

Implementation Decision Support System for Tourism Destination in Semarang, Central Java using TOPSIS Method

¹Resha Meiranadi Caturkusuma, ²Galuh Wilujeng Saraswati

^{1,2}Universitas Dian Nuswantoro, Semarang, Indonesia
(reshameiranadi@gmail.com)

Abstract. The tourism sector significantly contributes to the economic advancement of Indonesia at a national level with a contribution of 3.83% to Indonesia's GDP. Semarang is one of the regions with promising tourism potential. To assist tourists in determining the location of the region according to their preferences, a decision-support system is viable to be utilized. Through this study, researchers want to know the effectiveness of developing a decision support system for identifying tourist destinations in Semarang using the TOPSIS method. This technique was chosen because of its advantages in solving complex decision problems with uncertainty or incomplete information. This approach prioritizes alternatives by assessing their proximity to the ideal solution. Data used is quantitative data of entrance ticket prices, user ratings, and ratings in the Google Maps application obtained from the Kaggle platform. Testing is done by validating system performance through Black Box testing. The calculation and testing of the decision support system resulted in effective performance and provided 3 best alternatives including Taman Srigunting (old town), Goa Kreo, and Desa Wisata Lembah Kalipancur. The test results show that the TOPSIS method has a good level of effectiveness in the decision support system developed.

Keywords: decision support system, topsis method, tourist destination, tourism

RESEARCH BACKGROUND

Indonesia's cultural, natural, and historical diversity highlighted the important role of the tourism sector in the national economic growth. According to the data from Indonesia's Ministry of Tourism and Creative Economy, the tourism sector contributed to GDP by 3.83% until September 2023, marking a significant increase from the previous year's 3.6%. Beyond economic growth, tourism offers many opportunities, including regional development, cultural preservation, and job creation. The Greater Semarang region stands out as a promising area with vast tourism potential. As the capital of Jawa Tengah Province, Semarang boasts a rich tapestry of natural wonders, cultural landmarks, historical sites, and modern attractions (Sumastuti et al., 2021). Some examples of tourism locations in Semarang include Lawang Sewu, Saloka Theme Park, Sam Poo Kong Temple, Kota Lama Semarang, Pagoda Avalokitesvara, Kampung Pelangi, Ranggawarsita Museum, Dusun Semilir Eco Park, Umbul Sidomukti, Candi Gedong Songo, Ambarawa Train Museum, The Grand Mosque of Jawa Tengah, and other several destinations.

However, although many websites provide information about tourist areas in Semarang, not all tourists have enough time to look at all the information and compare it according to their preferences and priorities. Therefore, to help tourists determine their desired destination depending on their preferences and priorities, a decision support system will help determine tourist destinations (Santiary et al., 2018). DSS or stands for decision support system is a useful tool in assisting decision-making based on quantitatively recommended values according to the significance or weighting of criteria. (Trise Putra et al., 2020). Personalized decision support systems have the potential to significantly elevate Indonesia's tourism sector, enhancing competitiveness on the global stage (Qomariyah et al., 2020). In recent years, the TOPSIS algorithm has emerged as a promising solution for developing

such a decision support system. These algorithms have proven efficacy in e-commerce recommendation systems (Wang et al., 2014), the TOPSIS algorithm serves as the foundation for the tourism location DSS in the Greater Semarang area. By integrating various feature attributes such as price and user ratings, this system empowers tourists in making informed decisions when selecting destinations in Semarang.

Considering this context, creating a decision support system to identify tourist destinations is interesting, especially in Semarang City which has become a favorite destination and has a variety of tourist sites. At this time, the absence of a decision support system for tourist sites in Semarang that considers tourist preferences based on the importance of criteria is an interesting aspect to study. The benefit and cost criteria make the TOPSIS method an appropriate method to be implemented.

REVIEW OF RELATED LITERATURE

Decision Support System

A decision support system is a system designed to facilitate or aid in decision-making situation. (Buulolo et al., 2018). This system offers the best decision quickly based on the quantitative importance or weighting of criteria. (Santiary et al., 2018). The existence of DSS can help decision-making on complex problems and shorten it. The advantages of DSS include the ability to provide structured information, support data-based decision-making, and enable in-depth analysis to evaluate various alternatives. The application of decision support systems has been widely used in various industries, including the tourism sector. In this case, DSS can help make decisions for users ranging from determining tourist destinations for tourists to managerial decisions for tourism managers.

TOPSIS Method

The TOPSIS Method, acronym for Technique for Order Preference by Similarity to Ideal Solution is an approach for making decisions based on multiple criteria. This method works by ordering preferences by assessing their proximity to the ideal alternatives using Euclidean distance (Saputra & Gunawan, 2020). Since its introduction in 1981, TOPSIS has become a common tool used for multi-criteria decision-making in many industries, including management, industrial engineering, economics, and many other fields. The TOPSIS method has advantages in solving complex decision problems characterized by uncertainty or incomplete information. In addition, this method is also superior in performing good, fast, and precise organizing (Wahyunita & Nofiannor, 2022).

The flexibility of the TOPSIS method makes it suitable for many industries, including the tourism sector. This technique can be applied in creating a decision support system aimed at assisting tourists in selecting their desired destination based on prior information. For example, a study related to travel package recommendations showed the efficacy of the TOPSIS method in providing travel package recommendations based on previous information effectively (Singgalen, 2023).

The application of the TOPSIS method in general goes through several stages (Hibatullah et al., 2019), as follows:

1. Determine Criteria

The first stage is to determine the criteria that will be used to evaluate alternatives and provide solutions. The criteria selected are factors that are relevant to decision making.

2. Criteria Weighting

At this stage, the determined criteria are given a weight to indicate the relative importance of each criterion in decision making.

3. Normalization Decision Matrix

Following is to normalize the decision matrix. This step is done to eliminate bias that may arise due to different scales on each criterion using the following equation:

$$r_{ij} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}$$

4. Calculating Weighted Normalized Decision Matrix

After normalizing the matrix, then we find the product of the weights and the normalized decision matrix using the following equation:

$$V = [w_1 r_{11} \cdots w_n r_{1n} \quad \vdots \quad w_1 r_{m1} \cdots w_n r_{mn}]$$

5. Determining the Ideal Solutions

The ideal solutions are distinguished based on the previous calculation. The positive ideal solution represents the optimal combination of values for each criterion, whereas negative solution shows the least desirable combination of values for each criterion, as determined by the following equation:

$$A^+ = \{(V_{ij})(V_{ij} | j \in j'), i = 1, 2, \dots, m\} = \{V1^+, V2^+, \dots, Vm^+\}$$

$$A^- = \{(V_{ij})(V_{ij} | j \in j'), i = 1, 2, \dots, m\} = \{V1^-, V2^-, \dots, Vm^-\}$$

6. Calculating the Proximity of Each Solution Alternatives

After each ideal solution are identified, the subsequent stage involves computing the proximity between each solution and the ideal solutions, demonstrating their proximity or deviation. This is achieved through the utilization of the following equation:

$$S_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^+)^2}$$

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2}$$

7. Calculating Relative Preference Score

Next is calculate the relative preference score for each alternative using the following equation:

$$C_i^+ = \frac{S_i^-}{S_i^- + S_i^+}$$

Where $i = 1, 2, \dots, n$ and $0 < C < 1$;

8. Ranking Alternatives

In the final stage, alternatives are ranked according to their scores, with the top-ranking alternative having the highest relative preference score and the lowest-ranked alternative having the lowest score.

RESEARCH METHOD

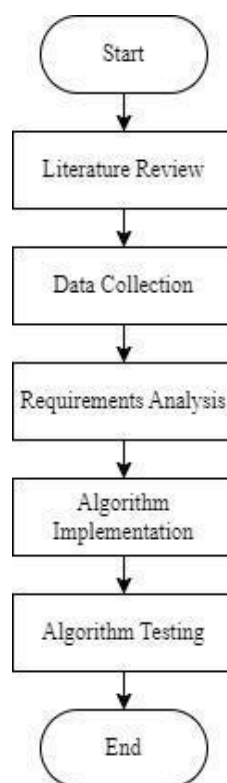


Figure 1 Research Method

This study uses quantitative data from the Kaggle repository and qualitative data focused on validating the testing data generated from the Semarang City Tourism Decision Support System including observation, interviews, and surveys using questionnaire techniques and documentation. In this study, the TOPSIS method used to produce a travel recommendation system in Semarang that is tailored to their respective preferences and priorities. The final result of this research is a travel recommendation system in Semarang City which is validated using accuracy measurement. Algorithm validation testing is done to determine the level of suitability of the resulting decision.

RESULTS AND DISCUSSION

Criteria Weighting

In the development of this decision support system, the weighting criteria and selecting alternative data is based on several key factors. These criteria included Price, with a weight of 0.3, Rating, assigned a weight of 0.2, and Google Reviews, weighted at 0.5. This deliberate allocation of weights reflects the varying importance of each criterion in the decision-making process, ensuring a comprehensive evaluation of tourist destinations in Semarang.

Table 1 Table 1

No	Criteria	Status	Weight
1	Price	Cost	0.3
2	Rating	Benefit	0.2
3	Google Reviews	Benefit	0.5

TOPSIS Method Calculation

The TOPSIS method calculation relies on the weighting assigned to predetermined criteria. into the 30 alternatives available in the dataset. This stage begins with pre-processing by filtering tourist attractions located in Semarang. Semarang. After the pre-processing is complete, the stage continues to the calculation of the result scores. The outcomes are depicted in the table presented below..

Table 2 Table 2

No	Alternative	Result Score
1	Candi Gedong Songo	0.774440
2	Grand Maerakaca	0.773546
3	Kampung Pelangi	0.623342
4	Gereja Blenduk	0.671972
5	Sam Poo Kong Temple	0.551235
6	Desa Wisata Lembah Kalipancur	0.838794
7	Taman Kasmaran	0.810834
8	Wana Wisata Penggaron	0.713447
9	Masjid Kapal Semarang	0.795069
10	Kampoeng Djadhoel Semarang	0.700858
11	Indonesia Kaya Park	0.721558
12	Taman Bunga Celosia	0.587427
13	Hutan Wisata Tinjomoyo Semarang	0.667019
14	Pura Giri Natha	0.607416
15	Danau Rawa Pening	0.651802
16	Pantai Cipta	0.828395
17	Museum Old City 3D Trick Art	0.761707
18	Lawang Sewu	0.191329
19	Taman Srigunting	0.912799
20	Waduk Jatibarang	0.630860
21	Umbul Sidomukti	0.576595
22	Obyek Wisata Goa Kreo	0.891042
23	Wisata Lereng Kelir	0.764881
24	Wisata Eling Bening	0.635228
25	Hutan Pinus Kayon	0.658878
26	Kota Lama Semarang	0.529405

No	Alternative	Result Score
27	La Kana Chapel	0.786655
28	Goa Rong	0.716929
29	Kampoeng Kopi Banaran	0.761706
30	Kampung Tematik Jawi	0.682588

Ranking Alternatives

The calculations carried out produce a ranking of alternatives shown in the diagram below.

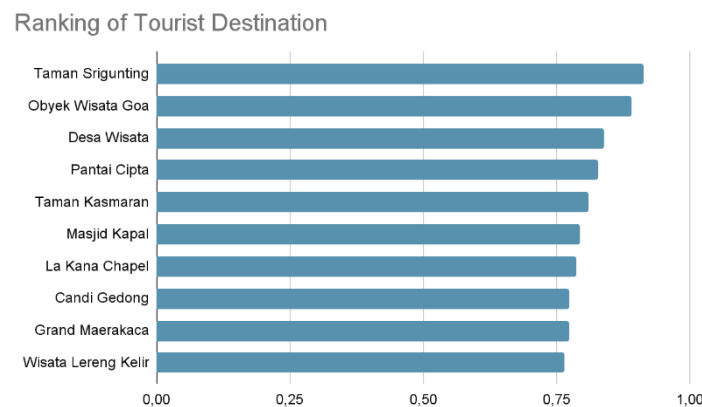


Figure 2 Alternative Ranking

In the TOPSIS calculation, Srigunting Park emerged as the top-ranked tourist destination, boasting a score of 0.91, signifying its closeness to the ideal solution. Following closely behind, Goa Kreo secured the second position with a score of 0.89, while Kalipancur Valley Tourism Village claimed the third spot with a score of 0.84. These rankings showcase the effectiveness of the TOPSIS method in evaluating and selecting the most suitable tourist destinations in Semarang, providing valuable insights for tourists and stakeholders alike.

CONCLUSION

In conclusion, the implementation of a decision support system for tourist destinations in Semarang utilizing the TOPSIS method found a good result in providing tourist destination recommendations. This decision support system for tourist destinations in Semarang used 3 criteria, such as price, rating, and Google review, and 30 tourist destinations in Semarang as the alternative data. The output of this decision support system is the ideal solution for tourist destinations that tourists will visit. Based on the criteria that have been determined, the three best solutions for tourist destinations in Semarang are Taman Srigunting (old town), Goa Kreo, and Desa Wisata Lembah Kalipancur.

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