

Decision-Making System for Selecting Alternative Product Purchase Stores in Tokopedia Using A Combination of SAW and TOPSIS

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ABSTRACT

In the era of advancing digital technology enabling online business transactions, e-commerce platforms like Tokopedia have rapidly grown in Indonesia, providing consumers with a wide array of products and services. However, this abundance of choices often leads to consumer confusion when selecting alternative stores for their purchases. Additionally, Tokopedia's search filter feature is limited, merely sorting products based on selected criteria without considering the consumer's specific needs. To address these issues, a decision-making system is essential, aiding consumers in choosing products from alternative stores that best align with their individual preferences and predetermined criteria. This study proposes a combined methodology employing the Simple Additive Weighting (SAW) method and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). Initially, the SAW method normalizes values (r), which are subsequently ranked using the TOPSIS method to generate recommendations for alternative stores based on input criteria and weights. The adoption of this decision-making system is poised to enhance the online shopping experience for Tokopedia users by providing well-informed recommendations, improving overall satisfaction, and streamlining the purchasing process. In conclusion, this research offers a promising approach to addressing the challenges posed by the abundance of choices in online retail, ultimately benefiting both consumers and online businesses.

Keywords: E-Commerce, Tokopedia, SAW, TOPSIS



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INTRODUCTION

Nowadays, digital technology and the internet are increasingly developing which allows people to conduct business transactions online. E-commerce or electronic commerce is a form of trade that uses digital technology to buy and sell products or services via the internet. One of the e-commerce platforms that is growing rapidly in Indonesia is Tokopedia. According to iPrice, the Tokopedia page was visited by an average of 157.2 million people every month in the first quarter of 2022. This number has increased by 5.1% from the previous quarter, namely the fourth quarter of 2021 which recorded 149.6 million visits (Dihni, 2022). Tokopedia provides thousands of products sold by different sellers, thus providing many choices for consumers.

However, the many choices often make consumers confused in choosing products from several alternative stores. Moreover, in the author's opinion, in choosing alternative stores, consumers often consider many factors such as product prices, location, shipping costs, ratings. The long transaction or delivery process is also sometimes an obstacle for consumers (Kominfo, 2017). In addition, the filter feature in searching for products on Tokopedia is not accurate in getting the results that consumers want to get because the filter feature itself only sorts based on the selected criteria without any ranking of the criteria needed by consumers. Therefore, a decision-making system is needed that can help consumers in choosing products from alternative stores that best suit consumer needs. The method in the decision-making system that can be applied is a combination of the Simple Additive Weighting (SAW) method and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). (Gregorius & Ernawati, 2013) explained that the SAW and TOPSIS methods have a simple and easy-to-understand concept. Both methods are efficient in calculation and are able to measure the relative performance of an alternative decision using simple mathematical concepts. According to (Septy & Devega, 2022) the TOPSIS method will consider the best and worst alternatives in each available solution. However, this method is less effective in producing weights that take into account the relationship between criteria (Septy & Devega, 2022). According to (Heriawan & Subawa, 2019) combining the TOPSIS method with other methods such as SAW is needed for weighting. The SAW method was chosen because this method can provide a more accurate assessment by considering the criteria value of the weight of each predetermined preference, and normalizing the matrix by taking into account the value of the attributes, including the benefit and cost values of the criteria to be used (Heriawan & Subawa, 2019). Another study conducted by (Putu & Sudarsana, 2022) concluded that the combination of SAW and Topsis methods was able to provide better results than using only one method, namely SAW or TOPSIS (Putu & Sudarsana, 2022).

This research aims to find out the combination of SAW and TOPSIS methods and build a decision-making system to find alternative stores for a product on Tokopedia.

METHODS

The type of research used is a type of system development research. This research was chosen because what was done was the development of a website-based decision-making system using a combination of SAW and TOPSIS methods. The research was conducted at the Faculty of Computer Science, University of Jember. The research was conducted for 5 months from March to July 2023. The stages in this research consist of 4 stages, namely data collection (problem identification and literature study), implementation of a combination of SAW and TOPSIS methods, system development, and system testing.

Decision Support System (DSS) is an information system that is used to support decision making by integrating and processing intellectual resources or data in a computerized manner in order to obtain information in the form of alternative choices which will later be used for decision making based on the problems given. Decision Support System (SPK) can be interpreted as a system that helps decision makers or the decision maker in facilitating decision making by processing the information provided.

The Simple Additive Weighting (SAW) method is one of the most popular decision-making methods in Decision Support Systems (SPK). This method calculates the relative preference value of each alternative in the given criteria. This relative preference value is then used to determine the relative ranking of each alternative. SAW assumes that the criteria weights are known in advance and can be calculated using a subjective or objective approach. This method consists of two attributes, namely the benefit criteria attribute which has a positive value and the cost attribute which has a negative value. The steps in using the Simple Additive Weighting (SAW) method are as follows:

1. Determine the choice of alternatives offered (A_i).
2. Determine the criteria that will be the basis for decision making (C_i).
3. Determine the weight of each preference or the level of importance of each criterion using the weight vector W

$$W = [W_1, W_2, W_3, W_4, \dots, W_j] \quad \dots (1)$$

4. Create a suitability rating table for each alternative choice on each criterion.
5. Create a normalization matrix based on criteria (C_i) to adjust to the type of benefit or cost attribute. This normalization matrix R is used to calculate the relative value of each alternative on each criterion

$$rij = \frac{X_{ij}}{\text{Max } X_{ij}} \text{ if } j \text{ is a benefit attribute} \quad \dots (2)$$

$$rij = \frac{\text{Min } X_{ij}}{X_{ij}} \text{ if } j \text{ is a cost attribute} \quad \dots (3)$$

Description:

r_{ij} = normalized rating

$\text{Max } X_{ij}$ = the highest value of all alternatives in one column and attribute row

$\text{Min } X_{ij}$ = the lowest value of all alternatives in one column and attribute row

X_{ij} = row and column attributes

6. Finding the final preference value by summing the product of each normalized matrix row element (R) with the weight (W) corresponding to the matrix column.

$$V_i = \sum_{j=1}^n w_j r_{ij} \quad \dots (4)$$

Description:

V_i = preference value

w_j = weight of criteria that have been applied

r_{ij} = normalization result R

7. The result of the final value of the largest preference (V_i) is chosen as the best alternative as a solution.

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method is a popular decision-making method in SPK. This method is used to solve alternative selection problems by calculating the distance between alternatives and the best ideal solution and the worst ideal solution in the decision space. The alternative that has the closest distance to the best ideal solution and the farthest distance from the worst ideal solution will be the best alternative selected.

1. Determine the alternatives to be selected
2. Determine the criteria for the basis of decision making
3. Determine the weight of each criterion
4. Create a normalized decision matrix using the following formula

$$R_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \quad \dots (5)$$

Where X_{ij} is the initial matrix that will be normalized with i is the number of rows, and j is the number of columns as many as m .

5. Create a weighted decision matrix by multiplying the weight of each criterion (W_i) by the result of the normalized decision matrix R

$$y_{ij} = W_i R_{ij} \quad \dots (6)$$

6. Determine the positive and negative ideal solution matrix using the following formula:

$$A^+ = \text{Max}(y_1^+, y_2^+, y_3^+, \dots, y_n^+) \quad \dots (7)$$

$$A^- = \text{Min}(y_1^-, y_2^-, y_3^-, \dots, y_n^-) \quad \dots (8)$$

7. Determine the distance between the value of each alternative with the positive ideal solution matrix and the negative ideal solution matrix using the formula:

$$D_i^+ = \sqrt{\sum_{j=1}^n (y_i^+ - y_{ij})^2}, i = 1, 2, \dots, n \quad \dots (9)$$

$$D_i^- = \sqrt{\sum_{j=1}^n (y_{ij} - y_i^-)^2}, i = 1, 2, \dots, n \quad \dots (10)$$

8. Determining the final value of preference for each alternative with the formula:

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad \dots (11)$$

9. The result of the largest final value is chosen as the best alternative as a solution.

RESULTS AND DISCUSSION

This research produces a decision-making system to select alternative stores for purchasing products on Tokopedia. This system is built using a combination of SAW and TOPSIS methods. In producing the best alternative, the SAW method is used for the initial process to determine the normalization value of the R matrix, while the TOPSIS method is used for the selection process.

A. Analysis process using SAW method

To test the performance of the system, the author conducted a simulation using data from users who wanted to find an Asus VivoBook 14X M1403Q RAM 8 gb laptop on Tokopedia. Taken 5 alternative stores and 7 criteria as in the following table.

Table 1. Store data and criteria weights

Alternative Store	Price	Rating	Number sold	Criteria			
				Seller Status	shipping cost	Location	Order time
Top Tech	7746000	5	449	4	86000	3	5
EnVicStore	7694999	5	437	4	86000	3	3
AMD OfficialStore	7694999	5	2082	4	104000	3	4
ROGS Store	7746000	5	144	4	104000	3	6
ALIENWARE Official	7917000	5	240	4	104000	3	5
Criteria Weight	Cost	Benefit	Benefit	Benefit	Cost	Cost	Cost
	5	5	5	4	3	2	5

Source : Data processed, 2023

Guided by the steps of the SAW method, after the data is collected, the next step is to create a normalization matrix R. At this stage, the store alternative table data will be normalized using the following formula.

$$rij = \frac{Xij}{Max Xij} \text{ if } j \text{ is a benefit attribute,}$$

$$rij = \frac{Min Xij}{Xij} \text{ if } j \text{ is a cost attribute.}$$

One of the calculations is the price data from the TopTech store data, because it includes the cost criteria, based on the formula above, the minimum value of each price data is sought, and a value of 7694999 is found which is then divided by the price data from the TopTech store, namely 7746000, so that a value of 0.993415828 is found. For the calculation flow of other data, it is also the same as above. So that the normalization data matrix is obtained as follows.

0.993415828	1	0.215658021	1	1	1	0.6
1	1	0.209894332	1	1	1	1
1	1	1	1	0.826923	1	0.75
0.993415828	1	0.069164265	1	0.826923	1	0.5
0.971958949	1	0.115273775	1	0.826923	1	0.6

B. Ranking Process using TOPSIS Method

Based on the steps of the TOPSIS method, after finding the normalized value of the data, then proceed to find the weighted normalized value until finding the final value of preference in each alternative.

1. Creating a weighted normalization matrix

At this stage, the previous normalized data will be normalized again with the weight value that has been determined using the formula:

$$y_{ij} = W_i R_{ij}$$

Namely the multiplication between the data in the normalization matrix and the weight of each criterion. One of them is the TopTech store price data that has been normalized, namely 0.993415828 multiplied by the weight of the price criteria, namely 5, so that a value of 4.967079138 is obtained. For the calculation flow of other data is also the same as above. So that the weighted normalization matrix data is obtained as follows.

4.967079138	5	1.078290106	4	3	2	3
5	5	1.049471662	4	3	2	5
5	5	5	4	2.480769	2	3.75
4.967079138	5	0.345821326	4	2.480769	2	2.5
4.859794745	5	0.576368876	4	2.480769	2	3

2. Determining the ideal solution

At this stage, the weighted normalized data is then searched for positive and negative ideal solution values using the formula Max (y1+,y2+,...yn+) for positive ideal solutions and Min (y1-,y2-,...yn-) for negative ideal solutions. Where the positive ideal solution takes the largest value from the previous weighted normalization matrix data, while the negative ideal solution takes the smallest value from the previous weighted normalization matrix data. So that the positive and negative ideal solution values are obtained as follows.

Positive Ideal Solution

4.859794745	5	5	4	2.480769	2	2.5
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Negative Ideal Solution

5	5	0.345821326	4	3	2	5
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3. Finding the weighted distance of the ideal solution

At this stage, the previous positive and negative ideal solution data will find the distance between the two using the following formula.

$$D_i^+ = \sqrt{\sum_{j=1}^n (y_i^+ - y_{ij})^2}, i = 1, 2, \dots, n \quad \text{for positive ideal solution distance}$$

$$D_i^- = \sqrt{\sum_{j=1}^n (y_{ij} - y_i^-)^2}, i = 1, 2, \dots, n \quad \text{for negative ideal solution distance}$$

One of the calculations is data from the TopTech store (D1), which is as follows.

$$\begin{aligned}
 D_1^+ &= \sqrt{(4.859794745 - 4.967079138)^2 + (5 - 5)^2 + (5 - 1.078290106)^2 + (4 - 4)^2 + (2.480769 - 3)^2 + (2 - 2)^2 + (2.5 - 3)^2} \\
 &= 3.988849336
 \end{aligned}$$

$$D_i^- = \sqrt{(4.967079138 - 5)^2 + (5 - 5)^2 + (1.078290106 - 0.345821326)^2 + (4 - 4)^2 + (3 - 3)^2 + (2 - 2)^2 + (3 - 2.5)^2}$$

$$= 2.130163$$

For the calculation flow of other data, it is also the same as above. So that the matrix value is obtained as follows.

Table 2. Positive and negative ideal distance matrix values

D1 +	3.988849336	D1 -	2.130163
D2 +	4.705946478	D2 -	0.70365
D3 +	1.257838429	D3 -	4.847007
D4 +	4.655415027	D4 -	2.553563
D5 +	4.451798774	D5 -	2.083845

Source : Data processed, 2023

4. Determining the final preference score

One of the calculations is the Top Tech data to get the final value of preference by sharing the value of D1- divided by the sum between D1- and D1+, so that it becomes $2.130163 / (2.130163 + 3.988849336) = 0.348122028$. For the calculation flow of other data is also the same as above so that the final preference value of all data is obtained and the largest value becomes the best alternative as a solution as presented in the following table.

Table 3. Final preference score

Top Tech	0.348122028	3
EnVicStore	0.130074451	5
AMD OfficialStore	0.793960653	1
ROGS Store	0.354219841	2
ALIENWARE Official	0.318843119	4

Source : Data processed, 2023

Based on manual testing using Microsoft Excel application with the system made, the difference in rounding values is obtained but does not affect the final ranking. Based on this comparison, the accuracy of the system calculation is considered more accurate than the manual calculation because the manual calculation only uses 9 numbers behind the comma, while the system calculation is more than 9 numbers behind the comma. So that it can be said, the calculation accuracy level is more than 95% in accordance with the manual calculation comparison.

CONCLUSIONS

Based on the research that has been done, it can be concluded that the application of the combination of SAW and TOPSIS methods in the decision-making system for selecting alternative stores for purchasing products on Tokopedia consists of several steps. The first step is analysis using the SAW method to find the normalization matrix value R, then proceed by using the TOPSIS method flow in finding the weighted normalization value until determining the final value of preference to determine the ranking of alternative stores that have been entered. The process of selecting alternative stores using a decision support system is better and more accurate than using manual calculations because manual calculations only use 9 numbers behind the comma, while system calculations are more than 9 numbers behind the comma.

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