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# APPLICATION OF THE ENTROPY–MARCOS METHOD IN A DECISION SUPPORT SYSTEM FOR SELECTING TOURIST DESTINATIONS IN SEMARANG

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**Abstract**

Tourism is an important sector that supports regional economic growth. In the Semarang area, the increasing number of tourist destinations provides many options for visitors, but it can also make it difficult for tourists to determine the most appropriate destination based on several considerations. Therefore, this study aims to develop a decision support system for selecting tourist destinations using a multi-criteria decision-making approach. The criteria used in this study include travel time, ticket price, tourist facilities, and destination rating. The data were obtained from digital tourism information and questionnaire responses from 64 respondents. The Entropy method was used to determine objective criteria weights based on data variation, while the MARCOS method was applied to rank tourist destination alternatives based on their proximity to ideal and anti-ideal solutions. The results show that Kota Lama is the most recommended tourist destination with the highest final score, followed by Lawang Sewu and Pagoda Avalokitesvara. The validation results using Spearman correlation analysis produced a coefficient value of 0.9879, indicating a very strong agreement between the ranking results generated by the Entropy–MARCOS model and tourist preference rankings. This study contributes by integrating objective weighting and ranking methods using digital tourism data to provide a structured approach for tourism decision support systems.

Keywords: Decision Support System; Entropy; MARCOS; Tourist Destination; Semarang

***Abstrak***

*Pariwisata merupakan sektor penting yang mendukung pertumbuhan ekonomi regional. Di wilayah Semarang, meningkatnya jumlah destinasi wisata memberikan banyak pilihan bagi pengunjung, namun hal ini juga dapat menyulitkan wisatawan dalam menentukan destinasi yang paling sesuai berdasarkan beberapa pertimbangan. Oleh karena itu, penelitian ini bertujuan untuk mengembangkan sistem pendukung keputusan dalam pemilihan destinasi wisata menggunakan pendekatan pengambilan keputusan multi-kriteria. Kriteria yang digunakan dalam penelitian ini meliputi waktu perjalanan, harga tiket, fasilitas wisata, dan peringkat destinasi. Data diperoleh dari informasi pariwisata digital dan tanggapan kuesioner dari 64 responden. Metode Entropy digunakan untuk menentukan bobot kriteria objektif berdasarkan variasi data, sementara metode MARCOS diterapkan untuk mengurutkan alternatif destinasi wisata berdasarkan kedekatan mereka dengan solusi ideal dan anti-ideal. Hasil menunjukkan bahwa Kota Lama adalah destinasi wisata yang paling direkomendasikan dengan skor akhir tertinggi, diikuti oleh Lawang Sewu dan Pagoda Avalokitesvara. Hasil validasi menggunakan analisis korelasi Spearman menghasilkan nilai koefisien 0.9879, menunjukkan kesepakatan yang sangat kuat antara hasil peringkat yang dihasilkan oleh model Entropy–MARCOS dan peringkat preferensi wisatawan. Studi ini berkontribusi dengan mengintegrasikan metode penimbangan dan peringkat objektif menggunakan data pariwisata digital untuk menyediakan pendekatan terstruktur bagi sistem pendukung keputusan pariwisata.*

*Kata kunci: Sistem Pendukung Keputusan; Entropy; MARCOS; Destinasi Wisata; Semarang*

## INTRODUCTION

Tourism is one of the sectors that plays an important role in supporting the regional economy. In the Semarang City and Semarang Regency areas, the tourism sector has grown rapidly with the emergence of various tourist destinations offering a variety of attractions, ranging from historical,

religious, and cultural tourism to nature tourism(Utami, Tya, and Widyasputri 2023). The diversity of these tourist destinations provides many choices for tourists, but on the other hand, it can also cause confusion in determining the most suitable tourist destination for the needs and conditions of tourists(Kerakyatan and Kota 2024).

For tourists, especially local tourists and tourists with limited visitation time, the selection of tourist destinations is not only determined by the appeal of a place, but is also influenced by practical factors(Yandi, Mahaputra, and Mahaputra 2023). These factors include travel time to the tourist location, entrance fees, and the availability of supporting facilities at the tourist location. Information related to these factors is generally obtained in an unstructured manner, such as through recommendations from friends, social media, or brief reviews on the internet(Li et al. 2022). This situation often leads to subjective decisions that may not necessarily result in the optimal choice of tourist destination.

Based on data from the Semarang City Central Statistics Agency (BPS), the number of domestic tourist visits in 2023 was recorded at more than six million visits(Sadtyaji 2022), while foreign tourist visits also showed sustainable tourism activity. The high number of visits shows that the tourism sector in the Semarang area has great potential and continues to grow(Pengelolaan et al. 2021). Therefore, the availability of accurate, objective, and easy-to-understand information is increasingly important to help tourists determine the appropriate tourist destinations(Andika and Subanu 2023).

The development of information technology provides opportunities to utilize digital data as a basis for decision making(Basid, Zuleika, and Kusumasari 2024). One platform that is widely used by tourists is Google Maps, which provides information such as estimated travel time to tourist locations, destination ratings based on visitor experiences, and general information related to tourist attractions. Although this information is often used by individual tourists, its use as a basis for structured and systematic decision making is still relatively limited.

The problem of selecting tourist destinations can be viewed as a multi-criteria decision-making problem, as it involves several criteria that need to be considered simultaneously(Pramesti and Setiawan 2024). In this study, four main criteria were used, namely travel time to the tourist location (minutes), ticket price (rupiah), tourist facilities, and rating. destinations. These four criteria were chosen because they are objective, easy to measure, and relevant to tourists' needs in determining travel destinations.

Previous studies have applied decision support systems in selecting tourist destinations, but most still use subjective weighting methods that depend on respondent assessments. This approach has the potential to produce less objective criteria weights, especially when the data varies. In addition, the use of digital data such as travel time and destination ratings from Google Maps has generally not been systematically processed as part of the multi-criteria decision-making process.

Based on these issues, this study proposes the use of the Entropy method to determine criterion weights objectively based on data variation, thereby reducing subjectivity in the weighting process(Citra, Santoso, and Sriyasa 2024)(Atim, Wibawa, and Marcos 2024). Furthermore, the MARCOS (Measurement of Alternatives and Ranking according to Compromise Solution) method is used to rank tourist destinations based on their proximity to ideal and anti-ideal solutions(Atim 2024). By combining these two methods, this study is expected to provide more objective, structured, and easy-to-understand tourist destination recommendations for tourists in the Semarang area(Sophia 2023).

However, previous studies have not fully integrated objective weighting methods with structured ranking techniques using digital tourism data. Most previous research still relies on subjective weighting methods based on expert or respondent assessments, which may introduce bias in determining the importance of criteria. In addition, the utilization of digital information such as travel time, ticket price, facilities, and destination ratings obtained from platforms like Google Maps has not been systematically incorporated into a multi-criteria decision-making framework for tourist destination selection.

Therefore, this study proposes a decision support model that integrates the Entropy method to determine objective criteria weights and the MARCOS method to rank tourist destinations based on their proximity to ideal and anti-ideal solutions. Furthermore, the results are validated using Spearman correlation analysis to ensure the consistency of the ranking results. This combination provides a more objective, structured, and data-driven approach for recommending tourist destinations in the Semarang area.

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## RESEARCH METHODS

The conceptual structure called the "research framework" organizes the steps and procedures of the research, as well as the logical sequence of the study as a whole. The research framework provides a solid foundation for designing, conducting, and interpreting research findings properly(Marcos et al. 2014). Figure 1 shows how the research framework is created.

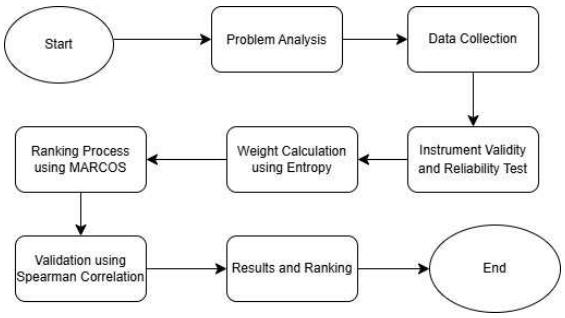


Figure 1. Research Workflow

### Problem Analysis

Selecting tourist destinations in the Semarang area is an issue that involves many criteria, such as travel time, admission prices, facilities, and destination ratings. Information about these criteria is generally obtained from various unstructured sources, so tourists often find it difficult to determine the most suitable tourist destination. In addition, each criterion has a different level of importance, so an approach is needed that can process and compare alternative tourist destinations objectively. Therefore, this research requires a decision support system that can help tourists determine tourist destinations based on several criteria in a structured and data-driven manner.

### Data Collection

This research data consists of primary and secondary data. Primary data was obtained through questionnaires distributed to 64 tourist respondents to assess the facilities available at each tourist destination. The questionnaire used a scoring scale ranging from 0 to 10 to evaluate the level of facilities at each tourist destination.

The sampling technique used in this study was purposive sampling, where respondents were selected based on specific criteria relevant to the research objectives. The criteria for respondents were tourists who had visited at least one tourist destination in Semarang City or Semarang Regency. A total of 64 respondents participated in the questionnaire survey, and their responses were used to evaluate the facility criteria for each tourist destination.

Secondary data was obtained from Google Maps to obtain information on travel time and tourist destination ratings, as well as from official tourism management sources to obtain data on admission ticket prices. In addition, data from the Central Statistics Agency (BPS) was used as supporting data to describe the state of tourism in the Semarang area.

### Instrument Validity and Reliability Test

Before the questionnaire data were used in the analysis, validity and reliability tests were conducted to ensure that the instrument measured the intended variables consistently. The validity test was carried out using the Pearson correlation method by comparing the correlation coefficient of each item with the r-table value at a significance level of 0.05. Questionnaire items were considered valid if the correlation value was greater than the r-table value.

The reliability test was conducted using Cronbach's Alpha to measure the internal consistency of the questionnaire. An instrument is considered reliable if the Cronbach's Alpha value is greater than 0.70, indicating that the questionnaire items have good reliability and can be used for further analysis.

Table 1. selected data

| No | Alternative | Travel Time (minutes) | Ticket Price (IDR) | Facilities (0–10) | Rating |
|---|---|---|---|---|---|
| 1 | Kota Lama | 10 | 0 | 8 | 4.6 |
| 2 | Lawang Sewu | 8 | 20000 | 9 | 4.7 |
| 3 | Candi Gedong Songo | 60 | 75000 | 7 | 4.5 |
| 4 | Taman Bunga Celosia | 55 | 30000 | 8 | 4.6 |
| 5 | Dusun Semilir | 50 | 30000 | 9 | 4.5 |
| 6 | Sam Poo Kong | 15 | 20000 | 8 | 4.6 |
| 7 | Goa Kreo | 35 | 10000 | 6 | 4.3 |

| | | | | | |
|---|---|---|---|---|---|
| 8 | Pagoda Avalokitesvara | 20 | 0 | 7 | 4.6 |
| 9 | Umbul Sidomukti | 55 | 25000 | 8 | 4.5 |
| 10 | Curug Lawe | 70 | 15000 | 5 | 4.4 |

The alternatives in this study represent several tourist destinations in the Semarang area that are evaluated to determine the most suitable destination for visitors(Cholil et al. 2023). Each alternative is assessed using four criteria, namely travel time (C1), ticket price (C2), facilities (C3), and rating (C4). Travel time and ticket price are categorized as cost criteria because lower values are generally preferred by tourists. Meanwhile, facilities and rating are classified as benefit criteria, where higher values indicate better conditions. These criteria are used to evaluate each alternative before the data is processed using the Entropy method to determine the weight of each criterion and the MARCOS method to obtain the final ranking of tourist destinations.

**ENTROPY Weighting Method**

The entropy weighting method allows researchers to assign weights to criteria that are objective and consistent, based on the distribution of values in the data(Hadad 2024)(Handoko 2024). This produces more measurable and data-driven results(Yusran and Priandika 2025). The steps in this method are to create a decision matrix using the following equation.

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

Next, the decision matrix is normalized using the equation:

$$k_{ij} = \frac{x_{ij}}{\max x_{ij}} \quad (2)$$

After that, the value of the criteria matrix is calculated using the equation:

$$a_{ij} = \frac{k_{ij}}{\sum_{i=1}^{m} k_{ij}} \quad (3)$$

The next step is to calculate the entropy value using the equation:

$$E_j = -\frac{1}{\ln m} \sum_{i=1}^{m} \left[ a_{ij} \cdot \ln (a_{ij}) \right] \quad (4)$$

Next, calculate the dispersion value using the equation:

$$D_j = 1 - E_j \quad (5)$$

The final step is to calculate the weight of the criteria dispersion using the equation:

$$W_j = \frac{D_j}{\sum_{j=1}^{n} D_j} \quad (6)$$

**MARCOS Method**

In decision-making processes where there are many alternatives and decisions must be made based on a set of conflicting criteria, the MARCOS method is often used(Companies 2025). This method involves measuring and evaluating alternatives against various criteria, and then ranking them to find the most suitable compromise(Demir et al. 2024). This method includes creating a decision matrix based on alternative assessment data(Thinh 2022). Next, the ideal solution and anti-ideal solution are found using the following equation.

For benefit criteria:

$$AAI = \min x_{ij}, AI = \max x_{ij} \quad (7)$$

For cost criteria:

$$AAI = \max x_{ij}, AI = \min x_{ij} \quad (8)$$

The equations for determining ideal solutions and anti-ideal solutions consist of two forms, where equation (2) is used for criteria with benefits and equation (3) is used for criteria with costs.

The next step is to normalize the matrix using the following equation.

For benefit criteria:

$$n_{ij} = \frac{x_{ij}}{x_{ai}} \quad (9)$$

For cost criteria:

$$n_{ij} = \frac{x_{ai}}{x_{ij}} \quad (10)$$

The matrix normalization equation consists of two forms, where equation (4) is used for criteria with benefit types and equation (5) is used for criteria with cost types.

The next step is to multiply the weights by the normalization results using the following equation.

$$v_{ij} = w_j \times n_{ij} \qquad (11)$$

The alternative utility value (S_i) is obtained by summing all weighted normalization matrix values using the following equation.

$$S_i = \sum_{j=1}^{n} v_{ij} \qquad (12)$$

Next, the utility value relative to the ideal and anti-ideal solutions is determined:

$$K_i^- = \frac{S_i}{S_{ai}} \qquad (13)$$

$$K_i^+ = \frac{S_i}{S_{aai}} \qquad (14)$$

The final step is to calculate the ideal utility value, anti-ideal utility, and final utility value using the following equation.

$$f(K_i^+) = \frac{K_i^+}{K_i^+ + K_i^-} \qquad (15)$$

$$f(K_i^-) = \frac{K_i^-}{K_i^+ + K_i^-} \qquad (16)$$

$$f(K_i) = \frac{1}{1 + \frac{f(K_i^-)}{f(K_i^+)}} \qquad (17)$$

The value f(K_i) is used as the basis for ranking alternatives, where the alternative with the largest value f(K_i) is the best alternative.

## RESULTS AND DISCUSSION

This section presents the results obtained from the implementation of the Entropy and MARCOS methods in determining the best tourist destinations in the Semarang area. The process begins with collecting data on tourist destinations based on several criteria, namely travel time, ticket price, facilities, and rating. The collected data are then processed using the Entropy method to determine the weight of each criterion objectively. After obtaining the criteria weights, the MARCOS method is applied to calculate the preference values and produce a ranking of tourist destinations. The results of these calculations are then analyzed to see which destinations are considered the most recommended based on the criteria used in this study.

### Weighting Using Entropy

Table 2. Normalization Results

| Alternatif | C1 | C2 | C3 | C4 |
|---|---|---|---|---|
| Kota Lama | 0.8 | 1.0 | 0.888 | 0.978 |
| Lawang Sewu | 1.0 | 0.5 | 1.0 | 1.0 |
| Candi Gedong Songo | 0.133 | 0.133 | 0.777 | 0.957 |
| Taman Bunga Celosia | 0.145 | 0.333 | 0.888 | 0.978 |
| Dusun Semilir | 0.16 | 0.333 | 1.0 | 0.957 |
| Sam Poo Kong | 0.533 | 0.5 | 0.888 | 0.978 |
| Goa Kreo | 0.228 | 1.0 | 0.666 | 0.914 |
| Pagoda Avalokitesvara | 0.4 | 1.0 | 0.777 | 0.978 |
| Umbul Sidomukti | 0.145 | 0.4 | 0.888 | 0.957 |
| Curug Lawe | 0.114 | 0.666 | 0.555 | 0.936 |

In terms of ticket price criteria, there are several tourist destinations that do not charge an entrance fee or are free. These values are still used as original data in the decision matrix. However, in the normalization stage of the MARCOS method, a ticket price of zero is considered the most favorable condition, so it is given the highest normalization value. This is done so that the calculation process continues to run smoothly and does not result in division by zero.

Next, calculate the value of the criteria matrix using equation (3)

Table 3. Nilai Matrix

| Alternatif | C1 | C2 | C3 | C4 |
|---|---|---|---|---|
| Kota Lama | 0.2186 | 0.1705 | 0.1067 | 0.1015 |
| Lawang Sewu | 0.2732 | 0.0852 | 0.12 | 0.1038 |
| Candi Gedong Songo | 0.0364 | 0.0227 | 0.0933 | 0.0993 |
| Taman Bunga Celosia | 0.0397 | 0.0568 | 0.1067 | 0.1015 |
| Dusun Semilir | 0.0437 | 0.0568 | 0.12 | 0.0993 |
| Sam Poo Kong | 0.1457 | 0.0852 | 0.1067 | 0.1015 |

| | | | | |
|---|---|---|---|---|
| Goa Kreo | 0.0624 | 0.1705 | 0.08 | 0.0949 |
| Pagoda Avalokitesvara | 0.1093 | 0.1705 | 0.0933 | 0.1015 |
| Umbul Sidomukti | 0.0397 | 0.0682 | 0.1067 | 0.0993 |
| Curug Lawe | 0.0312 | 0.1136 | 0.0667 | 0.0971 |

Next, calculate the value of the criteria matrix using equation (3)

$$E_1 = \frac{-1}{\ln(10)}[\quad -2.0047] = 0.8706$$

$$E_2 = \frac{-1}{\ln(10)}\sum_{i=1}^{10}[a_{i2}\ln(a_{i2})]$$

$$E_2 = \frac{-1}{\ln(10)}[\quad -2.1666] = 0.9410$$

$$E_3 = \frac{-1}{\ln(10)}\sum_{i=1}^{10}[a_{i3}\ln(a_{i3})]$$

$$E_3 = \frac{-1}{\ln(10)}[\quad -2.2891] = 0.9941$$

$$E_4 = \frac{-1}{\ln(10)}\sum_{i=1}^{10}[a_{i4}\ln(a_{i4})]$$

$$E_4 = \frac{-1}{\ln(10)}[\quad -2.3023] = 0.9999$$

Next, calculate the dispersion value using equation (5). The results of the dispersion value calculation are as follows.

$$D_2 = 1 - E_2 = 1 - 0.9410 = 0.0590$$
$$D_3 = 1 - E_3 = 1 - 0.9941 = 0.0059$$
$$D_4 = 1 - E_4 = 1 - 0.9999 = 0.0001$$

Next, calculate the weight value of the criteria using equation (6). The results of the weight value calculation are as follows.

Calculate the sum of dispersion:

$$\sum_{j=1}^{4} D_j = 0.1294 + 0.0590 + 0.0059 + 0.0001 = 0.1944$$

Next, the weight of each criterion:

$$W_1 = \frac{D_1}{\sum D_j} = \frac{0.1294}{0.1944} = 0.6654$$

$$W_2 = \frac{D_2}{\sum D_j} = \frac{0.0590}{0.1944} = 0.3037$$

$$W_3 = \frac{D_3}{\sum D_j} = \frac{0.0059}{0.1944} = 0.0302$$

$$W_4 = \frac{D_4}{\sum D_j} = \frac{0.0001}{0.1944} = 0.0007$$

Based on the results of the Entropy method calculation, the travel time criterion has the greatest weight compared to other criteria. This shows that the difference in travel time between destinations is significant enough to have a major impact on decision making. Meanwhile, the facilities and rating criteria have a smaller weight because their values are relatively similar at each tourist destination. This finding is consistent with tourism behavior theory which states that accessibility and travel time are important factors influencing tourist destination preferences, especially for local tourists with limited travel time.

**Ranking Using MARCOS**

The MARCOS method is a multi-criteria decision-making technique used to evaluate and rank alternatives based on several criteria, taking into account compromise solutions. This method begins by determining the best (ideal) and worst (anti-ideal) alternatives as references, and then compares the performance of each alternative against these two reference points.

Table 4. Ideal solution data and anti-ideal solution data

| Alternative | C1 Time (Cost) | C2 Price (Cost) | C3 Facilities (Benefits) | C4 Rating (Benefit) |
|---|---|---|---|---|
| AAI | 70 | 75000 | 5 | 4.3 |
| Kota Lama | 10 | 0 | 8 | 4.6 |
| Lawang Sewu | 8 | 20000 | 9 | 4.7 |
| Candi Gedong Songo | 60 | 75000 | 7 | 4.5 |
| Taman Bunga Celosia | 55 | 30000 | 8 | 4.6 |
| Dusun Semilir | 50 | 30000 | 9 | 4.5 |
| Sam Poo Kong | 15 | 20000 | 8 | 4.6 |

| | | | | |
|---|---|---|---|---|
| Goa Kreo | 35 | 10000 | 6 | 4.3 |
| Pagoda Avalokitesvara | 20 | 0 | 7 | 4.6 |
| Umbul Sidomukti | 55 | 25000 | 8 | 4.5 |
| Curug Lawe | 70 | 15000 | 5 | 4.4 |
| AI | 8 | 10000 | 9 | 4.7 |

The next step is to normalize the matrix using equations (4) and (5).

Table 5. Matrix Normalization

| Alternatif | C1 | C2 | C3 | C4 |
|---|---|---|---|---|
| AAI | 0.1143 | 0.1333 | 0.5556 | 0.9149 |
| Kota Lama | 0.8 | 1.0 | 0.8889 | 0.9787 |
| Lawang Sewu | 1.0 | 0.5 | 1.0 | 1.0 |
| Candi Gedong Songo | 0.1333 | 0.1333 | 0.7778 | 0.9574 |
| Taman Bunga Celosia | 0.1455 | 0.3333 | 0.8889 | 0.9787 |
| Dusun Semilir | 0.16 | 0.3333 | 1.0 | 0.9574 |
| Sam Poo Kong | 0.5333 | 0.5 | 0.8889 | 0.9787 |
| Goa Kreo | 0.2286 | 1.0 | 0.6667 | 0.9149 |
| Pagoda Avalokitesvara | 0.4 | 1.0 | 0.7778 | 0.9787 |
| Umbul Sidomukti | 0.1455 | 0.4 | 0.8889 | 0.9574 |
| Curug Lawe | 0.1143 | 0.6667 | 0.5556 | 0.9362 |
| AI | 1.0 | 1.0 | 1.0 | 1.0 |

The next step is to determine the utility value of the alternatives (Ki) using equations (7) and (8) obtained from (Si) using equation (6).

Table 6. Utility Value Calculation Results

| Alternatif | Nilai S_i | Nilai K_i- | Nilai K_i+ |
|---|---|---|---|
| AAI | 0,1339 | - | - |
| Kota Lama | 0,8635 | 6,4473 | 0,8635 |
| Lawang Sewu | 0,8482 | 6,3325 | 0,8482 |
| Pagoda Avalokitesvara | 0,5940 | 4,4350 | 0,5940 |
| Sam Poo Kong | 0,5343 | 3,9888 | 0,5343 |
| Goa Kreo | 0,4765 | 3,5579 | 0,4765 |
| Curug Lawe | 0,2959 | 2,2094 | 0,2959 |
| Umbul Sidomukti | 0,2458 | 1,8349 | 0,2458 |
| Dusun Semilir | 0,2386 | 1,7811 | 0,2386 |
| Taman Bunga Celosia | 0,2255 | 1,6839 | 0,2255 |
| Candi Gedong Songo | 0,1534 | 1,1450 | 0,1534 |
| AI | 1,0000 | - | - |

The final step is to calculate the final utility value using equations (9), (10), and (11). The final utility value is used as the basis for ranking alternatives.

Table 7. Final Utility Value Calculation Results

| Alternatif | Nilai f(K_i+) | Nilai f(K_i-) | Nilai f(K_i) |
|---|---|---|---|
| Kota Lama | 0,1181 | 0,8819 | 0,8501 |
| Lawang Sewu | 0,1181 | 0,8819 | 0,8349 |
| Pagoda Avalokitesvara | 0,1181 | 0,8819 | 0,5848 |
| Sam Poo Kong | 0,1181 | 0,8819 | 0,5259 |
| Goa Kreo | 0,1181 | 0,8819 | 0,4691 |
| Curug Lawe | 0,1181 | 0,8819 | 0,2913 |
| Umbul Sidomukti | 0,1181 | 0,8819 | 0,2419 |

| | | | |
|---|---|---|---|
| Dusun Semilir | 0,1181 | 0,8819 | 0,2348 |
| Taman Bunga Celosia | 0,1181 | 0,8819 | 0,2220 |
| Candi Gedong Songo | 0,1181 | 0,8819 | 0,1510 |

From the table above, the final scores for each customer were obtained using the MARCOS method. These results will be ranked using the method that has been used.

Table 8. Alternative Ranking

| Alternatif | Nilai Akhir | Ranking |
|---|---|---|
| Kota Lama | 0,8501 | 1 |
| Lawang Sewu | 0,8349 | 2 |
| Pagoda Avalokitesvara | 0,5848 | 3 |
| Sam Poo Kong | 0,5259 | 4 |
| Goa Kreo | 0,4691 | 5 |
| Curug Lawe | 0,2913 | 6 |
| Umbul Sidomukti | 0,2419 | 7 |
| Dusun Semilir | 0,2348 | 8 |
| Taman Bunga Celosia | 0,2220 | 9 |
| Candi Gedong Songo | 0,1510 | 10 |

Based on the results shown in Table 8, Kota Lama obtained the highest final score of 0.8501, followed by Lawang Sewu with a score of 0.8349. This result indicates that Kota Lama is considered the most recommended tourist destination based on the selected criteria. To provide clearer visualization of the ranking results, the distribution of final scores for each tourist destination is presented in Figure 2

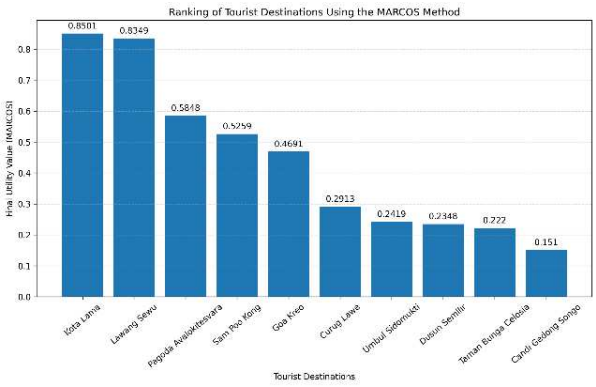


Figure 2. Visualization of Tourist Destination Ranking

The results of this study indicate that travel time has the highest weight among the evaluated criteria in determining tourist destinations. This finding is consistent with previous research that applied decision support systems in tourism selection. For example(Erlangga et al. 2023). developed a tourism recommendation system using the BWM–MARCOS method which successfully ranked tour package alternatives based on several criteria and helped tourists determine the most suitable destination. Similarly, other studies have also applied multi-criteria decision making methods such as SAW to recommend tourist destinations based on user preferences and travel factors. These findings confirm that decision support systems are effective tools for assisting tourists in selecting destinations objectively and systematically(Yota et al. 2021)(Hardianto 2025).

**System Validation Using Spearman's Correlation**

System validation was conducted to determine the level of conformity between the tourism destination rankings produced by the Entropy–MARCOS method and tourist preferences. The method used for validation was Spearman's correlation, as this method is suitable for measuring the relationship between two sets of ranked data.
At this stage, the ranking results of the MARCOS method were compared with the tourist preference ranking obtained from the questionnaire results. The Spearman correlation value was calculated using the following equation:

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

where r_s is the Spearman correlation coefficient, d_i is the difference between the MARCOS method ranking and the tourist

preference ranking for alternative i, and n is the number of alternatives.

Table 9. Result Sperman

| No | Destinasi Wisata | Ranking MARCOS | Ranking Wisatawan | d | $d^2$ |
|---|---|---|---|---|---|
| 1 | Kota Lama | 1 | 1 | 0 | 0 |
| 2 | Lawang Sewu | 2 | 2 | 0 | 0 |
| 3 | Pagoda Avalokitesvara | 3 | 4 | -1 | 1 |
| 4 | Sam Poo Kong | 4 | 3 | 1 | 1 |
| 5 | Goa Kreo | 5 | 5 | 0 | 0 |
| 6 | Curug Lawe | 6 | 6 | 0 | 0 |
| 7 | Umbul Sidomukti | 7 | 7 | 0 | 0 |
| 8 | Dusun Semilir | 8 | 8 | 0 | 0 |
| 9 | Taman Bunga Celosia | 9 | 9 | 0 | 0 |
| 10 | Candi Gedong Songo | 10 | 10 | 0 | 0 |
| | Jumlah | | | | 2 |

$$\sum d_i^2 = 2, \ n = 10$$

Calculation of Sperman's correlation coefficient

$$r_{s = 1-\frac{6(2)}{10(10^2-1}}$$

$$r_{s = 1-\frac{12}{990}}$$

$$r_{s = 1-\ 0{,}0121 = 0{,}9879}$$

Based on the calculation results, a Spearman correlation value of 0.9879 was obtained. This value is in the range of 0.80–1.00, which indicates a very strong relationship between the Entropy–MARCOS method ranking and tourist preference ranking. This shows that the decision support system developed has a high level of conformity with tourist preferences, so that the resulting recommendations can be considered valid and acceptable.

The Spearman correlation test shows a strong correlation between the ranking results and respondent preferences. However, it is important to note that the high correlation value may also be influenced by respondent bias. Since the data were collected using questionnaires, respondents might have subjective perceptions regarding travel time, cost, and facilities. Therefore, future research could involve a larger sample size and more diverse respondents to minimize potential bias and improve the robustness of the validation process.

## CONCLUSIONS AND SUGGESTIONS

### Conclusion

This study successfully developed a decision support system to help determine tourist destinations in Semarang by combining the Entropy and MARCOS methods. The Entropy method was used to determine the weight of each criterion objectively based on the variation of data obtained from respondents. The calculation results show that travel time is the most influential criterion with a weight of 0.6654. This indicates that ease and efficiency of access to tourist locations are the main considerations for tourists in Semarang, compared to ticket prices and available facilities.

Furthermore, the MARCOS method was used to rank tourist destinations based on their proximity to the ideal solution. From the results of the analysis, Kota Lama ranked first as the most recommended destination with a utility value of 0.8501, followed by Lawang Sewu with a value of 0.8349. To ensure the accuracy of the developed model, testing was carried out using Spearman's correlation. The test results showed a correlation value of 0.9879, indicating that the system's recommendations were highly consistent with the respondents' preferences.

### Suggestion

Although the results of the study show a very high level of accuracy, this study still has several limitations. One of them is the relatively limited number of respondents, namely 64 people. In addition, the use of purposive sampling techniques has the potential to cause bias because the respondents selected may have relatively similar characteristics or preferences. This could also be one of the reasons why the correlation values produced are very high.

For future research, several things can be developed to make the research results stronger and more representative. First, the number of respondents can be increased with more diverse backgrounds so that the research results can represent the preferences of tourists more broadly. Second, the assessment criteria can be added, for example by considering the availability of public transportation, parking fees, or visitor capacity at each tourist destination. In addition, the decision support system model that has been developed also has the potential to be implemented in the form of a mobile-based application so that it can provide more practical and real-time tourist destination recommendations for tourists.

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