An Integrated Multi Criteria Decision Making Method For Fashion Selection

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Abstract. ZOOM Fashion is a business engaged in the sale of clothing, which is currently undergoing development and is in great demand in the community. In these companies, performance improvements are needed, so companies must be more careful in buying clothes to be resold in order to find out which clothes are of high quality. TOPSIS uses the principle that the chosen alternative must have the closest distance from the positive ideal solution and the longest distance from the negative ideal solution from a geometric point of view by using the distance between two points to determine the relative proximity of an alternative. this method is very well used for the completion of fashion selection. this research is expected to help in determining quality clothing in accordance with the fashion needed at this time, so that the existence of this system makes it easy to find out the needs of the community in the field of clothing.

1. Introduction

Fashion is a blend of styles with designs that tend to be chosen, favored and used by most people who are able to provide comfort at a certain time. Fashion is formed from a blend of styles with designs that meet the tastes of the wearer. The style of dress is an appearance of the material used that has a difference from the clothes that other people wear, while the design is something more special than style. most people don't know the quality of the clothes they are going to buy. therefore when choosing or buying clothes, the public must know and be careful about the quality of the clothes they want to buy.

2. Methodology

Many have used Multi-Criteria Decision Analysis over the past few decades. Its role has increased significantly in different fields of science, especially as new methods evolve and old methods increase [1]. Two basic approaches to MCDM are decisions taken from multiple attributes and decision making from multiple objectives [2]. Computer-based information systems and can support business or organizational decision making activities are said to be decision support systems. This system provides organizational planning by assisting decision making. [3]

The use of TOPSIS to make the selection of alternatives provided, provided that the alternative chosen must have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution [4]. The principle of using the TOPSIS method is that the chosen alternative must have a short distance from the positive ideal solution and the farthest from the
negative ideal solution from a geometric point of view using Euclidean distance to determine the relative proximity of an alternative to the optimal solution [5]. The formula used in this method is as follows:

1. Normalize each alternative value (normalized matrix) and weighted normalized matrix [6].
   \[ r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \]
   With \( i=1,2,\ldots,m \); and \( j=1,2,\ldots,n \).
   Where:
   \( r_{ij} \) = normalized matrix \([i][j]\)
   \( x_{ij} \) = matriks ternormalisasi \([i][j]\)

2. Calculate the weighted matrix value.
   \[ Y_{ij} = w_i r_{ij} \]  
   with \( i=1,2,\ldots,m \); and \( j=1,2,\ldots,n \)
   \( A^+ = (Y_1^+, Y_2^+, \ldots, Y_n^+) \)
   \( A^- = (Y_1^-, Y_2^-, \ldots, Y_n^-) \)
   With condition:
   \( y_{ij} \) = weighted normalized matrix \([i][j]\)
   \( Y_i^+ \) = max \( y_{ij} \), if \( j \) is a profit attribute
   \( Y_i^- \) = min \( y_{ij} \), if \( j \) is a cost attribute
   \( Y_i^+ \) = max \( y_{ij} \), if \( j \) is a profit attribute
   \( Y_i^- \) = min \( y_{ij} \), if \( j \) is a cost attribute.

3. Calculate weighted distance values for each alternative to positive and negative ideal solutions. For a positive ideal solution [7]
   \[ D_i^+ = \sqrt{\sum_{j=1}^{n} (Y_i^+ - Y_{ij})^2} \]
   \( D_i^+ \) = the alternative distance of \( A_i \) with a positive ideal solution.
   \( Y_i^+ \) = Positive ideal solution \([i]\)
   \( y_{ij} \) = normal matrix weighted \([i][j]\)
   For negative ideal solutions [8].
   \[ D_i^- = \sqrt{\sum_{j=1}^{n} (Y_i^- - Y_{ij})^2} \]
   \( D_i^- \) = jarak alternative \( A_i \) dengan solusi ideal negative.
   \( Y_i^- \) = Solusi ideal Negative \([i]\)
   \( y_{ij} \) = weighted normalized matrix \([i][j]\)

4. Calculating Preference Values from each alternative.
   \[ V_i = \frac{D_i^-}{D_i^+ + D_i^-} \]
   \( V_i \) = The closeness of each alternative to the ideal solution

where:

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\(D_i^+\) = the alternative distance of \(A_i\) with a positive ideal solution.

\(D_i^-\) = the alternative distance of \(A_i\) with a negative ideal solution.

A larger \(V_i\) value indicates that the \(A_i\) alternative is preferred.

Fashion is a blend of styles with designs that tend to be chosen, favored and used by most people who are able to provide comfort at a certain time. Fashion is formed from a blend of styles with designs that meet the tastes of the wearer. The style of dress is an appearance of the material used that has a difference from the clothes that other people wear, while the design is something more special than style.

3. Results and Discussion

Analysis of the problems discussed is the implementation of a decision support system in the selection of fashion based on quality. As described in the previous chapter, there are many factors that are taken into consideration in determining the quality of a garment. The activity of determining the quality of a garment is an activity carried out by the community and shop owners, but there are some difficulties in determining the quality of clothing. The criteria used for this study are presented in the following table 1.

| Number | Code | Criteria   | Weight |
|--------|------|------------|--------|
| 1      | C1   | material   | 3      |
| 2      | C2   | Stitches   | 2      |
| 3      | C3   | Pattern    | 2      |
| 4      | C4   | Price      | 2      |
| 5      | C5   | Origin of the product | 1 |

The research using several alternatives as in the table 2 below:

| Number | Name            | Material | Stitches | Pattern      | Price | Origin of the Product |
|--------|-----------------|----------|----------|--------------|-------|-----------------------|
| 1      | Drexel Shirt    | Street   | Enough   | Not Good     | 140   | Local                 |
| 2      | Voresti Shirt   | Katun    | Neat     | Good         | 130   | Import                |
| 3      | Luccaman Shirt  | Beldu    | Enough   | Not Good     | 140   | Import                |
| 4      | Eighty Eight Shirt | Eight Flannel | Enough Good | 120   | Local                 |

Each criterion is given a range of values, as in the material criteria in table 3 below:

| Criteria | Name Of Material | Value |
|----------|------------------|-------|
|          | Beldu Fabric     | 1     |
Material

| Fabric Type   | Value |
|---------------|-------|
| Flannel Fabric| 3     |
| Street Fabric | 3     |
| Katun Fabric  | 4     |
| Denim/Jeans Fabric | 4   |
| Chinos/Drill Fabric | 3 |
| Spandex Fabric | 2     |

Range of values from Criteria of Stitches, presented in table 4:

| Criteria | Description | Value |
|----------|-------------|-------|
| Stitches | Neat        | 4     |
|          | Pretty Neat | 3     |
|          | Not Neat    | 2     |
|          | Not Neat    | 1     |

Range of values from Criteria of Pattern, presented in table 5:

| Criteria | Range | Value |
|----------|-------|-------|
| Pattern  | Good  | 4     |
|          | Quite good | 3     |
|          | Not Good | 2     |
|          | Bad    | 1     |

Range of values from Criteria of Price, presented in table 6:

| Criteria | Range (Thousand) | Value |
|----------|------------------|-------|
| Price    | < 200            | 4     |
|          | 140 – 110        | 3     |
|          | 120 – 90         | 2     |
|          | > 90             | 1     |

Range of values from Criteria of Origin Of Product, presented in table 7:

| Criteria | Range      | Value |
|----------|------------|-------|
| Origin Of Product | Locally Made | 3     |
|          | Import     | 4     |

Range of values from Rules for Assessing All Criteria, presented in table 8:

| Range  | Feasibility Status |
|--------|--------------------|
| 0 - 0.25 | Bad                |
0.26 – 0.50      
0.51 – 0.75      
0.76 – 1  

| 0.26 – 0.50 | Enough |
| 0.51 – 0.75 | Good   |
| 0.76 – 1     | Very Good |

a. Create a decision matrix. The matrix column states the existing criteria, while the matrix row represents an alternative. The reference to alternative decision matrix which will be evaluated based on criteria.

\[ r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \]

* \( X_{ij} \) is alternative performance to I for criteria to j.
* \( A_i \) (i=1,2,3,……,m) are possible alternatives.
* \( X_j \) (j=1,2,3,…..,m) is a criterion where alternative performance is measured.

In this study, the value of \( j \) is as follows:

\( J = 1 \) for criteria of material
\( J = 2 \) for criteria of Stitches
\( J = 3 \) for criteria of Pattern
\( J = 4 \) for criteria of Price
\( J = 5 \) for criteria of Origin Of Product

The results of the decision matrix formed from the initial data table of each alternative can be presented in the following example:

Table 9. Data Normalization Results of Customized Clothing From Table 2

| Alternative | Material | Stitches | Pattern | Price | Origin Of Product |
|-------------|----------|----------|---------|-------|-------------------|
| \( A_1 \)   | 3        | 3        | 2       | 4     | 3                 |
| \( A_2 \)   | 4        | 4        | 4       | 3     | 4                 |
| \( A_3 \)   | 2        | 3        | 2       | 4     | 4                 |
| \( A_4 \)   | 4        | 3        | 4       | 2     | 3                 |

Normalized Decision Matrix can be seen in the following agreement:

\[ r_{ij} = \frac{x_{ij}}{\sqrt{x_{11} + x_{21} + x_{31} + x_{41}}} \]

\[ x_1 = \sqrt{3^2 + 4^2 + 2^2 + 4^2} = 6.708 \]

\[ r_{11} = \frac{x_{11}}{x_1} = \frac{3}{6.708} = 0.447 \]

\[ r_{21} = \frac{x_{21}}{x_1} = \frac{4}{6.708} = 0.596 \]

\[ x_2 = \sqrt{3^2 + 4^2 + 3^2 + 3^2} = 6.557 \]

\[ r_{12} = \frac{x_{12}}{x_2} = \frac{3}{6.557} = 0.457 \]

\[ r_{31} = \frac{x_{31}}{x_1} = \frac{2}{6.708} = 0.298 \]

\[ r_{41} = \frac{x_{41}}{x_1} = \frac{4}{6.708} = 0.596 \]

\[ r_{32} = \frac{x_{32}}{x_2} = \frac{3}{6.557} = 0.457 \]
Calculation Result of Normalized Decision Matrix, presented in table 10:

| Number | Name of Alternative | Material Stitches Pattern Price Origin of Product |
|--------|---------------------|-----------------------------------------------|
| 1      | Drexel              | 0.447 0.457 0.316 0.596 0.424                  |
| 2      | Voresti             | 0.596 0.610 0.632 0.447 0.565                  |
| 3      | Luccaman            | 0.298 0.457 0.316 0.596 0.565                  |
| 4      | Eighty Eight        | 0.596 0.457 0.632 0.298 0.424                  |

b. After the normalized matrix is made, then it is to make a weighted Y normalized decision matrix whose elements are determined by the following formula:

Where:

\[ y_{ij} = w_j \cdot r_{ij} \]

\( y_{ij} \) are elements of normalized decision matrices R.

Weight \( w_j(w_1, w_2, w_3, \ldots, w_n) \) is the weight of the criteria of the criteria to \(-j\).

\( r_{ij} \) are elements of normalized decision matrices R.

The Weighted Normalization Decision Matrix presented in table 11:

| Number | Name of Alternative | Material | Stitches | Pattern | Price | Origin of Product |
|--------|---------------------|----------|----------|---------|-------|------------------|
| 1      | Drexel              |          |          |         |       |                  |
| 2      | Voresti             |          |          |         |       |                  |
| 3      | Luccaman            |          |          |         |       |                  |
| 4      | Eighty Eight        |          |          |         |       |                  |
Calculation of Weighted Normalized Decision Matrix Results, presented in table 12:

| Name of Alternative | Material | Stitches | Pattern | Price | Origin of Product |
|---------------------|----------|----------|---------|-------|-------------------|
| Drexel              | 1.341    | 0.914    | 0.632   | 1.192 | 0.424             |
| Voresti             | 1.788    | 1.22     | 1.264   | 0.894 | 0.565             |
| Luccaman            | 0.894    | 0.914    | 0.632   | 1.192 | 0.565             |
| Eighty Eight        | 1.788    | 0.914    | 1.264   | 0.596 | 0.424             |

C. Calculating Positive or Negative Values.

Formula:

\[ y_{ij} = w_i r_{ij} \]

\[ A^+ = (Y_1^+, Y_2^+, \ldots, Y_n^+) \]

\[ A^- = (Y_1^-, Y_2^-, \ldots, Y_n^-) \]

Under the condition

\[ y_{ij} = \begin{cases} 
\max_i y_{ij} & \text{if } j \text{ is profit attribute} \\
\min y_{ij} & \text{if } j \text{ is cost attribute} 
\end{cases} \]
\[ Y_j^- = \begin{cases} \max Y_{ij} & \text{if } j \text{ is profit attribute} \\ \min Y_{ij} & \text{if } j \text{ is cost attribute} \end{cases} \]

1) Ideal Positive Solution
\[ y_1^+ = \max \{1.341; 1.788; 0.894; 1.788\} = 1.788 \]
\[ y_2^+ = \max \{0.914; 1.22; 0.914; 0.914\} = 1.22 \]
\[ y_3^+ = \max \{0.632 ; 1.264 ; 0.632 ; 1.264\} = 1.264 \]
\[ y_4^+ = \max \{1.192; 0.894 ; 1.192 ; 0.596\} = 1.192 \]
\[ y_5^+ = \max \{0.424; 0.565 ; 0.565 ; 0.424\} = 0.565 \]

2) Ideal Negative Solution
\[ y_1^+ = \max \{1.341; 1.788; 0.894; 1.788\} = 0.894 \]
\[ y_2^+ = \max \{0.914; 1.22; 0.914; 0.914\} = 0.914 \]
\[ y_3^+ = \max \{0.632 ; 1.264 ; 0.632 ; 1.264\} = 0.632 \]
\[ y_4^+ = \max \{1.192; 0.894 ; 1.192 ; 0.596\} = 0.596 \]
\[ y_5^+ = \max \{0.424; 0.565 ; 0.565 ; 0.424\} = 0.424 \]

And, the results of determining the Ideal Positive Solution Matrix \((A^+)\) and the Ideal Negative Matrix \((A^-)\).

|   | 1.788 | 1.22 | 1.264 | 1.192 | 0.565 |
|---|-------|------|-------|-------|-------|
| \(A^+\) |       |      |       |       |       |
| \(A^-\) | 0.894 | 0.914| 0.632 | 0.596 | 0.424 |

Calculate the distance of weighted values for each alternative to positive and negative ideal solutions[9]. Next, determine the alternative distance from the ideal positive solution \((D^+)\) and the alternative distance from the negative ideal solution \((D^-)\).

Formula: \[ D_i^+ = \sqrt{\sum_{j=1}^{n} (y_i^+ - y(j))^2}; \quad i=1,2,\ldots,m. \]

\[ D_1^+ = \sqrt{(1.788 - 1.341)^2 + (1.22 - 0.914)^2 + (1.264 - 0.632)^2 + (1.192 - 1.192)^2 + (0.565 - 0.424)^2} = 0.842 \]

\[ D_2^+ = \sqrt{(1.788 - 1.788)^2 + (1.22 - 1.22)^2 + (1.264 - 1.264)^2 + (1.192 - 0.894)^2 + (0.565 - 0.565)^2} = 0.296 \]

\[ D_3^+ = \sqrt{(1.788 - 0.894)^2 + (1.22 - 0.914)^2 + (1.264 - 0.632)^2 + (1.192 - 1.192)^2 + (0.565 - 0.565)^2} = 1.136 \]
\[ D_4^+ = \sqrt{(1.788 - 1.788)^2 + (1.22 - 0.914)^2 + (1.264 - 1.264)^2 + (1.92 - 0.596)^2 + (0.565 - 0.424)^2} \]
\[ = 0.683 \]

Formula: \[ D_i^- = \sqrt{\sum_{j=1}^{n} (y_{ij}^+ - y_{ij})^2}; \quad i=1,2,\ldots,m. \]

\[ D_1^- = \sqrt{(0.894 - 1.341)^2 + (0.914 - 0.914)^2 + (0.632 - 0.632)^2 + (0.596 - 1.192)^2 + (0.424 - 0.424)^2} \]
\[ = 0.744 \]

\[ D_2^- = \sqrt{(0.894 - 1.788)^2 + (0.914 - 1.22)^2 + (0.632 - 1.264)^2 + (0.596 - 0.894)^2 + (0.424 - 0.424)^2} \]
\[ = 1.182 \]

\[ D_3^- = \sqrt{(0.894 - 0.894)^2 + (0.914 - 0.914)^2 + (0.632 - 0.632)^2 + (0.596 - 1.192)^2 + (0.424 - 0.565)^2} \]
\[ = 0.611 \]

\[ D_4^- = \sqrt{(0.894 - 1.788)^2 + (0.914 - 0.914)^2 + (0.632 - 1.264)^2 + (0.596 - 0.596)^2 + (0.424 - 0.424)^2} \]
\[ = 1.094 \]

Distance Calculation Results Alternatively From Ideal Positive Solutions and Ideal Negative Solutions, presented in table 13:

| Alternative | \( D^+ \) | \( D^- \) |
|-------------|----------|----------|
| Drexel      | 0.842    | 0.744    |
| Voresti     | 0.296    | 1.182    |
| Luccaman    | 1.136    | 0.611    |
| Eighty Eight| 0.683    | 1.094    |

d. Calculating Preference Value (V) for Each Alternative.

Formula: \[ V_i = \frac{D_i^-}{D_i^- + D_i^+}; \quad \text{Where } i=1,2,\ldots,m. \]

\[ V_1 = \frac{0.744}{0.744 + 0.842} = \frac{0.744}{1.586} = 0.469 \]
\[ V_2 = \frac{1.182}{1.182 + 0.298} = \frac{1.182}{1.48} = 0.798 \]
\[ V_3 = \frac{0.611}{0.611 + 1.136} = \frac{0.611}{1.747} = 0.349 \]
\[ V_4 = \frac{1.098}{1.098 + 0.683} = \frac{1.098}{1.777} = 0.617 \]

e. Rank

The following is a table of the results of each alternative, while the reference in this ranking is based on the highest value of each alternative that will be selected for quality clothing. Here is the alternative ranking of the largest value \( V \) to the smallest value \( V \). The alternative with the largest \( V \) value is the best quality clothing. Presented in table 14.

| Alternatif | Total of Value | Feasibility Status |
|------------|----------------|-------------------|
| Voresti    | 0.798          | Very Good         |
| Eighty Eight | 0.617        | Good              |
| Drexel     | 0.469          | Not Bad           |
| Lucaman    | 0.349          | Not Bad           |

4. Conclusion

In analyzing and resolving the problems that occur regarding the assessment of clothing mode using a decision support system with the topsis method. Provide knowledge to the general public about the quality of good clothing. Make one of the references in using the topsis method to make elections with different cases.

Limitations

This study has limitations in adding criteria, further research needs to be extended especially from the alternatives used and the selection of criteria used.

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