International Journal of Applied Research and Sustainable Sciences (IJARSS)
Vol. 4 No. 4 , 2026: 357 - 366

A Decision Support Framework for Smart Tourism Recommendation Using Simple Additive Weighting: Insights from Biak Island

Elvis Pawan[1]*
Department of Information Systems, Faculty of Mathematics and Natural Sciences, Cenderawasih University
Corresponding Author: Elvis Pawan elvispawan09@gmail.com

A R T I C L E I N F O

Keywords: SAW, Biak, Tourist; Black-box, DSS

Received : 02 January
Revised : 25 March
Accepted: 25 April

A B S T R A C T

This research discusses the application of the Simple Additive Weighting (SAW) method in selecting the best tourist attractions in Biak Regency. The SAW method is used to rank tourist attractions based on a set of predetermined criteria, with the aim of providing recommendations for the best tourist destinations for visitors to Biak. Data on various tourist attractions and relevant criteria were collected and analyzed using the Simple Additive Weigthing method. The research results show that the Simple Additive Weigthing method is effective in helping tourists optimally choose tourist attractions in Biak. Based on blackbox testing, the developed system shows an accuracy level of 100%, making it suitable for implementation in supporting tourist decision-making.

DOI: https://doi.org/10.59890/ijarss.v4i4.240
E – ISSN : 3026-0205
https://jpnmultitechpublisher.my.id/index.php/ijarss/index

INTRODUCTION

Currently, tourism can be considered an important component of the continuously growing major industry, making this sector the second source of income in the region. The presence of tourist attractions that can alleviate fatigue from various activities encourages both local and foreign tourists (Marlina & Hidayati, 2023). One of the important parts of a region's economy is tourism. The city of Jayapura, with its extraordinary natural and cultural potential, has many natural tourist attractions that attract both local and foreign tourists. Nature tourism is a type of recreation and tourism that utilizes natural potential to enjoy its beauty, whether still in its natural state or cultivated to attract tourists (Samsudin Arifin Dabamona, 2023). The utilisation of information systems in the decision-making process has become crucial in the age of digital and quickly developing information technology. However, the problem for tourists is choosing which tourist attractions they will visit. Because of incomplete information about tourist attractions, travelers often become confused and rely on personal judgment, which can lead to poor decisions. Due to confusion or the time needed to select a tourist destination, this also raises the possibility that visitors will change their minds or even decide not to participate in tourist activities. A series of regulations and laws govern the selection of tourist destinations in Jayapura, as in the rest of Indonesia (Ekaristi et al., 2023). The aim of these regulations is to advance the tourism industry (Ekaristi et al., 2023). Thus, a system that uses the Simple Additive Weighting (SAW) method to assist visitors in selecting Jayapura tourism destinations that suit their tastes must be developed. A good decision support system can help tourists select tourist spots that align with their preferences and enhance their holiday experience. The Tourism Law (Number 10 of 2009) is one of the legal foundations that need to be considered because it regulates the main aspects of Indonesian tourism, such as tourist development, management, and promotion with the goal of raising the calibre of tourism services. In addition, Government Regulation of the Republic of Indonesia Number 50 of 2011 on Tourism provides further regulations on the development of Indonesian tourism, including how to manage tourist sites. Furthermore, the Regional Regulation (Perda) of Jayapura City serves as an important legal basis because it can regulate how tourist sites in Jayapura City are managed.

LITERATURE REVIEW

In order to accurately distribute the funds to those in need, the first study, "Implementation of the Simple Additive Weighting (SAW) method in selecting social fund recipients for poor families," seeks to offer a more effective and efficient method for choosing social fund recipients. (Vaneza et al., 2021).

The second study, "Decision support system in selecting student housing (boarding) using the simple additive weighting (SAW) method," aims to provide an understanding of the SAW method in the context of selecting housing and to develop a system that can assist students in choosing housing according to their needs and preferences (Adriantama & Brianorman, 2021). The objective of the third study, "Application of the Simple Additive Weighting method in a decision support system for selecting the best employees," is to utilize technology and the

SAW calculation method to create a system that helps companies make better decisions regarding the selection of the best employes, focusing on employe performance and dedication. The main objective of this research is to provide rankings that can be used as a guide in selecting the fifth research objective, "Decision support system for selecting tourist attraction locations in Central Aceh using the TOPSIS method," which aims to develop and implement a decision support system that assists tourists in choosing tourist attraction locations in Central Aceh. In this case, the TOPSIS method—technique for order preference by similarity to ideal solution—is used to build this system. The seventh research objective, "Decision support system for selecting natural tourist attractions in the Special Region of Yogyakarta using the Tsukamoto fuzzy method," is to create a system that can help tourists choose natural tourist attractions in the Special Region of Yogyakarta more easily and efficiently. Additionally, this research uses the Tsukamoto fuzzy method to make recommendations based on the criteria they set (OR Putri, 2021). The eighth research objective, "Decision support system for selecting the best tourist attractions in Sragen Regency using the weighted product method," is to create a decision support system for selecting the best tourist attractions in Sragen Regency. This research uses the weighted product method as a basis to rank tourist attractions based on important factors such as location, facilities, cost, and safety (Muqorobin & Ma'ruf, 2022). With the existence of this application, the research aims to assist the tourism office in making decisions about which tourist attractions are most suitable.

METHODOLOGY

A. Metode Simple Additive Weigthing (SAW)

One technique for resolving an issue in a decision support system is Simple Additive Weighting (SAW), which can identify the optimal option among several available options. (Kaliszewski & Podkopaev, 2016; Pawan et al., 2020; Setiawati et al., 2021), where the alternatives referred to here are tourist attractions in the city of Jayapura. Next, you can use the formula as shown in equation 1 to calculate the normalized performance.

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$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{Max\ x_{ij}} \ If\ the\ benefit\ attribute\ is\ j \\ \dfrac{\min x_{ij}}{x_{ij}} \ If\ the\ cost\ it\ attribute\ is\ j \end{cases}$$

Explanation: rij : normalized performance rating value xij = : attribute value for each criterion max xij : highest value for each criterion min xij : lowest value for each criterion

Using the same formula as in equation 2, calculate the preference weight value for each option..

$$v_i = \sum_{j=1}^{n} w_j r_{ij} \quad (2)$$

Explanation: Vi: each criterion's preference value Wj is the weight assigned to each criterion, and rij is the normalised performance rating.

Testing Techniques

The black box method for testing software functionality involves examining the execution results thru the data processed on the designed software (Raffin et al., 2022; Uminingsih et al., 2022). Table 1 shows the results of the black box testing.

Table 1. Test Scenario

No	Test Scenario	Expected result	Remarks
1	Filling in the correct username and password	The dashboard menu is accessed thru the application.	True
2	Add Alternative	The database contains additional options that can be accessed thru the system..	True
3	Create, Read, Update, and Delete functions	adding, viewing, modifying, and deleting data as desired by the user	True
4	Print travel recommendation results	The application displays and prints the ranking results according to the criteria and weights entered.	true

RESEARCH RESULT

To select the best tourist destination, the Simple Additive Weighting (SAW) method uses a sample of tourist spots as alternatives. The purpose of this method is to select one from many tourist attractions or options to visit based on previously established criteria.

1. Criteria

The criteria used can be seen in Table 2

Table 2. Criteria

Criteria code	criteria	weight	remarks
C1	Visit Cost (A1)	20%	Cost
C2	Distance to Tourist Attraction (km) (A2)	15%	Cost
C3	Cleanliness (A3)	25%	Benefit
C4	Safety (A4)	20%	Benefit
C5	Popularity (A5)a	20%	Benefit

In Table 2, there is a list of criteria used as a reference in selecting the best alternatives or tourist attractions.

2. Alternative

To choose a tourist destination, use various options as shown in Table 3.

Table 3. List of tourist attractions in Biak Regency

No	Alternative Code	Alternative Name
1	A01	Bosnik Beach
2	A02	Wari Beach
3	A03	Tanjung Barari Beach
4	A04	Batu Picah Beach
5	A05	Mokmer Beach
6	A06	Owi Island & Wundi Island
7	A07	Padaido Island
8	A08	Jepan Cave
9	A09	Lake Samares
10	A10	Wafsarak waterfall
11	A11	Karmon waterfall
12	A12	Biak Bird Park & Orchid Garden
13	A13	World War II Monument
14	A14	Pepera Monument
15	A15	Five Chamber Cave
16	A16	Padwa Old Tomb
17	A17	Mandow Park
18	A18	Bosnik Market
19	A19	Yadibur Beach

Table 3 shows a list of tourist attractions or alternative options used as samples for the decision support system. To make the calculations easier, each alternative is assigned a code. For example, code A01 is given to the Bosnik Beach Alternative.

3. Decision Matrix

In Table 4, the decision matrix represents the values of each alternative for each predetermined criterion.

Table 4. Decision Matrix Table

Alternative	**Criteria 1**	**Criteria 2**	**Criteria 3**	**Criteria 4**	**Criteria 4**
A01	30.000	14	4	3	4
A02	65.000	46	3	4	5
A03	45.000	43	5	4	5
A44	75.000	52	3	5	5
A05	7.000	4	2	2	3

Remarks :
Alt = Alternative
C= Criteria

4. Normalization

Values successfully gathered from each alternative and its criteria mark the start of normalization. The normalization matrix is calculated in the following way: Calculation of C1 from A01 to A05, with C4 having a maximum value of 750000 as C1 is a cost.

$$A01 \quad \frac{\min\{30.000,65.000,45.000,75.000,7000\}}{30000} = \frac{7000}{30000} = 0{,}23$$

$$A02 \quad \frac{\min\{30.000,65.000,45.000,75.000,7000\}}{65000} = \frac{7000}{650000} = 0{,}10$$

$$A03 \quad \frac{\min\{30.000,65.000,45.000,75.000,7000\}}{45000} = \frac{7000}{45000} = 0{,}15$$

$$A04 \quad \frac{\min\{30.000,65.000,45.000,75.000,7000\}}{75000} = \frac{7000}{75000} = 0{,}09$$

$$A05 \quad \frac{\min\{30.000,65.000,45.000,75.000,7000\}}{7000} = \frac{7000}{7000} = 1$$

Calculating C2 based on A01 – A05, with C2 having a Maximum Value of 52 since it is a cost so:

$$A01 \quad \frac{\min[14,46,43,52,4]}{14} = \frac{4}{14} = 0{,}28$$

$$A02 \quad \frac{\min[14,46,43,52,4]}{46} = \frac{4}{46} = 0{,}08$$

$$A03 \quad \frac{\min[14,46,43,52,4]}{43} = \frac{4}{43} = 0{,}09$$

$$A04 \quad \frac{\min[14,46,43,52,4]}{52} = \frac{4}{52} = 0{,}07$$

$$A05 \quad \frac{\min[14,46,43,52,4]}{4} = \frac{4}{4} = 1$$

C3 is calculated from A01 – A05, with its Maximum Value set at 5, as C3 represents a benefit. Therefore:

$$A01 \quad \frac{5}{\max[4,3,5,3,2\}} = \frac{4}{5} = 0{,}8$$

$$A02 \quad \frac{5}{\max[4,3,5,3,2\}} = \frac{3}{5} = 0{,}6$$

$$A03 \quad \frac{5}{\max[4,3,5,3,2\}} = \frac{5}{5} = 1$$

$$A04 \quad \frac{5}{\max[4,3,5,3,2\}} = \frac{3}{5} = 0{,}6$$

$$A05 \quad \frac{5}{\max[4,3,5,3,2\}} = \frac{2}{5} = 0{,}4$$

The calculation of C4 based on A01 to A05 has a maximum limit of 5 for C4, as C1 is considered a benefit. Therefore:

$$A01\ \frac{3}{\max[3,4,4,5,2\}} = \frac{3}{5} = 0{,}6$$

$$A02\ \frac{4}{\max[3,4,4,5,2\}} = \frac{4}{5} = 0{,}8$$

$$A03\ \frac{4}{\max[3,4,4,5,2\}} = \frac{4}{5} = 0{,}8$$

$$A04\ \frac{5}{\max[3,4,4,5,2\}} = \frac{5}{5} = 1$$

$$A05\ \frac{2}{\max[3,4,4,5,2\}} = \frac{2}{5} = 0{,}4$$

C5 is calculated from A01 to A05, with its Maximum Value being 5, as C5 represents a benefit. Therefore:

$$A01\ \frac{4}{\max[4,5,5,5,3]} = \frac{4}{5} = 0{,}8$$

$$A02\ \frac{5}{\max[4,5,5,5,3]} = \frac{5}{5} = 1$$

$$A03\ \frac{5}{\max[4,5,5,5,3]} = \frac{5}{5} = 1$$

$$A04\ \frac{5}{\max[4,5,5,5,3]} = \frac{5}{5} = 1$$

$$A05\ \frac{3}{\max[4,5,5,5,3]} = \frac{3}{5} = 0{,}6$$

After that, the normalization results are converted into a normalization matrix, preference values are assigned, and in the final step, the weights for each criterion are multiplied.

$$R = \begin{bmatrix} 0{,}23 & 0.28 & 0.8 & 0.6 & 0.8 \\ 0{,}10 & 0{,}08 & 0{,}6 & 0.8 & 1 \\ 0{,}15 & 0.09 & 1 & 0.8 & 1 \\ 0.09 & 0.07 & 0{,}6 & 1 & 1 \\ 1 & 1 & 0.4 & 0.4 & 0{,}6 \end{bmatrix}$$

Nilai bobot W = {20,15,25,20,20}

A1 = (0,23x20)+(0,28x15)+(0,8x25)+(0,6x20)+(0,8x20) = 56,8
A2 = (0.10x20)+(0,08x15)+(0,6x25)+(0,8x20)+(1x20) = 54,2
A3 = (0,15x20)+(0,09x15)+(1x25)+(0,8x20)+(0,33x20) = 51,95
A3 = (0,09x25)+(0,07x15)+(0,6x25)+(1x20)+(1x20) = 58,3
A3 = (1x20)+(1x15)+(0,4x25)+(0,4x20)+(0,6x20) = 65

5. User Interface
   a. Login form

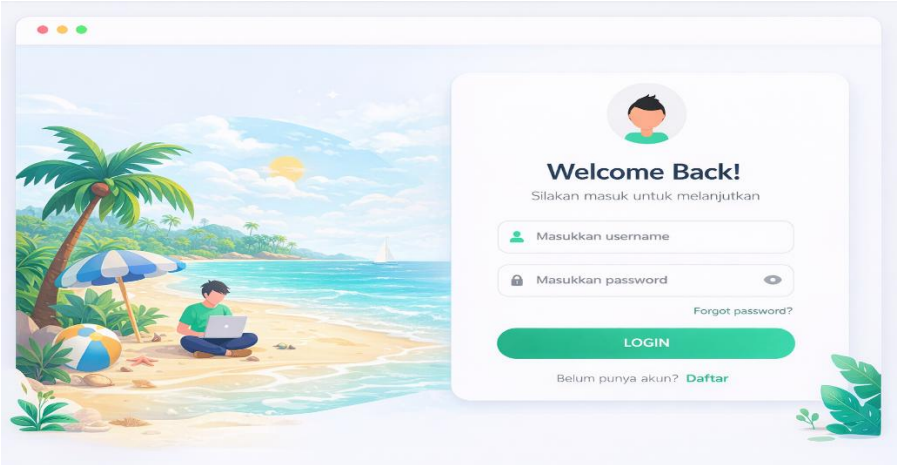

Figure 1. Login Form

Based on Figure 1, it is the login form used to access the application. In the login form, system users are required to use a password and username.

   b. Criteria form

Figure 2. Criteria Form

Based on Figure 2, it is a form to display the criteria data used in the application, there are 5 criteria with two types of attributes, namely cost and benefit.

   c. data Alternative form

Figure 3. Alternative form

Based on image 3, it is an alternative data used in the application, which includes the name of the tourist attraction, code, and the functions create, read, update, and delete.

CONCLUSIONS AND RECOMMENDATIONS

According to this study, the SAW approach is perfect for the Biak Regency's decision support system for choosing tourism attractions. This is due to the fact that SAW's findings and suggestions are presented as rankings, which facilitate the process of choosing options. The system has 100% accuracy and appropriateness, according to the blackbox method functionality test findings. Lastly, the user acceptability testing (UAT) findings show that the system is usable. The goal of this research is to improve the usability of the Android-based system. The SAW approach can also be used in conjunction with AHP and TOPSIS to increase the accuracy of suggestions.

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