4\}$
- $C_{23} = \{j, V_{2j} \geq V_{3j}\} = \{3, 4\}$
- $C_{24} = \{j, V_{2j} \geq V_{4j}\} = \{3, 4\}$
- $C_{25} = \{j, V_{2j} \geq V_{5j}\} = \{1, 3, 4\}$
- $C_{26} = \{j, V_{2j} \geq V_{6j}\} = \{1, 3, 4\}$
- $C_{27} = \{j, V_{2j} \geq V_{7j}\} = \{1, 2, 3, 4\}$
- $C_{28} = \{j, V_{2j} \geq V_{8j}\} = \{1, 3, 4\}$
- $C_{31} = \{j, V_{3j} \geq V_{1j}\} = \{1, 2, 4\}$
- $C_{32} = \{j, V_{3j} \geq V_{2j}\} = \{1, 2, 3, 4\}$
- $C_{34} = \{j, V_{3j} \geq V_{4j}\} = \{1, 2, 3\}$
- $C_{35} = \{j, V_{3j} \geq V_{5j}\} = \{1, 2, 3, 4\}$
- $C_{36} = \{j, V_{3j} \geq V_{6j}\} = \{1, 2, 3, 4\}$
- $C_{37} = \{j, V_{3j} \geq V_{7j}\} = \{1, 2, 3, 4\}$
- $C_{38} = \{j, V_{3j} \geq V_{8j}\} = \{1, 2, 3, 4\}$
- $C_{41} = \{j, V_{4j} \geq V_{1j}\} = \{1, 2, 4\}$
- $C_{42} = \{j, V_{4j} \geq V_{2j}\} = \{1, 2, 4\}$
- $C_{43} = \{j, V_{4j} \geq V_{3j}\} = \{2, 4\}$
- $C_{45} = \{j, V_{4j} \geq V_{5j}\} = \{1, 2, 4\}$
- $C_{46} = \{j, V_{4j} \geq V_{6j}\} = \{1, 2, 4\}$
- $C_{47} = \{j, V_{4j} \geq V_{7j}\} = \{1, 2, 4\}$
- $C_{48} = \{j, V_{4j} \geq V_{8j}\} = \{1, 2, 4\}$
- $C_{51} = \{j, V_{5j} \geq V_{1j}\} = \{1, 2, 4\}$
- $C_{52} = \{j, V_{5j} \geq V_{2j}\} = \{1, 2, 3, 4\}$
- $C_{53} = \{j, V_{5j} \geq V_{3j}\} = \{2, 3, 4\}$
- $C_{54} = \{j, V_{5j} \geq V_{4j}\} = \{2, 3\}$
- $C_{56} = \{j, V_{5j} \geq V_{6j}\} = \{1, 2, 3, 4\}$
- $C_{57} = \{j, V_{5j} \geq V_{7j}\} = \{1, 2, 3, 4\}$
- $C_{58} = \{j, V_{5j} \geq V_{8j}\} = \{1, 2, 3, 4\}$
- $C_{61} = \{j, V_{6j} \geq V_{1j}\} = \{1, 2, 4\}$
- $C_{62} = \{j, V_{6j} \geq V_{2j}\} = \{1, 2, 3, 4\}$
- $C_{63} = \{j, V_{6j} \geq V_{3j}\} = \{2, 3, 4\}$
- $C_{64} = \{j, V_{6j} \geq V_{4j}\} = \{2, 3\}$
- $C_{65} = \{j, V_{6j} \geq V_{5j}\} = \{1, 2, 3, 4\}$
- $C_{67} = \{j, V_{6j} \geq V_{7j}\} = \{1, 2, 3, 4\}$
- $C_{68} = \{j, V_{6j} \geq V_{8j}\} = \{1, 2, 3, 4\}$
- $C_{71} = \{j, V_{7j} \geq V_{1j}\} = \{1, 2, 4\}$
- $C_{72} = \{j, V_{7j} \geq V_{2j}\} = \{2, 3, 4\}$
- $C_{73} = \{j, V_{7j} \geq V_{3j}\} = \{3, 4\}$
- $C_{74} = \{j, V_{7j} \geq V_{4j}\} = \{3\}$
- $C_{75} = \{j, V_{7j} \geq V_{5j}\} = \{3, 4\}$
- $C_{76} = \{j, V_{7j} \geq V_{6j}\} = \{3, 4\}$
- $C_{78} = \{j, V_{7j} \geq V_{8j}\} = \{1, 3, 4\}$
- $C_{81} = \{j, V_{8j} \geq V_{1j}\} = \{1, 2, 4\}$
- $C_{82} = \{j, V_{8j} \geq V_{2j}\} = \{2, 3, 4\}$
- $C_{83} = \{j, V_{8j} \geq V_{3j}\} = \{2, 3, 4\}$
- $C_{84} = \{j, V_{8j} \geq V_{4j}\} = \{2, 3, 4\}$
- $C_{85} = \{j, V_{8j} \geq V_{5j}\} = \{2, 3, 4\}$
- $C_{86} = \{j, V_{8j} \geq V_{6j}\} = \{2, 3, 4\}$
- $C_{87} = \{j, V_{8j} \geq V_{7j}\} = \{1, 2, 3, 4\}$

In Order to get the set *concordance* :

Table 7 Concordance Association

Alternative	Concordance							
A1	-	3,4	3,4	3,4	3,4	3,4	1,3,4	1,3,4
A2	1,2,4	-	3,4	3,4	1,3,4	1,3,4	1,2,3,4	1,3,4
A3	1,2,4	1,2,3,4	-	1,2,3	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
A4	1,2,4	1,2,4	2,4	-	1,2,4	1,2,4	1,2,4	1,2,4
A5	1,2,4	1,2,3,4	2,3,4	2,3	-	1,2,3,4	1,2,3,4	1,2,3,4



<b>A6</b>	1,2,4	1,2,3,4	2,3,4	2,3	1,2,3,4	-	1,2,3,4	1,2,3,4
<b>A7</b>	1,2,4	2,3,4	3,4	3	3,4	3,4	-	1,3,4
<b>A8</b>	1,2,4	2,3,4	2,3,4	2,3,4	2,3,4	2,3,4	1,2,3,4	-

b. *Discordance*

- |   |   |
|---|---|
| $D_{12} = \{j, V_{1j} < V_{2j}\} = \{1, 2\}$    | $D_{51} = \{j, V_{5j} < V_{1j}\} = \{3\}$       |
| $D_{13} = \{j, V_{1j} < V_{3j}\} = \{1, 2\}$    | $D_{52} = \{j, V_{5j} < V_{2j}\} = \{ \}$       |
| $D_{14} = \{j, V_{1j} < V_{4j}\} = \{1, 2, 4\}$ | $D_{53} = \{j, V_{5j} < V_{3j}\} = \{1\}$       |
| $D_{15} = \{j, V_{1j} < V_{5j}\} = \{1, 2\}$    | $D_{54} = \{j, V_{5j} < V_{4j}\} = \{1, 4\}$    |
| $D_{16} = \{j, V_{1j} < V_{6j}\} = \{1, 2\}$    | $D_{56} = \{j, V_{5j} < V_{6j}\} = \{ \}$       |
| $D_{17} = \{j, V_{1j} < V_{7j}\} = \{2\}$       | $D_{57} = \{j, V_{5j} < V_{7j}\} = \{ \}$       |
| $D_{18} = \{j, V_{1j} < V_{8j}\} = \{2\}$       | $D_{58} = \{j, V_{5j} < V_{8j}\} = \{ \}$       |
| $D_{21} = \{j, V_{2j} < V_{1j}\} = \{3\}$       | $D_{61} = \{j, V_{6j} < V_{1j}\} = \{3\}$       |
| $D_{23} = \{j, V_{2j} < V_{3j}\} = \{1, 2\}$    | $D_{62} = \{j, V_{6j} < V_{2j}\} = \{ \}$       |
| $D_{24} = \{j, V_{2j} < V_{4j}\} = \{1, 2, 4\}$ | $D_{63} = \{j, V_{6j} < V_{3j}\} = \{1\}$       |
| $D_{25} = \{j, V_{2j} < V_{5j}\} = \{2\}$       | $D_{64} = \{j, V_{6j} < V_{4j}\} = \{1, 4\}$    |
| $D_{26} = \{j, V_{2j} < V_{6j}\} = \{2\}$       | $D_{65} = \{j, V_{6j} < V_{5j}\} = \{ \}$       |
| $D_{27} = \{j, V_{2j} < V_{7j}\} = \{ \}$       | $D_{67} = \{j, V_{6j} < V_{7j}\} = \{ \}$       |
| $D_{28} = \{j, V_{2j} < V_{8j}\} = \{2\}$       | $D_{68} = \{j, V_{6j} < V_{8j}\} = \{ \}$       |
| $D_{31} = \{j, V_{3j} < V_{1j}\} = \{3\}$       | $D_{71} = \{j, V_{7j} < V_{1j}\} = \{3\}$       |
| $D_{32} = \{j, V_{3j} < V_{2j}\} = \{ \}$       | $D_{72} = \{j, V_{7j} < V_{2j}\} = \{1\}$       |
| $D_{34} = \{j, V_{3j} < V_{4j}\} = \{4\}$       | $D_{73} = \{j, V_{7j} < V_{3j}\} = \{1, 2\}$    |
| $D_{35} = \{j, V_{3j} < V_{5j}\} = \{ \}$       | $D_{74} = \{j, V_{7j} < V_{4j}\} = \{1, 2, 4\}$ |
| $D_{36} = \{j, V_{3j} < V_{6j}\} = \{ \}$       | $D_{75} = \{j, V_{7j} < V_{5j}\} = \{1, 2\}$    |
| $D_{37} = \{j, V_{3j} < V_{7j}\} = \{ \}$       | $D_{76} = \{j, V_{7j} < V_{6j}\} = \{1, 2\}$    |
| $D_{38} = \{j, V_{3j} < V_{8j}\} = \{ \}$       | $D_{78} = \{j, V_{7j} < V_{8j}\} = \{2\}$       |
| $D_{41} = \{j, V_{4j} < V_{1j}\} = \{3\}$       | $D_{81} = \{j, V_{8j} < V_{1j}\} = \{3\}$       |
| $D_{42} = \{j, V_{4j} < V_{2j}\} = \{3\}$       | $D_{82} = \{j, V_{8j} < V_{2j}\} = \{1\}$       |
| $D_{43} = \{j, V_{4j} < V_{3j}\} = \{1, 3\}$    | $D_{83} = \{j, V_{8j} < V_{3j}\} = \{1\}$       |
| $D_{45} = \{j, V_{4j} < V_{5j}\} = \{3\}$       | $D_{84} = \{j, V_{8j} < V_{4j}\} = \{1, 4\}$    |
| $D_{46} = \{j, V_{4j} < V_{6j}\} = \{3\}$       | $D_{85} = \{j, V_{8j} < V_{5j}\} = \{1\}$       |
| $D_{47} = \{j, V_{4j} < V_{7j}\} = \{3\}$       | $D_{86} = \{j, V_{8j} < V_{6j}\} = \{1\}$       |
| $D_{48} = \{j, V_{4j} < V_{8j}\} = \{3\}$       | $D_{87} = \{j, V_{8j} < V_{7j}\} = \{ \}$       |

In order to obtain the set of discordance:

**Tabel 8 Set Discordance**

Alternative	Discordance							
	A1	A2	A3	A4	A5	A6	A7	A8
<b>A1</b>	-	1,2	1,2	1,2,4	1,2	1,2	2	2
<b>A2</b>	3	-	1,2	1,2,4	2	2	0	2
<b>A3</b>	3	0	-	4	0	0	0	0
<b>A4</b>	3	3	1,3	-	3	3	3	3
<b>A5</b>	3	0	1	1,4	-	0	0	0
<b>A6</b>	3	0	1	1,4	0	-	0	0
<b>A7</b>	3	1	1,2	1,2,4	1,2	1,2	-	2
<b>A8</b>	3	1	1	1,4	1	1	0	-

5. Calculate the Matrics *Concordance* and *Discordance*

a. *Concordance*

$$C_{12} = W_3 + W_4 = 3 + 4 = 7 \qquad C_{51} = W_1 + W_2 + W_4 = 5 + 4 + 4 = 13$$



$C_{13} = W_3 + W_4$	$= 3 + 4$	$= 7$	$C_{52} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$
$C_{14} = W_3 + W_4$	$= 3 + 4$	$= 7$	$C_{53} = W_2 + W_3 + W_4$	$= 4 + 3 + 4$	$= 11$
$C_{15} = W_3 + W_4$	$= 3 + 4$	$= 7$	$C_{54} = W_2 + W_3$	$= 4 + 3$	$= 7$
$C_{16} = W_3 + W_4$	$= 3 + 4$	$= 7$	$C_{56} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$
$C_{17} = W_1 + W_3 + W_4$	$= 5 + 3 + 4$	$= 12$	$C_{57} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$
$C_{18} = W_1 + W_3 + W_4$	$= 5 + 3 + 4$	$= 12$	$C_{58} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$
$C_{21} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 13$	$C_{61} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 13$
$C_{23} = W_3 + W_4$	$= 3 + 4$	$= 7$	$C_{62} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$
$C_{24} = W_3 + W_4$	$= 3 + 4$	$= 7$	$C_{63} = W_2 + W_3 + W_4$	$= 4 + 3 + 4$	$= 11$
$C_{25} = W_1 + W_3 + W_4$	$= 5 + 3 + 4$	$= 12$	$C_{64} = W_2 + W_3$	$= 4 + 3$	$= 7$
$C_{26} = W_1 + W_3 + W_4$	$= 5 + 3 + 4$	$= 12$	$C_{65} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$
$C_{27} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$	$C_{67} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$
$C_{28} = W_1 + W_3 + W_4$	$= 5 + 3 + 4$	$= 12$	$C_{68} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$
$C_{31} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 13$	$C_{71} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 13$
$C_{32} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$	$C_{72} = W_2 + W_3 + W_4$	$= 4 + 3 + 4$	$= 11$
$C_{34} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$	$C_{73} = W_3 + W_4$	$= 3 + 4$	$= 7$
$C_{35} = W_1 + W_2 + W_3$	$= 5 + 4 + 3$	$= 12$	$C_{74} = W_3$	$= 3$	
$C_{36} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$	$C_{75} = W_3 + W_4$	$= 3 + 4$	$= 7$
$C_{37} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$	$C_{76} = W_3 + W_4$	$= 3 + 4$	$= 7$
$C_{38} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$	$C_{78} = W_1 + W_3 + W_4$	$= 5 + 3 + 4$	$= 12$
$C_{41} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 13$	$C_{81} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 13$
$C_{42} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 16$	$C_{82} = W_2 + W_3 + W_4$	$= 4 + 3 + 4$	$= 11$
$C_{43} = W_2 + W_4$	$= 4 + 4$	$= 9$	$C_{83} = W_2 + W_3 + W_4$	$= 4 + 3 + 4$	$= 11$
$C_{45} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 13$	$C_{84} = W_2 + W_3 + W_4$	$= 4 + 3 + 4$	$= 11$
$C_{46} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 13$	$C_{85} = W_2 + W_3 + W_4$	$= 4 + 3 + 4$	$= 11$
$C_{47} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 13$	$C_{86} = W_2 + W_3 + W_4$	$= 4 + 3 + 4$	$= 11$
$C_{48} = W_1 + W_2 + W_4$	$= 5 + 4 + 4$	$= 13$	$C_{87} = W_1 + W_2 + W_3 + W_4$	$= 5 + 4 + 3 + 4$	$= 16$

So its concordance matrix are:

$$C = \begin{bmatrix} - & 7 & 7 & 3 & 7 & 7 & 12 & 12 \\ 13 & - & 7 & 3 & 12 & 12 & 16 & 12 \\ 13 & 16 & - & 12 & 16 & 16 & 16 & 16 \\ 13 & 13 & 8 & - & 13 & 13 & 13 & 13 \\ 13 & 16 & 11 & 7 & - & 16 & 16 & 16 \\ 13 & 16 & 11 & 7 & 16 & - & 16 & 16 \\ 13 & 11 & 7 & 3 & 7 & 7 & - & 12 \\ 13 & 11 & 11 & 7 & 11 & 11 & 16 & - \end{bmatrix}$$

#### b. Discordance

$$d_{12} = \frac{\max\{0,7906-1,5811\};|0,9314-1,2418\}}{\max\{0,7906-1,5811\};|0,9314-1,2418\};|1,5435-1,0290\};|1,3670-1,3670\}} \\ = \frac{\max\{0,7906; 0,3105; 0,5145; 0\}}{\max\{0,7906; 0,3105\}} \\ = \frac{0,7906}{0,7906} = 1$$

$$d_{13} = \frac{\max\{0,7906-3,1623\};|0,9314-1,5523\}}{\max\{0,7906-3,1623\};|0,9314-1,5523\};|1,5435-1,0290\};|1,3670-1,3670\}} \\ = \frac{\max\{2,3717; 0,6209\}}{\max\{2,3717; 0,6209; 0\}} \\ = \frac{2,3717}{2,3717} = 1$$

$$d_{14} = \frac{\max\{0,7906-2,3717\};|0,9314-1,5523\};|1,3670-1,7087\}}{\max\{0,7906-2,3717\};|0,9314-1,5523\};|1,5435-0,5145\};|1,3670-1,7087\}}$$

$$D_{51} = \frac{\max\{1,0290-1,5435\}}{\max\{1,5811-0,7906\};|1,5523-0,9314\};|1,0290-1,5435\};|1,3670-1,3670\}} \\ = \frac{\max\{0,7906; 0,6209; 0,5145; 0\}}{\max\{0,7906\}} \\ = \frac{0,7906}{0,7906} = 1$$

$$D_{52} = \frac{\max\{0\}}{\max\{1,5811-1,5811\};|1,5523-1,2418\};|1,0290-1,0290\};|1,3670-1,3670\}} \\ = \frac{\max\{0\}}{\max\{0; 0,3105; 0; 0\}} \\ = \frac{0}{0,3105} = 0$$

$$D_{53} = \frac{\max\{0\}}{\max\{1,5811-3,1623\};|1,5523-1,5523\};|1,0290-1,0290\};|1,3670-1,3670\}}$$





$$\begin{aligned}
 &= \frac{\max\{1,5811 ; 0,6209;0,3147\}}{\max\{1,5811 ; 0,6209; 1,0290 ; 0,3417\}} \\
 &= \frac{1,5811}{1,5811} = 1 \\
 d_{15} &= \frac{\max\{0,7906-1,5811\};|0,9314-1,5523\}}{\max\{0,7906-1,5811\};|0,9314-1,5523\};|1,5435-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0,7906; 0,6209\}}{\max\{0,7906; 0,6209; 0,5145 ; 0\}} \\
 &= \frac{0,7906}{0,7906} = 1 \\
 d_{16} &= \frac{\max\{0,7906-1,5811\};|0,9314-1,5523\}}{\max\{0,7906-1,5811\};|0,9314-1,5523\};|1,5435-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0,7906; 0,6209; 0,5145 ; 0\}}{\max\{0,7906; 0,6209; 0,5145 ; 0\}} \\
 &= \frac{0,7906}{0,7906} = 1 \\
 d_{17} &= \frac{\max\{0,9314-1,2418\}}{\max\{0,7906-0,7906\};|0,9314-1,2418\};|1,5435-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0,3105\}}{\max\{0; 0,3105; 0,5145 ; 0\}} \\
 &= \frac{0,3105}{0,5145} = 0,6034 \\
 d_{18} &= \frac{\max\{0,9314-1,5523\}}{\max\{0,7906-0,7906\};|0,9314-1,5523\};|1,5435-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0,6209\}}{\max\{0; 0,6209; 0,5145 ; 0\}} \\
 &= \frac{0,6209}{0,6209} = 1 \\
 d_{21} &= \frac{\max\{1,0290-1,5435\}}{\max\{1,5811-0,7906\};|1,2418-0,9314\};|1,0290-1,5435\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0,5145\}}{\max\{0,7906; 0,3105 ; 0,5145 ; 0\}} \\
 &= \frac{0,5145}{0,7906} = 0,6508 \\
 d_{23} &= \frac{\max\{1,5811-3,1623\};|1,2418-1,5523\}}{\max\{1,5811-3,1623\};|1,2418-1,5523\};|1,0290-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{1,5811; 0,3105\}}{\max\{1,5811; 0,3105; 0 ; 0\}} \\
 &= \frac{1,5811}{1,5811} = 1 \\
 d_{24} &= \frac{\max\{1,5811-2,3717\};|1,2418-1,5523\};|1,3670-1,7087\}}{\max\{1,5811-2,3717\};|1,2418-1,5523\};|1,0290-0,5145\};|1,3670-1,7087\}} \\
 &= \frac{\max\{0,7906;0,3105;0,3417\}}{\max\{0,7906;0,3105; 0 ; 0,3417\}} \\
 &= \frac{0,7906}{0,7906} = 1 \\
 d_{25} &= \frac{\max\{1,2418-1,5523\}}{\max\{1,5811-1,5811\};|1,2418-1,5523\};|1,0290-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0,3150\}}{\max\{0 ; 0,3150; 0 ; 0\}} \\
 &= \frac{0,3150}{0,3150} = 1 \\
 d_{26} &= \frac{\max\{1,2418-1,5523\}}{\max\{1,5811-1,5811\};|1,2418-1,5523\};|1,0290-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0,3150\}}{\max\{0 ; 0,3150; 0 ; 0\}} \\
 &= \frac{0,3150}{0,3150} = 1
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{\max\{0\}}{\max\{0; 1,5811 ; 0 ; 0\}} \\
 &= \frac{0}{1,5811} = 0 \\
 D_{54} &= \frac{\max\{0\}}{\max\{1,5811-2,3717\};|1,3670-1,7087\}} \\
 &= \frac{\max\{0\}}{\max\{1,5811-2,3717\};|1,5523-1,5523\};|1,0290-0,5145\};|1,3670-1,7087\}} \\
 &= \frac{\max\{0,7906;0,3417\}}{\max\{0,7906; 0 ; 0,5145 ; 0,3417\}} \\
 &= \frac{0,7906}{0,7906} = 1 \\
 D_{56} &= \frac{\max\{0\}}{\max\{1,5811-1,5811\};|1,5523-1,5523\};|1,0290-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0\}}{\max\{0; 0 ; 0 ; 0\}} \\
 &= \frac{0}{0} = 0 \\
 D_{57} &= \frac{\max\{0\}}{\max\{1,5811-0,7906\};|1,5523-1,2418\};|1,0290-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0\}}{\max\{0,7906; 0,3105 ; 0 ; 0\}} \\
 &= \frac{0}{0,7906} = 0 \\
 D_{58} &= \frac{\max\{0\}}{\max\{1,5811-0,7906\};|1,5523-1,5523\};|1,0290-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0\}}{\max\{0,7906; 0 ; 0 ; 0\}} \\
 &= \frac{0}{0,7906} = 0 \\
 D_{61} &= \frac{\max\{1,0290-1,5435\}}{\max\{1,5811-0,7906\};|1,5523-0,9314\};|1,0290-1,5435\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0,7906\}}{\max\{0,7906; 0,6209 ; 0,5145 ; 0\}} \\
 &= \frac{0,7906}{0,7906} = 1 \\
 D_{62} &= \frac{\max\{0\}}{\max\{1,5811-1,5811\};|1,5523-1,2418\};|1,0290-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0\}}{\max\{0; 0,3105 ; 0 ; 0\}} \\
 &= \frac{0}{0,3105} = 0 \\
 D_{63} &= \frac{\max\{0\}}{\max\{1,5811-3,1623\};|1,5523-1,5523\};|1,0290-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0\}}{\max\{0; 1,5811 ; 0 ; 0\}} \\
 &= \frac{0}{1,5811} = 0 \\
 D_{64} &= \frac{\max\{1,5811-2,3717\};|1,3670-1,7087\}}{\max\{1,5811-2,3717\};|1,5523-1,5523\};|1,0290-0,5145\};|1,3670-1,7087\}} \\
 &= \frac{\max\{0,7906;0,3417\}}{\max\{0,7906; 0 ; 0,5145 ; 0,3417\}} \\
 &= \frac{0,7906}{0,7906} = 1 \\
 D_{65} &= \frac{\max\{0\}}{\max\{1,5811-1,5811\};|1,5523-1,5523\};|1,0290-1,0290\};|1,3670-1,3670\}} \\
 &= \frac{\max\{0\}}{\max\{0; 0 ; 0 ; 0\}}
 \end{aligned}$$



$$d_{27} = \frac{\max\{0\}}{\max\{|1,5811-0,7906|; |1,2418-1,2418|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0\}}{\max\{0,7906; 0; 0; 0\}} = \frac{0}{0,7906} = 0$$

$$d_{28} = \frac{\max\{|1,2418-1,5523|\}}{\max\{|1,5811-0,7906|; |1,2418-1,5523|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0,3105\}}{\max\{0,7906; 0,3105; 0; 0\}} = \frac{0,3105}{0,7906} = 0,3927$$

$$d_{31} = \frac{\max\{|1,0290-1,5435|\}}{\max\{|3,1623-0,7906|; |1,5523-0,9314|; |1,0290-1,5435|; |1,3670-1,3670|\}} = \frac{\max\{0,5145\}}{\max\{2,3717; 0,6209; 0,5145; 0\}} = \frac{0,5145}{2,3717} = 0,2169$$

$$d_{32} = \frac{\max\{0\}}{\max\{|3,1623-1,5811|; |1,5523-1,2418|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0\}}{\max\{1,5811; 0,3105; 0; 0\}} = \frac{0}{1,5811} = 0$$

$$d_{34} = \frac{\max\{|1,3670-1,7087|\}}{\max\{|3,1623-2,3717|; |1,5523-1,5523|; |1,0290-0,5145|; |1,3670-1,7087|\}} = \frac{\max\{0,3417\}}{\max\{0,7906; 0; 0,5415; 0,3417\}} = \frac{0,3417}{0,7906} = 0,4323$$

$$d_{35} = \frac{\max\{0\}}{\max\{|3,1623-1,5811|; |1,5523-1,5523|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0\}}{\max\{1,5811; 0; 0; 0\}} = \frac{0}{1,5811} = 0$$

$$d_{36} = \frac{\max\{0\}}{\max\{|3,1623-1,5811|; |1,5523-1,5523|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0\}}{\max\{1,5811; 0; 0; 0\}} = \frac{0}{1,5811} = 0$$

$$d_{37} = \frac{\max\{0\}}{\max\{|3,1623-0,7906|; |1,5523-1,2418|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0\}}{\max\{2,3717; 0,3105; 0; 0\}} = \frac{0}{2,3717} = 0$$

$$d_{38} = \frac{\max\{0\}}{\max\{|3,1623-0,7906|; |1,5523-1,5523|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0\}}{\max\{2,3717; 0; 0; 0\}} = \frac{0}{2,3717} = 0$$

$$d_{41} = \frac{\max\{|0,5145-1,5435|\}}{\max\{|2,3717-0,7906|; |1,5523-0,9314|; |0,5145-1,5435|; |1,7087-1,3670|\}}$$

$$= \frac{0}{0} = 0$$

$$D_{67} = \frac{\max\{0\}}{\max\{|1,5811-0,7906|; |1,5523-1,2418|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0\}}{\max\{0,7906; 0,3105; 0; 0\}} = \frac{0}{0,7906} = 0$$

$$D_{68} = \frac{\max\{0\}}{\max\{|1,5811-0,7906|; |1,5523-1,5523|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0\}}{\max\{0,7906; 0; 0; 0\}} = \frac{0}{0,7906} = 0$$

$$D_{71} = \frac{\max\{|1,0290-1,5435|\}}{\max\{|0,7906-0,7906|; |1,2418-0,9314|; |1,0290-1,5435|; |1,3670-1,3670|\}} = \frac{\max\{0,5145\}}{\max\{0; 0,3105; 0,5145; 0\}} = \frac{0,5145}{0,5145} = 1$$

$$D_{72} = \frac{\max\{|0,7906-1,5811|\}}{\max\{|0,7906-1,5811|; |1,2418-1,2418|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0,7906\}}{\max\{0,7906; 0; 0; 0\}} = \frac{0,7906}{0,7906} = 1$$

$$D_{73} = \frac{\max\{|0,7906-3,1623|; |1,2418-1,5523|\}}{\max\{|0,7906-3,1623|; |1,2418-1,5523|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{2,3717; 0,3105; 0; 0\}}{\max\{2,3717; 0,3105; 0; 0\}} = \frac{2,3717}{2,3717} = 1$$

$$D_{74} = \frac{\max\{|0,7906-2,3717|; |1,2418-1,5523|\}}{\max\{|0,7906-2,3717|; |1,2418-1,5523|; |1,0290-0,5145|; |1,3670-1,3670|\}} = \frac{\max\{1,5811; 0,3105; 0,5145; 0,3417\}}{\max\{1,5811; 0,3105; 0,5145; 0,3417\}} = \frac{1,5811}{1,5811} = 1$$

$$D_{75} = \frac{\max\{|0,7906-1,5811|; |1,2418-1,5523|\}}{\max\{|0,7906-1,5811|; |1,2418-1,5523|; |1,0290-0,5145|; |1,3670-1,3670|\}} = \frac{\max\{0,7906; 0,3105; 0; 0\}}{\max\{0,7906; 0,3105; 0; 0\}} = \frac{0,7906}{0,7906} = 1$$

$$D_{76} = \frac{\max\{|0,7906-1,5811|; |1,2418-1,5523|\}}{\max\{|0,7906-1,5811|; |1,2418-1,5523|; |1,0290-0,5145|; |1,3670-1,3670|\}} = \frac{\max\{0,7906; 0,3105; 0; 0\}}{\max\{0,7906; 0,3105; 0; 0\}} = \frac{0,7906}{0,7906} = 1$$

$$D_{78} = \frac{\max\{|1,2418-1,5523|\}}{\max\{|0,7906-0,7906|; |1,2418-1,5523|; |1,0290-1,0290|; |1,3670-1,3670|\}} = \frac{\max\{0,3105\}}{\max\{0; 0,3105; 0; 0\}}$$



$$\begin{aligned}
&= \frac{\max\{1,0290\}}{\max\{1,5811; 0,6209; 1,0290; 0,3147\}} \\
&= \frac{1,0290}{1,5811} = 0,6508 \\
d_{42} &= \frac{\max\{0,5145-1,5435\}}{\max\{2,3717-1,5811; 1,5523-1,2418; 0,5145-1,0290; 1,7087-1,3670\}} \\
&= \frac{\max\{0,5145\}}{\max\{0,7906; 0,3105; 0,5145; 0,3147\}} \\
&= \frac{0,5145}{0,7906} = 0,6508 \\
d_{43} &= \frac{\max\{2,3717-3,1623; 0,5145-1,5435\}}{\max\{2,3717-3,1623; 1,5523-1,5523; 0,5145-1,0290; 1,7087-1,3670\}} \\
&= \frac{\max\{0,7906; 0,5145\}}{\max\{0,7906; 0; 0,5145; 0,3147\}} \\
&= \frac{0,7906}{0,7906} = 1 \\
d_{45} &= \frac{\max\{0,5145-1,0290\}}{\max\{2,3717-1,5811; 1,5523-1,5523; 0,5145-1,0290; 1,7087-1,3670\}} \\
&= \frac{\max\{0,5145\}}{\max\{0,7906; 0; 0,5145; 0,3147\}} \\
&= \frac{0,5145}{0,7906} = 0,6508 \\
d_{46} &= \frac{\max\{0,5145-1,0290\}}{\max\{2,3717-1,5811; 1,5523-1,5523; 0,5145-1,0290; 1,7087-1,3670\}} \\
&= \frac{\max\{0,5145\}}{\max\{0,7906; 0; 0,5145; 0,3147\}} \\
&= \frac{0,5145}{0,7906} = 0,6508 \\
d_{47} &= \frac{\max\{0,5145-1,0290\}}{\max\{2,3717-0,7906; 1,5523-1,2418; 0,5145-1,0290; 1,7087-1,3670\}} \\
&= \frac{\max\{0,5145\}}{\max\{1,5811; 0,3105; 0,5145; 0,3147\}} \\
&= \frac{0,5145}{1,5811} = 0,3254 \\
d_{48} &= \frac{\max\{0,5145-1,0290\}}{\max\{2,3717-0,7906; 1,5523-1,5523; 0,5145-1,0290; 1,7087-1,3670\}} \\
&= \frac{\max\{0,5145\}}{\max\{1,5811; 0; 0,5145; 0,3147\}} \\
&= \frac{0,5145}{1,5811} = 0,3254
\end{aligned}$$

$$\begin{aligned}
&= \frac{0,3105}{0,3105} = 1 \\
D_{81} &= \frac{\max\{0\}}{\max\{0,7906-0,7906; 1,5523-0,9314; 1,0290-1,5435; 1,3670-1,3670\}} \\
&= \frac{\max\{0\}}{\max\{0; 0,6209; 0,5145; 0\}} \\
&= \frac{0}{0,6209} = 0 \\
D_{82} &= \frac{\max\{0,7906-1,5811\}}{\max\{0,7906-1,5811; 1,5523-1,2418; 1,0290-1,0290; 1,3670-1,3670\}} \\
&= \frac{\max\{0,7906\}}{\max\{0,7906; 0,3105; 0; 0\}} \\
&= \frac{0,7906}{0,7906} = 1 \\
D_{83} &= \frac{\max\{0,7906-3,1623\}}{\max\{0,7906-3,1623; 1,2418-1,5523; 1,0290-1,0290; 1,3670-1,3670\}} \\
&= \frac{\max\{2,3717; 0; 0; 0\}}{\max\{2,3717; 0; 0; 0\}} \\
&= \frac{2,3717}{2,3717} = 1 \\
D_{84} &= \frac{\max\{0,7906-2,3717; 1,3670-1,7087\}}{\max\{0,7906-2,3717; 1,5523-1,5523; 1,0290-0,5145; 1,3670-1,7087\}} \\
&= \frac{\max\{1,5811; 0,3417\}}{\max\{1,5811; 0; 0,5145; 0,3417\}} \\
&= \frac{1,5811}{1,5811} = 1 \\
D_{85} &= \frac{\max\{0,7906-1,5811\}}{\max\{0,7906-1,5811; 1,5523-1,5523; 1,0290-0,5145; 1,3670-1,3670\}} \\
&= \frac{\max\{0,7906; 0; 0; 0\}}{\max\{0,7906; 0; 0; 0\}} \\
&= \frac{0,7906}{0,7906} = 1 \\
D_{86} &= \frac{\max\{0,7906-1,5811\}}{\max\{0,7906-1,5811; 1,5523-1,5523; 1,0290-0,5145; 1,3670-1,3670\}} \\
&= \frac{\max\{0,7906; 0; 0; 0\}}{\max\{0,7906; 0; 0; 0\}} \\
&= \frac{0,7906}{0,7906} = 1 \\
D_{87} &= \frac{\max\{0\}}{\max\{0,7906-0,7906; 1,5523-1,2418; 1,0290-1,0290; 1,3670-1,3670\}} \\
&= \frac{\max\{0\}}{\max\{0; 0,3105; 0; 0\}} \\
&= \frac{0}{0,3105} = 0
\end{aligned}$$

So the discordance matrix is:



$$D = \begin{bmatrix} - & 1 & 1 & 1 & 1 & 1 & 0,6034 & 1 \\ 0,6508 & - & 1 & 1 & 1 & 1 & 0 & 0,3927 \\ 0,2169 & 0 & - & 0,4323 & 0 & 0 & 0 & 0 \\ 0,6508 & 0,6508 & 1 & - & 0,6508 & 0,6508 & 0,3254 & 0,3254 \\ 0,6508 & 0 & 1 & 0 & - & 0 & 0 & 0 \\ 0,6508 & 0 & 1 & 1 & 0 & - & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & - & 1 \\ 0,8286 & 1 & 1 & 1 & 1 & 1 & 0 & - \end{bmatrix}$$

6. Determine the Dominant Concordance Matrix and Dominant *Discordan*

a. *Concordance*

$$\underline{C} = \frac{651}{56} = 11,6250$$

Sehingga matriks dominan *concordancenya* adalah :

$$F = \begin{bmatrix} - & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 1 & - & 0 & 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & - & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & - & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & - & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & - & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & - & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 & - \end{bmatrix}$$

b. *Discordance*

$$\underline{d} = \frac{34}{56} = 0,6077$$

Sehingga matriks dominan *discordancenya* adalah :

$$G = \begin{bmatrix} - & 1 & 1 & 1 & 1 & 1 & 0 & 1 \\ 1 & - & 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & - & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & - & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & - & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 & - & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & - & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 0 & - \end{bmatrix}$$

7. Determine *Aggregate Dominance Matrix*

$$F = \begin{bmatrix} - & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 1 & - & 0 & 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & - & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & - & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & - & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & - & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & - & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 & - \end{bmatrix} \times G = \begin{bmatrix} - & 1 & 1 & 1 & 1 & 1 & 0 & 1 \\ 1 & - & 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & - & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & - & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & - & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 & - & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & - & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 0 & - \end{bmatrix}$$

So that *aggregate matrix dominancenya* :

$$E = \begin{bmatrix} - & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & - & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & - & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & - & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & - & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & - & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & - & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & - \end{bmatrix}$$

8. Elimination of Less Favorable Alternatives

Based matriks E, found that A4 (Ayla) has a value of 1 at most as many as 4 so that Ayla is the best alternative to be chosen.

2. System Results

a. *Home Page*

After the user has successfully logged in, the Home menu will appear first. This interface contains several navigation buttons.

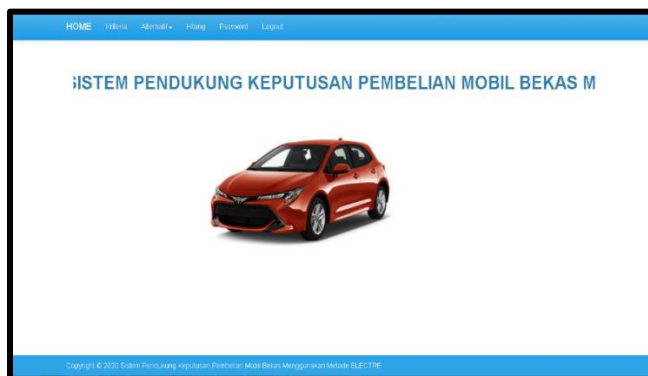


Figure 1 Home page

**b. Criteria Page**

When the user selects the criteria navigation button, a list of criteria will appear including the criteria code column, the criteria list, weights along with the print button to print the criteria report, the Edit button to change the criteria data if needed, and the clear button to delete the criteria data from the storage media. Refresh button to refresh criteria page.

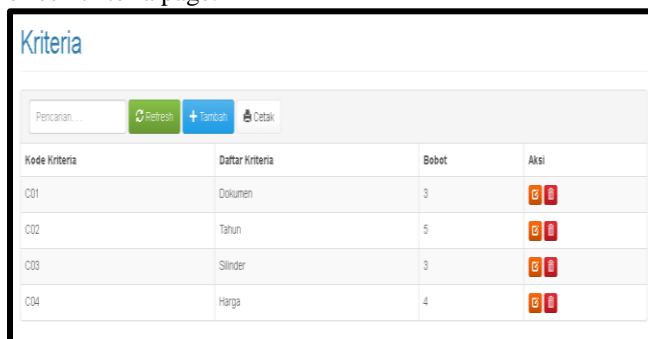


Figure 2 Criteria page

On the criteria page there is a navigation button "Add" to add new criteria. The criteria code will be filled in automatically, enter the criteria name and the weight then select save.

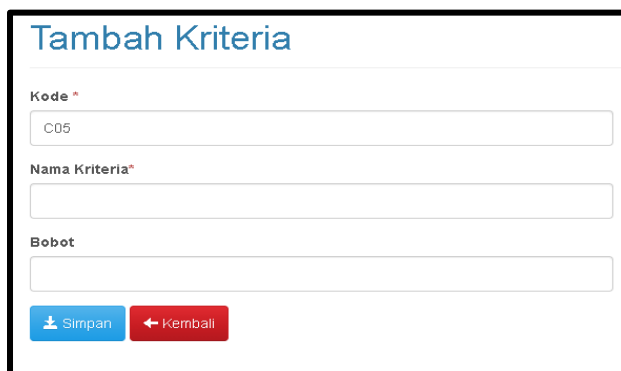


Figure 3 Add Criteria page

**c. Alternative Menu**

The Alternative Menu has two sub menus namely Alternative List and Alternative Value. The Alternative List page includes a code field, an alternative list, a print button to print alternative reports, an Edit button to change alternative data if needed, and a clear button to remove alternative data from storage. A refresh button to refresh the alternative list page.

Kode	Daftar Alternatif	G	I
A01	Innova	G	I
A02	Tertus	G	I
A03	Agya	G	I
A04	Ayla	G	I
A05	Calya	G	I
A06	Xenia	G	I
A07	Yaris	G	I
A08	Brio	G	I

**Figure 4 Alternative List Page**

**d. Calculate Page**

The calculation page contains all calculation results using the ELECTRE method starting from the decision matrix, R matrix, V matrix, concordance, discordance, concordance matrix, discordance matrix, dominant concordance matrix, discordance dominant matrix, and aggregate dominance matrix E. Print button to print the result output ranking.

	Dokumen	Tahun	Silinder	Harga
Innova	1	3	3	4
Tertus	2	4	2	4
Agya	4	5	2	4
Ayla	3	5	1	5
Calya	2	5	2	4
Xenia	2	5	2	4
Yaris	1	4	2	4
Brio	1	5	2	4

**Figure 5 Count Page (Decision Matrix)**

	Innova	Tertus	Agya	Ayla	Calya	Xenia	Yaris	Brio	Total	Rank
Ayla	1	1	0	-	1	1	0	0	4	1
Tertus	1	-	0	0	1	1	0	0	3	2
Yaris	1	0	0	0	0	0	-	1	2	3
Calya	1	0	0	0	-	0	0	0	1	4
Xenia	1	0	0	0	0	-	0	0	1	5
Brio	1	0	0	0	0	0	0	-	1	6
Innova	-	0	0	0	0	0	0	1	1	7
Agya	0	0	-	0	0	0	0	0	0	8

**Figure 6 Count Pages (Aggregate Dominance Matrix E)**

**4. Discussion**

Based on the E matrix, it is found that A4 (Ayla) has a value of 1 at most, which is 4 so that Ayla is the best alternative to choose. SPK for Used Car Purchases that are designed to operate properly and correctly and accurately because the output from manual analysis and analysis output with the SPK for Used Car Purchases is entirely appropriate.

**5. Conclusion**

Based on the results of research that has been conducted by researchers, it can be concluded that the Decision Support System which is applied using the ELECTRE method can facilitate the decision making of used car purchases. The process of buying used cars using the ELECTRE method, starts from determining the decision matrix, normalizing the decision matrix, determining the weighting of the normalized decision matrix, determining the set of concordance and discordance matrices, calculating the concordance and discordance matrices, determining the dominant concordance matrix and dominant discordance. , determine the aggregate dominance matrix and then eliminate the

less favorable alternatives. For further system development, it is hoped that additional criteria can be added according to the needs of system users so as to improve system performance. It is hoped that in the future this method can be further developed by using more and more extensive data processing for used cars, so that this SPK can really be used as a support for decision making for used car purchases. To get a better comparison of results, it is hoped that this used car purchasing decision support system will be tested and compared using other SPK methods.

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