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Recommendation System for Selection of Beach Tourist Attraction in Serdang Bedagai Applying the TOPSIS Algorithm

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Abstract

One of the regencies in North Sumatra, specifically the Serdang Bedagai Regency, has many exciting beach attractions for the public to visit. Each beach attraction offers its own excellence. In this circumstance, it could be a hesitation which to decide on, considering that there are a great number of beaches lying in the Serdang Bedagai Regency. This research uses five criteria such as facilities, security, hygiene, road access, and price. As well as the alternatives of several beach attractions such as Pondok Indah beach, Mutiara beach, Klang beach, Cermin beach, Romantic beach, Gudang Garam beach, Sri Mersing beach, Bali Lestari beach, Wong Rame beach, and Cemara Kembar beach. Therefore, a system is built to be used for the public in deciding on beach attractions by applying a recommendation system for selecting any beach attractions. According to the calculations in table 3.3 with the RPI as the reference value. The highest RPI value among beach attractions is the Bali Lestari beach with an RPI value of 1, the second is Romantic beach with an RPI value of 0.462, and Cermin beach with an RPI value of 0.462.

Keywords: *Serdang Bedagai, Beach, Decision Support System, Topsis*

1. Introduction

Beach attractions are the most popular destinations for people to visit for a vacation. One of the regencies in North Sumatra, specifically the Serdang Bedagai Regency, has many interesting beach attractions for the public to visit such as Pondok Indah beach, Mutiara Indah beach, Klang beach, mirror beach, romantic beach, salt warehouse beach, Sri Mersing beach, Bali Lestari beach, Wong Rame beach, and Cemara Kembar beach. The tourism need is constantly increasing put the Government of Serdang Bedagai Regency necessarily continues improving the development of beach attractions account the main factor for the public eager to visit the beach is the potential and enticements of the beach attractions have itself. Undoubtedly that beach attraction is one of the largest sources of regional income for the Regency, as well as one of the coast inhabitants' main incomes [1].

Thus far, the public has obtained information about beach attractions from colleagues either kin or they are just seeking information through the internet to decide on the beach attractions because each of these attractions offers its excellence. There is a lot of information on the internet, yet not everyone has spare time for it to compare [2]. This matter triggers the public to look for any adequate beach attraction according to their needs [3]. Consequently, a recommendation system for the selection of beach attraction objects is needed to regulate which beaches are the most interested in according to the public choices. The recommendation system is feasible to use by the public who aim to travel to beaches in Serdang Bedagai [4]. The criteria for regulating beach tourism objects are divided into benefit and price. Where this research uses the criteria, facilities, security, hygiene, road access, and cost. The benefit criterion is a criterion that supports a particular alternative chosen, while the cost criterion is the contrary. One of the algorithms that

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concern both types of criteria is the Technique for Orders Preference by Similarity to Ideal Solution (TOPSIS) algorithm[5].

2. Research Methodology

2.1. Decision Support System

A Decision Support System is a system that is proficient in providing problem-solving capability within structured problem conditions, semi-structured problems, and unstructured problems [6]. During the modeling in building a decision support system, steps are taken for instance feasibility studies, design, selection, and decision of building a decision support system [7].

2.2. TOPSIS

Technique for Orders Preference by Similarity to Ideal Solution (TOPSIS) is one of the algorithms in decision making, where the best-chosen alternative is not just the shortest distance from the positive ideal solution yet has the longest distance from the negative ideal solution [8]. This concept is widely used in several MADM models to solve practical decision problems. Following the TOPSIS that a kind of pretty simple and easy-to-understand algorithm, computationally efficient, and the capability of measuring the relative performance of alternative decisions in a simple mathematical form the accurate values as the outcome[9].

2.3. Attractions

A tourist attraction is a destination place that attracts the public or tourists as willing to travel to. In particular, adequate natural attractions for recreation whether mountains, lakes, rivers, seas, or beaches. The other form is building objects such as museums, palaces, etc. Hence, if a tourism object is advanced will be a potential support for one of the regional incomes[10].

3. Result and Discussion

In this section, the decision support system for selecting beach attractions adopts the TOPSIS algorithm is the main topic. For the completion of this research using 10 alternative beach attractions with 5 criteria. The author obtained the value of each criterion by distributing questionnaires to the public or tourists. Furthermore, the author defines completing this research using the TOPSIS method, which has 6 stages in the process.

Tabel 1. Alternative Table of Questionnaire Results

No	Alternative	Facilities	Security	Hygenie	Road Access	Cost
1	Pondok Permai Beach	6	6	6	6	6
2	Mutiara Indah Beach	6	6	6	6	6
3	Klang Beach	6	6	6	6	6
4	Cermin Beach	8	6	6	6	6
5	Romantis Beach	8	6	6	6	6
6	Gudang Garam Beach	6	6	6	6	6
7	Sri Mersing Beach	6	6	6	6	6
8	Bali Lestari Beach	8	8	8	6	6
9	Wong Rame Beach	6	6	6	6	6
10	Cemara Kembar Beach	6	6	6	6	6

a) From the table above, a matrix is built, as follows :

$$X = \begin{bmatrix} 6 & 6 & 6 & 6 & 6 \\ 6 & 6 & 6 & 6 & 6 \\ 6 & 6 & 6 & 6 & 6 \\ 8 & 6 & 6 & 6 & 6 \\ 8 & 6 & 6 & 6 & 6 \\ 6 & 6 & 6 & 6 & 6 \\ 6 & 6 & 6 & 6 & 6 \\ 8 & 8 & 8 & 6 & 6 \\ 6 & 6 & 6 & 6 & 6 \\ 6 & 6 & 6 & 6 & 6 \end{bmatrix}$$

b) Then the Normalization of original criteria comparison matrix:

$$r_{11} = \frac{x_{11}}{\sum_{i=1}^{10} x_{ij}^2} = \frac{6}{\sqrt{6^2+6^2+6^2+8^2+8^2+6^2+6^2+8^2+6^2+6^2}} = \frac{6}{\sqrt{36+36+36+64+64+36+36+64+36+36}} = 0{,}28$$

$$r_{12} = \frac{x_{12}}{\sum_{i=1}^{10} x_{ij}^2} = \frac{6}{\sqrt{6^2+6^2+6^2+6^2+6^2+6^2+6^2+8^2+6^2+6^2}} = \frac{6}{\sqrt{36+36+36+36+36+36+36+64+36+36}} = 0{,}30$$

$$r_{13} = \frac{x_{13}}{\sum_{i=1}^{10} x_{ij}^2} = \frac{6}{\sqrt{6^2+6^2+6^2+6^2+6^2+6^2+6^2+8^2+6^2+6^2}} = \frac{6}{\sqrt{36+36+36+36+36+36+36+64+36+36}} = 0{,}30$$

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$$r_{104} = \frac{x_{104}}{\sum_{i=1}^{10} x_{ij}^2} = \frac{6}{\sqrt{6^2+6^2+6^2+6^2+6^2+6^2+6^2+6^2+6^2+6^2}} = \frac{6}{\sqrt{36+36+36+36+36+36+36+36+36+36}} = 0{,}31$$

$$r_{105} = \frac{x_{105}}{\sum_{i=1}^{10} x_{ij}^2} = \frac{6}{\sqrt{6^2+6^2+6^2+6^2+6^2+6^2+6^2+6^2+6^2+6^2}} = \frac{6}{\sqrt{36+36+36+36+36+36+36+36+36+36}} = 0{,}31$$

In addition the r_{ij} matrix is obtained as follows:

$$X = \begin{bmatrix} 0{,}28 & 0{,}30 & 0{,}30 & 0{,}31 & 0{,}31 \\ 0{,}28 & 0{,}30 & 0{,}30 & 0{,}31 & 0{,}31 \\ 0{,}28 & 0{,}30 & 0{,}30 & 0{,}31 & 0{,}31 \\ 0{,}37 & 0{,}30 & 0{,}30 & 0{,}31 & 0{,}31 \\ 0{,}37 & 0{,}30 & 0{,}30 & 0{,}31 & 0{,}31 \\ 0{,}28 & 0{,}30 & 0{,}30 & 0{,}31 & 0{,}31 \\ 0{,}28 & 0{,}30 & 0{,}30 & 0{,}31 & 0{,}31 \\ 0{,}37 & 0{,}40 & 0{,}40 & 0{,}31 & 0{,}31 \\ 0{,}28 & 0{,}30 & 0{,}30 & 0{,}31 & 0{,}31 \\ 0{,}28 & 0{,}30 & 0{,}30 & 0{,}31 & 0{,}31 \end{bmatrix}$$

c) Building a weighted normalized matrix:

The weight value of each criterion is determined on a scale of 1 to 100 based on the priority of each criterion.

Tabel 2. Table of Weight Values

No	Criterion	Weight Value (w)
1	Facility	25
2	Security	20
3	Hygenie	20
4	Road Access	20
5	Cost	15

The following equation is used to get the the y_{ij} element from the r_{ij} element given below:

$$y_{ij} = w_i \, r_{ij} \qquad (1)$$

$$y_{ij} = \begin{bmatrix} 0{,}07 & 0{,}06 & 0{,}06 & 0{,}06 & 0{,}04 \\ 0{,}07 & 0{,}06 & 0{,}06 & 0{,}06 & 0{,}04 \\ 0{,}07 & 0{,}06 & 0{,}06 & 0{,}06 & 0{,}04 \\ 0{,}09 & 0{,}06 & 0{,}06 & 0{,}06 & 0{,}04 \\ 0{,}09 & 0{,}06 & 0{,}06 & 0{,}06 & 0{,}04 \\ 0{,}07 & 0{,}06 & 0{,}06 & 0{,}06 & 0{,}04 \\ 0{,}07 & 0{,}06 & 0{,}06 & 0{,}06 & 0{,}04 \\ 0{,}09 & 0{,}08 & 0{,}08 & 0{,}06 & 0{,}04 \\ 0{,}07 & 0{,}06 & 0{,}06 & 0{,}06 & 0{,}04 \\ 0{,}07 & 0{,}06 & 0{,}06 & 0{,}06 & 0{,}04 \end{bmatrix}$$

d) Determination of positive ideal solution (v^+) and negative ideal solution (v^-):

To calculate the positive ideal solution v^+ and the negative ideal solution v^- for each criterion, with the following equation:

$v^+ = (max(y_{i1}), \max(y_{i2}), \dots, \max(y_{in})) = (v_1^+, v_2^+, \dots, v_n^+)$ (2)

$v^- = (min(y_{i1}), \min(y_{i2}), \dots, \min(y_{in})) = (v_1^-, v_2^-, \dots, v_n^-)$ (3)

$v^+ = (0{,}09\ ; 0{,}08\ ;\ 0{,}08\ ;\ 0{,}06\ ; 0{,}04)$

$v^- = (0{,}07\ ;\ 0{,}06\ ;\ 0{,}06\ ; 0{,}06\ ; 0{,}04)$

e) Calculation of the distance on each criterion between the positive ideal solution v^+ and the negative ideal solution v^-

For the 1st attraction:

$$d^+ = \sqrt{(0{,}09-0{,}07)^2 + (0{,}08-0{,}06)^2 + (0{,}08-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}04-0{,}04)^2}$$
$$= \sqrt{0{,}0004 + 0{,}0004 + 0{,}0004 + 0 + 0} = 0{,}037$$
$$d^- = \sqrt{(0{,}07-0{,}07)^2 + (0{,}06-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}04-0{,}04)^2}$$
$$= \sqrt{0} = 0$$

For the 2nd attraction:

$$d^+ = \sqrt{(0{,}09-0{,}07)^2 + (0{,}08-0{,}06)^2 + (0{,}08-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}04-0{,}04)^2}$$
$$= \sqrt{0{,}0004 + 0{,}0004 + 0{,}0004 + 0 + 0} = 0{,}037$$
$$d^- = \sqrt{(0{,}07-0{,}07)^2 + (0{,}06-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}04-0{,}04)^2}$$
$$= \sqrt{0} = 0$$

For the 3rd attraction:

$$d^+ = \sqrt{(0{,}09-0{,}07)^2 + (0{,}08-0{,}06)^2 + (0{,}08-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}04-0{,}04)^2}$$
$$= \sqrt{0{,}0004 + 0{,}0004 + 0{,}0004 + 0 + 0} = 0{,}037$$
$$d^- = \sqrt{(0{,}07-0{,}07)^2 + (0{,}06-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}04-0{,}04)^2}$$
$$= \sqrt{0} = 0$$

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For the 9th attraction:

$$d^+ = \sqrt{(0{,}09-0{,}07)^2 + (0{,}08-0{,}06)^2 + (0{,}08-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}04-0{,}04)^2}$$
$$= \sqrt{0{,}0004 + 0{,}0004 + 0{,}0004 + 0 + 0} = 0{,}037$$
$$d^- = \sqrt{(0{,}07-0{,}07)^2 + (0{,}06-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}06-0{,}06)^2 + (0{,}04-0{,}04)^2}$$
$$= \sqrt{0} = 0$$

For the 10th attraction:

$$d^+ = \sqrt{(0{,}09-0{,}07)^2+(0{,}08-0{,}06)^2+(0{,}08-0{,}06)^2+(0{,}06-0{,}06)^2+(0{,}04-0{,}04)^2}$$
$$= \sqrt{0{,}0004+0{,}0004+0{,}0004+0+0} = 0{,}037$$
$$d^- = \sqrt{(0{,}07-0{,}07)^2+(0{,}06-0{,}06)^2+(0{,}06-0{,}06)^2+(0{,}06-0{,}06)^2+(0{,}04-0{,}04)^2}$$
$$= \sqrt{0} = 0$$

f) Calculation of the relative Risk Priority Index (RPI) of the ideal solution:
A larger RPI value indicates that the alternative is preferred.

For the 1st attraction:

$$RPI = \frac{0}{0,037+0} = 0$$

For the 2nd attraction:

$$RPI = \frac{0}{0,037+0} = 0$$

For the 3rd attraction:

$$RPI = \frac{0}{0,037+0} = 0$$

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For the 9th attraction:

$$RPI = \frac{0}{0,037+0} = 0$$

For the 10th attraction:

$$RPI = \frac{0}{0,037+0} = 0$$

Tabel 3. Final Result

No	Beach Attractions	d^+	d^-	RPI
1	Bali Lestari Beach	0	0,037	1
2	Romantis Beach	0,028	0,024	0,462
3	Cermin Beach	0,028	0,024	0,462
4	Klang Beach	0,037	0	0
5	Mutiara Indah Beach	0,037	0	0
6	Gudang Garam Beach	0,037	0	0
7	Sri Mersing Beach	0,037	0	0
8	Pondok Permai Beach	0,037	0	0
9	Wong Rame Beach	0,037	0	0
10	Cemara Kembar Beach	0,037	0	0

According to the calculation above with the RPI as the reference value. The highest RPI value among the beach attractions is Bali Lestari Beach as the highest one with an RPI value of 1.

4. Conclusion

Based on the research that has been done, the conclusion drawn is that the system is capable on determining recommendations for coastal tourism objects using the TOPSIS

method based on the questionnaire distributed to 50 community respondents. This research is capable to get for the public or tourists easier ton deciding and choosing any beach attractions according to their needs.

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