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Determination of Product Orders Based on the Analytical Hierarchy Process Method

Dona Kurnia[1,*]

[1]*AMIK Boekittinggi, Bukittinggi, Indonesia*

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Correspondence

E-mail: jauzakiting@gmail.com*

A B S T R A C T

Decision-making in determining product orders is a method that managers can use to determine the type of product to be ordered again based on previous sales. Product orders to be reordered will be determined based on the highest number of sales among similar products. One of the methods that can be used is the AHP method, where the AHP method can assist managers in making decisions by providing a sequence of decision alternatives accompanied by a percentage on each alternative. The research method used in this journal is the system development life cycle (SDLC) which can describe the activities in this research in detail. The application of product orders with the AHP method will be applied to a case, namely an order for clothing products at a well-known clothing outlet in Bukittinggi. The product order system will be implemented into an application designed with the Visual Basic 2010 programming language and MySQL database to make it easier for managers to make decisions. With this research, it is hoped that it can help store managers in making decisions for determining clothing orders so that they can produce the best decisions that can provide benefits in the business that is being undertaken.

1. Introduction

The development of information technology has almost touched all aspects of human life, especially the economic aspect. Technological developments also significantly contribute to increasing the efficiency of small, medium and large business activities. In order to achieve good efficiency and effectiveness in managing a small or large business, a kind of system is needed to achieve this goal. All forms of small and large businesses will always be such a thing as decision-making activities in it carried out by the business actor, whether in the form of decision-making price of goods, business location, type of goods, etc. Often we encounter problems in the field that this decision-making activity sometimes takes a long time because in-depth analyzes must accompany it to make decisions that will have a positive effect on the business being carried out. Product ordering activities are one of the decision-making activities that must be planned. carefully by a business unit, especially in sales. These activities will determine whether the products we are going to sell will sell well in the market so that they produce profits or not. In this activity, sometimes business actors have difficulty determining goods such as what products to order, what amount, and what price difference must be determined to make a profit. As with determining clothing orders, the system will be designed in this journal by taking a case study at the largest clothing outlet in Bukittinggi, namely Dean

Boutique. Dean Boutique sells products with well-known labels in Indonesia with high quality and prices. Management has difficulty determining or choosing clothing orders due to the large number of types of clothing sold at these outlets and management also has difficulty in the number of clothes to be ordered regularly and maintaining the quality of the clothing products sold. Based on the research of Rizal Rachman et al., apparel entrepreneurs often have difficulty in determining the quality of apparel because apparel has a very varied quality level caused by the many types of raw materials. It causes the level of fabric quality, stitching, and size to be different [1].

Clothing is a necessity made of fabric fibers/textiles that serve to cover the body. Currently, clothing has become a basic human need other than food and shelter, even now clothing is not only a basic need but is also used as a symbol of status, position and position [2].

The author will build a decision support system in determining clothing orders based on the explanation above by applying the AHP method. With this research, it is hoped that it can help store managers make decisions for determining clothing orders so that they can produce the best decisions that can provide benefits in the business that is being undertaken. So it can be concluded that the purpose of this research is to answer the problems that occur, especially in decision making by managers in determining product orders to achieve perfect efficiency and effectiveness in ongoing business activities.

Decision Support System (DSS) is an interactive computer-based system that helps users make decisions using data and modeling in solving unstructured and semi-structured problems [3]. One of the Decision Support System models is the Analytical Hierarchy Process (AHP), a decision support model that will describe complex multi-factor and multi-criteria problems into a hierarchy [4]. AHP is designed to capture people's perceptions closely related to specific problems through procedures designed to arrive at a preference scale among various sets of alternatives [5].

The working principle of the AHP method is to simplify a complex problem into parts and arrange them in a hierarchical form. Furthermore, a numerical value is given subjectively about the significance of one variable and another variable. And with these various considerations, the alternative with the highest priority is chosen which plays a role in influencing the results of the system [6].

The following are the three basic principles of the AHP method, namely:

1. Decomposition

The basic principle of decomposition is to divide the problem structure into hierarchical parts, as illustrated in figure 1 below.

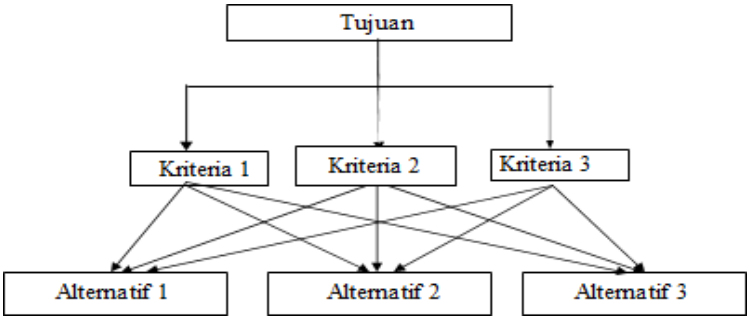


Figure 1. AHP Model Hierarchy [7]

2. Rating Comparison

The assessment will produce a rating scale in the form of numbers. Pairwise comparisons in the form of a matrix and when combined will form priorities as in table 1 below.

Table 1. Pairwise Comparison Rating Scale [8]

Level of Interest	Definition	Description
1	Equally important	Both elements have the same effect
3	Somewhat more important one over the other	Experience and judgment strongly favor one element compared to its partner
5	Quite important	Experiences and decisions show preference for activities over others
7	Very important	Experiences and decisions indicate a strong preference for one activity over another
9	Absolute more important	One element is absolutely preferred over its partner, at the highest level of confidence
2,4,6,8	The middle value between two adjacent decision values	When compromise is needed
Reciprocal	Opposite	If element i has one of the numbers on the scale of ratio 1 to 9 that has been set by Saaty when compared to element j , then j has the opposite when compared to element
Ratio	The ratio obtained directly from the measurement	

3. Priority Synthesis

The priority synthesis work process is by multiplying the local priority with the priority of the relevant criteria at the level above and adding it to each element at the level affected by the criteria and the result is a combination or what is known as global priority. Global priority is the weighting given to the local priority of the elements at the lowest level according to the criteria known as global priorities.

The AHP method is able to assist managers in making decisions by providing a sequence of decision alternatives accompanied by a percentage of each alternative. The reason for choosing this method is because the problems presented will be described in the form of a hierarchy and the calculations are carried out to the level of validity up to the tolerance limit for the inconsistencies of various parameters and alternatives used, taking into account the durability of the output of decision-making sensitivity analysis [9].

The steps/procedures that must be passed to solve problems in the AHP method are as follows:

1. Pinpoint issues define the problem and determine the desired solution.
2. Draw up a hierarchy of problems faced where the hierarchy is prepared to set goals/targets system as a whole at the top level.
3. Sets the priority of the elements by specifying the priority of the pair comparison elements , which compares the elements in pairs according to the given criteria and creates a pairwise comparison matrix.
4. Determine priority/Synthesis of Priority by:
   a. Sum the values in each column of the matrix.
   b. Divide each value from the column by the total column in the matrix to get the normalized matrix.
   c. Add up the values in each row and then divide by the number of elements to get the average value.
   d. Measure consistency. Measuring consistency serves to find out how good the consistency is in making a decision.
5. Calculating Consistency Index (CI)

CI = (λ maks-n)/n… ....(1)

Where:

n = number of elements

6. Calculating the ratio Consistency / Consistency Ratio (CR)

CR : CI/RC..... .....(2)

Where:

CR = Consistency Ratio CI = Consistency

Index IR= Random Consistency Index [10]

2. Method

In this study, the research methodology used is a chart containing the stages of thinking used to solve a problem known as the Research Framework as illustrated in figure 2.

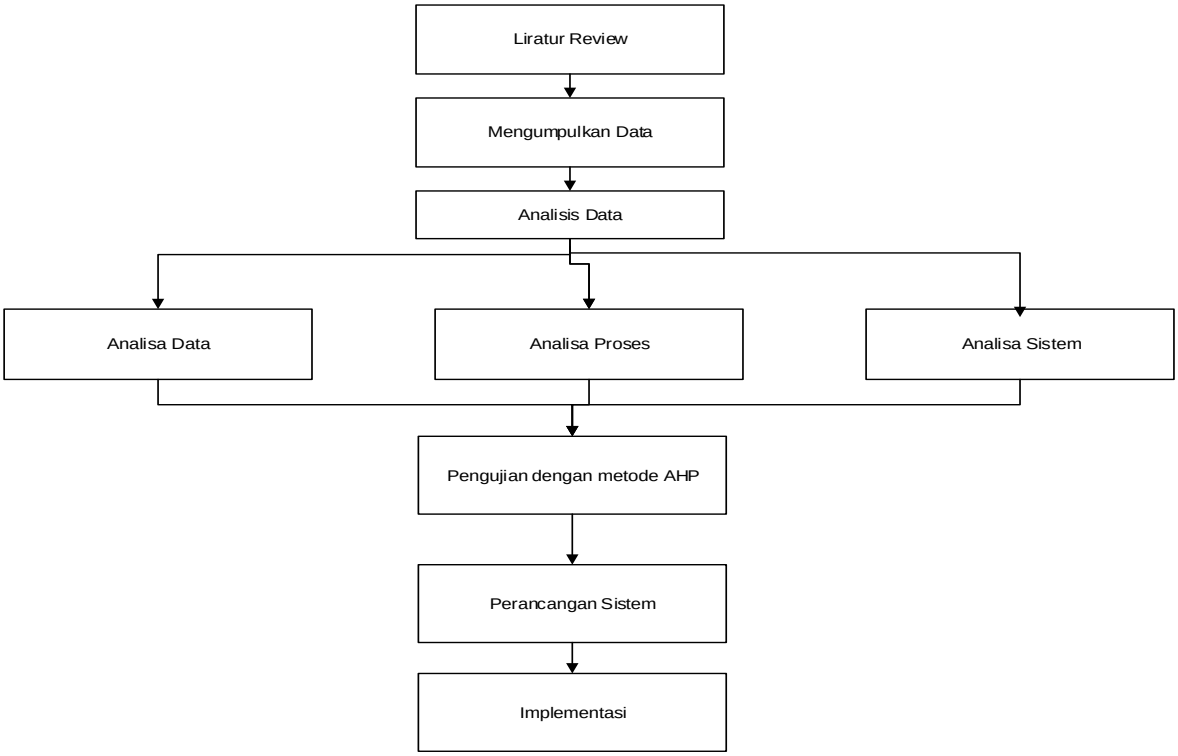


Figure 2. Framework for Employment Research

3. Results and Discussion

Determination of product orders is an activity in determining which products will be ordered again, through the AHP method it can be determined which products will be ordered first. This study discusses the determination of clothing orders with a case study at a boutique in the city of Bukittinggi, namely Dean Boutique. At Dean Boutique, the clothes sold are women's clothing with well-known brands with imported quality such as elizabet, vasco, menes, etc. The process of ordering clothes that Dean Boutique has carried out is only based on available stock without taking into account sales and losses experienced. For this reason, in this study, the order of clothing to be ordered was determined based on the AHP method with applications designed based on the AHP method, and the following is the manual calculation process for product determination using the AHP method.

a. Define problems, criteria and sub-criteria.
   1) Problem : Determine the clothes to be ordered based on the clothes that are often purchased by customers.
   2) Criteria : Stock, Capital Price , Sales.
   3) Sub Criteria : Vasco, Elizabeth, Mendes

b. Organize problems into a hierarchy

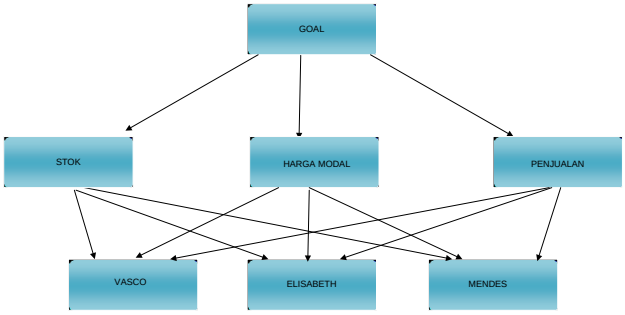


Figure 3. Hierarchical Design

c. Create a Pairwise Comparison Matrix for Each Criteria

Step 1 : Criteria Ranking Matrix

1) Stock is 2 times more important than sales, and 3 times more important than capital price.
2) Sales are 2 times more important than Capital Price.

Table 2. Criteria Ranking Matrix

Criteria	Stock	Capital Price	Sale
Stock	1,00	3,00	2,00
Capital Price	0,33	1,00	0,50
Sale	0,50	2,00	1,00
Total	1,83	6,00	3,50

Then add up the values in each row and then divide by the number of elements to get the average value.

Table 3. Average Value of Criteria Matrix Ranking

Criteria	Stock	Capital Price	Sale	Average
Stock	0,55	0,50	0,57	0,54
Capital Price	0,18	0,17	0,14	0,16
Sale	0,27	0,33	0,29	0,30
Average Amount				1,00

Step 2: Alternative Ranking Matrix

a. Alternative to Stock criteria
   - Vasco stock is 2x more important than elizabet and ½ x more important Mendes
   - Elizabeth stock 3x more important than Mendes

Table 4. Matrix of Stock Alternative Ranking

Alternative	Vasco	Elizabeth	Mendes
Vasco	1,00	2,00	0,50
Elizabeth	0,50	1,00	3,00
Mendes	2,00	0,33	1,00
Total	3,50	3,33	4,50

Then add up the values in each row and then divide by the number of elements to get the average value.

Table 5. Average Value of Stock Criteria Matrix Ranking

Alternative	Vasco	Elizabeth	Mendes	Average
Vasco	0,29	0,60	0,11	0,33
Elizabeth	0,14	0,30	0,67	0,37
Mendes	0,57	0,10	0,22	0,30
Average Amount				1,00

b. Alternatives to the Capital Price criteria
Example of product prices:
- Mendes capital price = 350000 - 500000
- Vasco capital price = 120000 – 200000
- Elizabeth capital price = 800000 – 1000000

For this reason, the logic for the price of capital is as follows:

- Vasco capital price is 1/3 more important than Mendes
- Elizabeth capital price is 2x more important than Mendes
- Elizabeth capital price is 6x more important than Vasco

Table 6. Alternatives for Capital Price Criteria

Alternative	Vasco	Elizabeth	Mendes
Vasco	1,00	0,17	0,33
Elizabeth	6,00	1,00	2,00
Mendes	3,00	0,50	1,00
Total	10,00	1,67	3,33

Then add up the values in each row and then divide by the number of elements to get the average value.

Table 7. Average Ranking Value of Capital Price Criteria

Alternative	Vasco	Elizabeth	Mendes	Average
Vasco	0,10	0,10	0,10	0,10
Elizabeth	0,60	0,60	0,60	0,60
Mendes	0,30	0,30	0,30	0,30
Average Amount				1,00

c. Alternative to sales criteria
- Vasco sales are 3x more sold than Mendes
- Mendes sales are 2x better than Elizabeth
- Vasco sales are 6x better than Elizabeth

Table 8. Alternatives to Sales Criteria

Alternative	Vasco	Elizabeth	Mendes
Vasco	1,00	6,00	3,00
Elizabeth	0,17	1,00	0,50
Mendes	0,33	2,00	1,00
Total	1,50	9,00	4,50

Then add up the values in each row and then divide by the number of elements to get the average value.

Table 9. Average Value of Sales Criteria Matrix Ranking

Alternative	Vasco	Elizabeth	Mendes	Average
Vasco	0,67	0,67	0,67	0,67
Elizabeth	0,11	0,11	0,11	0,11
Mendes	0,22	0,22	0,22	0,22
Average Amount				1,00

Step 3: Creating Paired Matrices

At this stage, we will compare the average value of the criteria and the average value of alternatives.

Table 10. Paired Matrix

	Stock	Capital Price	Sale		Criteria Average Score
Vasco	0,33	0,10	0,67		0,54
Elizabeth	0,37	0,60	0,11	X	0,16
Mendes	0,30	0,30	0,22		0,30

Then do the matrix multiplication as shown in the following table.

Table 11. Matrix Multiplication

Matrix Multiplication (Row X Column)				
	Stock	Capital Price	Sale	Amount
Vasco	0,18	0,02	0,20	0,39
Elizabeth	0,20	0,10	0,03	0,33
Mendes	0,16	0,05	0,07	0,28

From the results of the table above, it can be determined what brand clothing is the priority for determining product orders to be ordered in the next product order, along with the rankings that have been carried out.

Table 12. Ranking of Alternatives

1	Vasco	0,39
2	Elizabeth	0,33
3	Mendes	0,28

So the more recommended alternative for women's clothing that will be reordered is Vasco brand clothing with an amount of 0.39. From the calculation results above, it can be seen that the determination of product orders can be determined by the AHP method so that it can assist managers in making decisions in determining product orders. From the results of the above calculations will be implemented into an application that will facilitate the calculation process so that decision making can be done immediately. The following is the calculation of Index consistency and Ratio Consistency.

Calculating Consistency Ratio

Determine the Maximum Eiger value (λmax)

λmax = Total Ratio / n
= ((1,83+0.54) + (6,00+0,16) + (3,50+0,30))/3
= 12,33/3
= 4,11

CI = (λmax – n) / n -1
= (4,11 – 3) / 3 -1 = 0,56

CR = CI / RI
= 0.56/ 0.58
= 0,96

Note:

IR = 0.58 is a random index value for matrix size = 3 (According to the predetermined Random Index table).

When viewed from the CR, which is 0.96, the calculation results are declared correct because they are less or equal to 0,1.

After testing the method, the following results were obtained.

Table 13. Product Testing Table with AHP Method

Rank	Clothing Brand	Stock (Set)	Capital Price	Sale	Priority Results
1	Vasco	20	Rp. 200.000	200	0,39
2	Elizabeth	10	Rp. 1.000.000	135	0,33
3	Mendes	40	Rp. 500.000	70	0,28

The following is the input design of the application that is generated using the Visual Basic 2010 programming language with the MySql database generated from the determination of product orders using the AHP method.

1. Criteria Data Display

The criteria data form is a master form for criteria data input which contains the criteria code, criteria name and description.

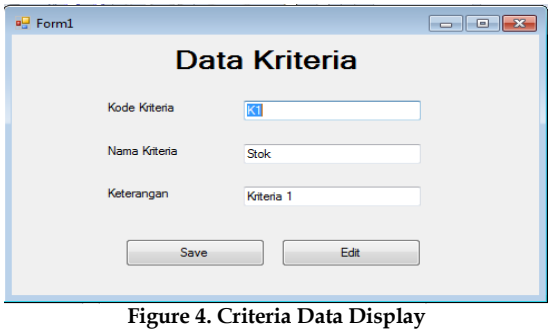


Figure 4. Criteria Data Display

2. Criteria Determination Data

The criteria determination form is a relational form for inputting criteria determination data that functions to find the ranking of criteria and look for CI and CR.

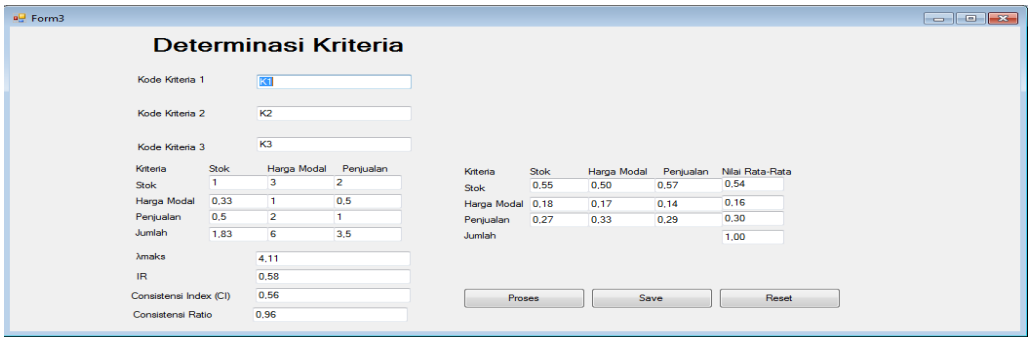


Figure 5. Criteria Data Display

3. Clothing Data Display/Alternative Data

The alternative data form is a master form for alternative data input and clothing data input.

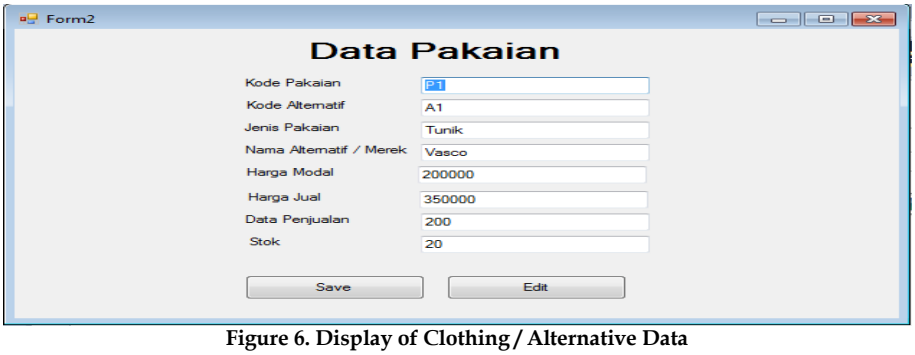


Figure 6. Display of Clothing / Alternative Data

4. Determination of Alternatives Per Criteria

Alternative data form per criteria is a relation form that is used to find alternative rankings.

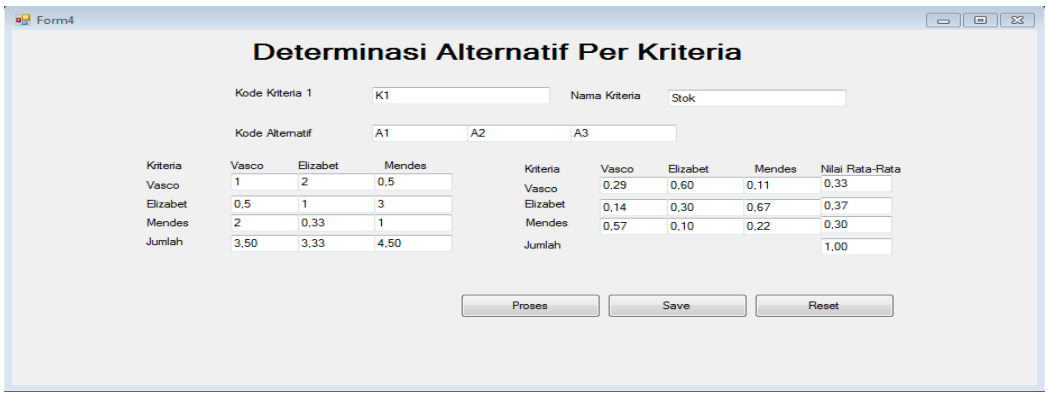


Figure 7. Determination of Alternatives Per Criteria

5. Paired Matrix Determination

   Paired matrix determination form is a relation form that is used to find paired matrices and product determination rankings.

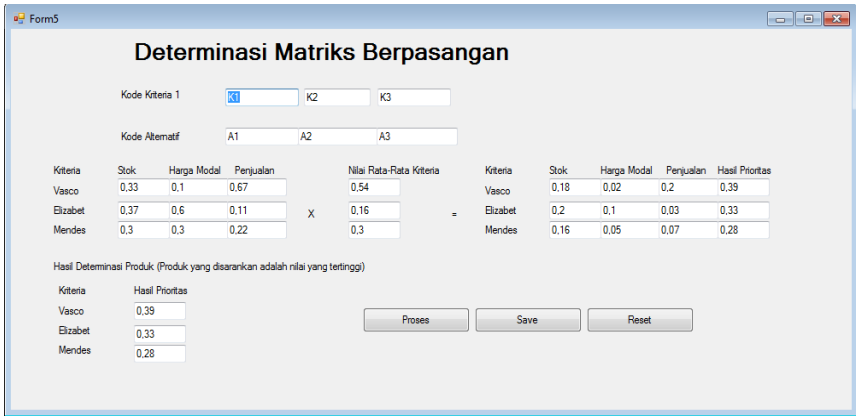
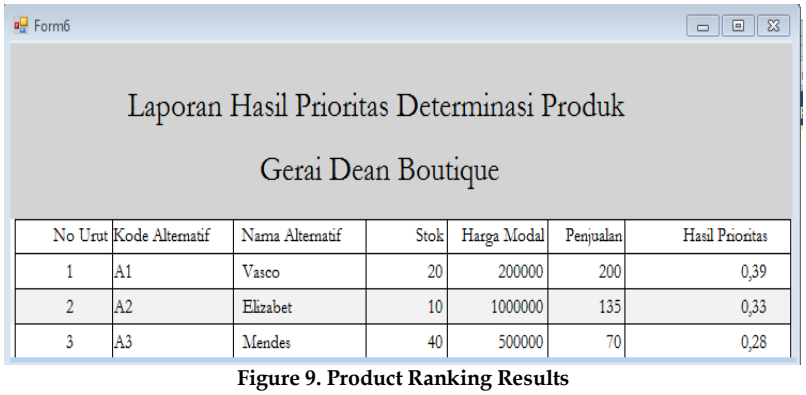


Figure 8. Determination of Pairwise Matrices

6. Product Ranking Results

   The product ranking results form is a form that displays the results of the priority and ranking of all alternatives in the form of a report.



No Urut	Kode Alternatif	Nama Alternatif	Stok	Harga Modal	Penjualan	Hasil Prioritas
1	A1	Vasco	20	200000	200	0,39
2	A2	Elizabet	10	1000000	135	0,33
3	A3	Mendes	40	500000	70	0,28

Figure 9. Product Ranking Results

```
Program AHP
Public Class Form1

    Private Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles
Button1.Click
        Dim simpan As String
        koneksi()
```

```
        simpan = "replace into  kriteria values('" & kdkriteria.Text & "','" & nmkriteria.Text &
"','" & ket.Text & "')"
        CMD = New OdbcCommand(simpan, Conn)
        CMD.ExecuteNonQuery()
        MsgBox("data berhasil di simpan", MsgBoxStyle.Information, "Information")
        Call awal()
    End Sub

    Private Sub Button2_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles
Button2.Click
        Dim edit As String
        koneksi()
        edit = "Update kriteria set nmkriteria='" & nmkriteria.Text & "' where kdkriteria ='" &
kdkriteria.Text & "'"
        CMD = New OdbcCommand(edit, Conn)
        CMD.ExecuteNonQuery()
        MsgBox("data berhasil di edit", MsgBoxStyle.Information, "Information")
        Call awal()
    End Sub
End Class
```

4. Conclusion

After doing research on the determination of the order of clothing products at the Dean Boutique Bukittinggi store, it can be concluded several things, namely first, product determination is an activity to determine which products will be ordered again. In the future, the second product order program design is designed to facilitate product ordering so that it can assist and speed up decision making by the leadership. One of the results of a decision support system using the Analytical Hierarchy Process (AHP) method is to be able to help speed up the decision-making process or information on criteria as desired. Furthermore, thirdly, the role of a computerized system supported by programming language applications will make it easier and speed up decision making and has its own added value compared to manual systems. The test results show that the priority of clothes with the Vasco brand is prioritized to be reordered in a short period.

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