Application of the Simple Additive Weighting Algorithm to Identify Boarding House Locations Surrounding the UNPAB Campus

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Abstract

This research aims to implement the Simple Additive Weighting (SAW) algorithm in determining the choice of boarding houses around the campus of Universitas Pembangunan Panca Budi (UNPAB). The problem faced by students is the difficulty in choosing a boarding house that meets their personal needs and preferences, such as distance from campus, rental price, facilities, and security. The SAW algorithm was chosen because of its ability to process various conflicting criteria and produce optimal decisions. In this study, several criteria used include rental price, distance, facilities, and security level. The SAW method works by assigning weights to each relevant criterion, then calculating the preference value for each boarding house based on the weighted sum of the scores for each boarding house alternative. The results of this study show that the SAW algorithm is capable of providing the most suitable boarding house recommendations according to student priorities based on the predetermined criteria. Thus, the implementation of the SAW algorithm can serve as an effective tool for students in choosing boarding houses around the UNPAB campus in an objective and structured manner.

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Keywords: Simple Additive Weighting, Boarding House, Selection of Boarding House, Unpab Development University, SAW algorithm

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Introduction

The development of several boarding houses in the city of Medan is very rapid. With the presence of various specific activities needed by potential boarding house users, many boarding houses have emerged, striving to improve their quality to attract as many consumers as possible. From the perspective of service quality and quantity, a hotel must be able to understand the needs of the consumers who will be staying. Apart from the boarding house, the guests who stay also have different needs and characteristics of purpose. The purpose of this research is to evaluate the existing conditions of boarding houses in this area, which will then serve as a basis for formulating recommendations for a comfortable boarding house design for residents [1]. This research aims to enrich information on determining accommodation and stay service rates in boarding house businesses using activity-based costing, which can serve as a standard in setting stay service rates at Wessabe Block C 55 boarding house and can be compared with the accommodation and stay rates currently set, as well as provide input that offers information on activity-based costing, especially if applied to boarding house service businesses [2].

Characteristics of the goals of prospective boarding house customers. Nowadays, prospective customers of boarding houses tend to seek experiences from previous guests because potential guests find it difficult to conduct surveys directly from one boarding house to another, and sometimes it does not meet their expectations. Usually, prospective customers of boarding houses look for criteria beyond price by seeking information from general acquaintances such as friends and family to find out about the experiences of people who have stayed at those boarding houses. Customers have a significant role and have the potential to positively influence the company. Customers must therefore be given preference by ensuring that their expectations are met [3].

Several reasons customers come and stay include friendly service, comfortable facilities, strategic location, and so on. For example, among the factors of service, comfort of facilities, and location, guests who will stay prioritise the comfort of facilities over the other factors. With the existing issues, a system was created to provide decisions to prospective boarding house customers in choosing a boarding house according to the most important priorities so that prospective boarding house customers do not feel disappointed with the boarding house they will stay in. An interactive computer-based system that helps decision-makers use data and various models to solve problems is called a Decision Support System (DSS). The methods possessed by DSS include the SMART method, fuzzy, Promethee (preference ranking), AHP, SAW (Simple Additive Weighting), and WP (Weight Product).

Research conducted by Rizal Rachman Simple Additive Weighting (SAW) is an appropriate strategy for evaluating employee performance. The study's findings indicate that the employee assessment is more accurate than the manual and facilitates the department head's reporting of employee performance outcomes. As a result, all employees—operational, staff, and policy-making—may develop a stronger work ethic during the performance evaluation process. The solution provided is to build an application for determining the best employees using the Simple Additive Weighting (SAW) method. [4] [5]. This research aims to assist store owners in making decisions regarding the location of branch stores. The method applied in this research is the SAW (Simple Additive Weighting) method [6].

Choosing a place to live or rent is one of the important decisions faced by students, especially for those from out of town who need accommodation close to campus. In big cities, including around the campus of Universitas Pembangunan Panca Budi (UNPAB), there are various options for boarding houses with different facilities, prices, and distances. The decision in choosing a boarding house is not only based on affordable prices but is also influenced by other factors such as the facilities provided, security, comfort, and distance from the campus. In many cases, students often struggle to make optimal decisions due to the numerous alternative options and various criteria that need to be considered.

In this context, an approach based on rational and objective decision-making becomes

important. One of the methods that can be used to help students choose a boarding house is the Simple Additive Weighting (SAW) algorithm. SAW is a decision-making method that can be used to select the best alternative by assigning weights to each existing criterion, then calculating the score of each alternative based on those weights. This method allows for a more structured and efficient decision-making process, as it can integrate various criteria and produce recommendations that align with user priorities. This research uses the SAW (Simple Additive Weighting) method, often also known as the weighted sum method. The basic concept of the SAW method is to find the weighted sum of performance ratings for each alternative across all attributes [7]. Decision support systems can assist decision-makers in obtaining recommendations for the best employees using the SAW (Simple Additive Weighting) method [8].

The utilisation of the SAW algorithm in the context of selecting boarding houses around the UNPAB campus is highly relevant considering the high demand from students to find optimal boarding houses with various considerations. By implementing the SAW algorithm, it is expected that a more efficient solution can be found to help students choose boarding houses that meet their needs and preferences. In addition, this research also aims to develop a technology-based application that can facilitate students in searching for and selecting the right boarding house around the UNPAB campus.

Literature Review

2.1 Basic Concepts of Systems

Decision Support System is a computer-based system that assists in the decision-making process through the use of data and decision models to solve semi-structured and unstructured problems. DSS, as an adaptive, interactive, and flexible computer-based information system, is specifically developed to support solutions to unstructured management problems to improve the quality of decision-making [9].

2.2 Definition of Decision Support System

According to experts Burch and Strater (Daihani, 2001), a decision support system is a specific information system designed to assist management in making decisions related to semi-structured and unstructured problems. According to [10], a decision support system means a system intended to support managerial decision-makers in semi-structured decision situations. The decision support system is intended to be a tool for decision-makers to expand their capabilities, but not to replace their judgement. Decision Support Systems differ from other information systems. There are several characteristics that distinguish it [10].

Decision support systems provide support for decision-makers in semi-structured and unstructured situations by integrating human judgement and computerised information. Decision Support System (DSS) is a system that provides problem-solving capabilities as well as communication abilities for problems with semi-structured and unstructured conditions. This system is used to assist in decision-making in semi-structured and unstructured situations, where no one knows exactly how the decision should be made [10].

Stages of DSS:

1. Problem definition
2. Collection of relevant data or information elements
3. Processing data into information in the form of graphical or written reports
4. Determining alternative solutions (which can be in percentages)

The purpose of DSS:

1. To help solve semi-structured problems
2. To support managers in making decisions on a problem
3. To improve the effectiveness, not the efficiency, of decision-making

Decision support systems are group-based systems used by managers or groups of managers at every level of the organization to make decisions in solving semi-structured problems [11].

2.3 Simple Additive Weighting (SAW)

The SAW method (Simple Additive Weighting) is often also known as the weighted sum method. The basic concept of the SAW method is to find the weighted sum of performance ratings for each alternative across all attributes. The SAW method requires the normalisation of the decision matrix (X) to a scale that can be compared with all existing alternative ratings [12].

The SAW method (Simple Additive Weighting) recognises two attributes, namely benefit criteria and cost criteria. The fundamental difference between these two criteria lies in the selection of criteria when making decisions. As for the steps to resolve using:

1. Determine Alternatives (Ai).
2. Determine the criteria that will be used as a reference in decision-making, namely Cj.
3. Provide a rating score for the suitability of each alternative on each criterion.
4. Determine the preference weight or level of importance (W) for each criterion.

$$W = (W1, W2, ...Wj) \quad (1)$$

5. Creating a compatibility rating table for each alternative on each criterion.
6. Create a decision matrix X formed from the compatibility rating table of each alternative on each criterion. The value x of each alternative (Ai) on each criterion (Cj) that has been determined, where i=1, 2, …m and j=1, 2, …n

$$X = \begin{pmatrix} x_{11}\, x_{12} \dots x_{ij} \\ x_{11}\, x_{12} \dots x_{ij} \\ - - - - - - \\ x_{i1}\, x_{i2} \dots x_{ij} \end{pmatrix} \quad (2)$$

7. Perform normalisation of the decision matrix by calculating the normalised performance rating (rij) of alternative Ai on the criteria Cj

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{Max_i\, X_{ij}} \\ \dfrac{Min_i\, X_{ij}}{X_{IJ}} \end{cases} \quad \text{If j is a benefit attribute/ If j is the cost attribute} \quad (3)$$

Explanation:
rij = normalised performance rating value
Xij = attribute value possessed from each criterion
Maxi Xij = the largest value from each criterion
Mini Xij = the smallest value from each criterion
benefit = if the largest value is the best
cost = if the smallest value is the best

It is said to be a profit criterion if the value of Xij provides a benefit to the decision-maker, conversely, a cost criterion if X_{ij} incurs a cost for the decision-maker. If it is a profit criterion, the value of Xij is divided by the maximum value of Xij from each column, whereas for the cost criterion, the minimum value of Xij from each column is divided by the value of X_{ij}.

The result of the normalised performance rating values (rij) forms a normalised matrix (R).

$$R = \begin{pmatrix} r_{11}\, r_{12} \cdots r_{ij} \\ r_{11}\, r_{12} \cdots r_{ij} \\ - - - - - - \\ r_{i1}\, r_{i2} \cdots r_{ij} \end{pmatrix} \quad (4)$$

8. The final preference value (Vi) is obtained from the sum of the multiplication of the elements of the normalised matrix row (R) with the preference weights (W) corresponding to the matrix column elements (W).

$$Vi = \sum_{j=1}^{n} W_j\, r_{ij} \quad (5)$$

Explanation:
Vi = ranking for each alternative
wj = weight value of each criterion
rij = normalised performance rating value

A higher calculated value of Vi indicates that alternative Ai is the best alternative (Kusumadewi, 2006).

Research Methodology

In [13], research methods can be defined as all methods or techniques used to conduct research. The methods or techniques used to conduct research thus refer to the methods employed by researchers in carrying out research operations. In other words, all methods used by researchers while studying their research problems are referred to as research methods.

In (Sugiyono, 2022), qualitative research is research used to study conditions of natural objects, where the researcher is the key instrument. Quoting from Moleong (2005:6), qualitative research is research that aims to understand phenomena about what is experienced by research subjects, such as behaviour, perception, motivation, actions, etc., holistically, and descriptively in the form of words and language, within a specific natural context and by utilising various natural methods. Quoting Suryono (2010), qualitative research is research used to investigate, discover, describe, and explain the quality or characteristics of social influences that cannot be explained, measured, or described through a quantitative approach.

This research uses a quantitative approach with a descriptive research method to implement the Simple Additive Weighting (SAW) algorithm in determining the choice of boarding houses around the campus of Universitas Pembangunan Panca Budi (UNPAB). The SAW method was chosen because of its ability to process data with multiple criteria and provide objective results in determining the best alternative.

Results

3.1 Metode Simple Additive Weighting (SAW)

This method requires decision-makers to determine the weight for each attribute. The total score for an alternative is obtained by summing all the products of the ratings (which can be compared across attributes) and the weight of each attribute. The rating of each attribute must be dimensionless, meaning it has undergone a normalisation process beforehand.

Example of the SAW method in selecting boarding houses In this example, 2 boarding house data will be calculated.

Here are the questions provided in the questionnaire, which consists of 8 questions with 5 answer options.

C1. How is the location of by the boarding house you are staying at?

1. Very Unstrategic, 2. Unstrategic, 3. Fairly Strategic, 4. Strategic, 5. Very Strategic

C2. How is the panorama presented by the boarding house?

1. Very unattractive, 2. Unattractive, 3. Fair, 4. Attractive, 5. Very attractive

C3. How are the hotel facilities offered by by the boarding house?

1. Very Uncomfortable 2. Uncomfortable 3. Fairly Comfortable 4. Comfortable 5. Very Comfortable

C4. How is the security provided by the boarding house?

1. Very Unsafe 2. Unsafe 3. Fairly Safe 4. Safe 5. Very Safe

C5. How is the quality of the food/drink products you received?

1. Very Poor 2. Poor 3. Fair 4. Good 5. Very Good

C6. How was the service by the boarding house?

1. Very Unfriendly 2. Unfriendly 3. Fair 4. Friendly 5. Very Friendly

C7. How is the cleanliness of the boarding house?

1. Very Dirty 2. Not Clean 3. Fairly Clean 4. Clean 5. Very Clean

Tabel 1. Criteria

Criteria	Explanation
Price	Price
C1	Location
C2	Panorama
C3	Facilites
C4	Security
C5	Quality of food products
C6	Service from the boarding house staff
C7	Cleanliness

The fuzzy number is converted into a crisp number.

Table 2. Weight

Fuzzy Number	Value
Very Unimportant	1
NotImportant	2
Quite Important	3
Important	4
Very Important	5

Weight Table Explanation:

1. Very Unimportant, then the Weight Value is 1 (one)
2. Unimportant, then the Weight Value is 2 (two)
3. Somewhat Important, then the Weight Value is 3 (three)
4. Important, then the Weight Value is 4 (four)
5. Very Important, then the Weight Value is 5 (five)

Table 3. Alternative Boarding Houses

No	Alternative	Criteria							
		Price	C1	C2	C3	C4	C5	C6	C7
1	Gatot Subroto	80000	Strategic	Beautiful	Comfortable	Safe	Enough	Friendly	Enough

2	Sunggal	50000	Strategic	Enough	Quite Comfortable	Fairly Safe	Baik	Friendly	Enough

Then, each alternative is assigned a value based on the condition of each criterion as shown in the table below.

Table 4. Boarding House Values

No	Alternative	Criteria							
		Price	C1	C2	C3	C4	C5	C6	C7
1	Gatot Subroto	85000	4	4	4	4	3	4	3
2	Sunggal	50000	4	3	3	3	4	4	3

After that, normalisation with the following formula:

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\max\limits_i x_{ij}} & \text{If j is atribut keuangan (benefit)} \\ \frac{\min\limits_i x_{ij}}{x_{ij}} & \text{if j is atribut biaya (cost)} \end{cases}$$

Normalisation (price):

$r_{11} = \frac{min(175:150)}{175} = \frac{150}{175} = 0{,}86$

$r_{21} = \frac{man(175:150)}{150} = \frac{175}{150} = 1{,}17$

Normalisation C1 (location)

$r_{12} = \frac{4}{max\ (4;4)} = \frac{4}{4} = 1$

$r_{22} = \frac{4}{max\ (4;4)} = \frac{4}{4} = 1$

Normalisation C2 (panorama):

$r_{13} = \frac{4}{max\ (4;3)} = \frac{3}{4} = 0{,}75$

$r_{32} = \frac{4}{max\ (4;3)} = \frac{4}{3} = 1,$ and so on.

Here are the normalisation results:

$$R6\begin{pmatrix} 0{,}86 & 1 & 0{,}75 & 0{,}75 & 0{,}75 & 1{,}33 & 1 & 1 \\ 1{,}17 & 1 & 1{,}33 & 1{,}33 & 1{,}33 & 0{,}75 & 1 & 1 \end{pmatrix}$$

After normalisation, the next step is to continue the ranking process by summing the weights given by prospective hotel guests. The weight data calculation using the formula V_i ∑_(j=1) ^n▒w_j r_ij yields the following results:

$= 0{,}86 + 1 + 0{,}75 + 0{,}75 + 0{,}75 + 1{,}33 + 1 + 1 = 7{,}44$

$V2 = 1{,}17 + 1 + 1{,}33 + 1{,}33 + 1{,}33 + 0{,}75 + 1 + 1 = 8{,}91$

(Having the highest value as the best alternative)

Table 5. Normalisation Results

No	Alternative	Criteria								
		Harga	C1	C2	C3	C4	C5	C6	C7	Ranking
1	Gatot Subroto	0,86	1	0,75	0,75	0,75	1,33	1	1	7,44
2	Sunggal	1,17	1	1,33	1,33	1,33	0,75	1	1	8,91

Alternatif terbaik = **8,91**

Conclusion

This research successfully implemented the Simple Additive Weighting (SAW) algorithm to determine the optimal boarding house options around the campus of Universitas Pembangunan Panca Budi (UNPAB). Based on the calculations using SAW, the selected boarding houses are those with the highest scores based on relevant criteria, namely rental price, distance from campus, facilities, security, and comfort. Through this research, it can be concluded that the SAW algorithm is an effective and objective method in helping students choose a boarding house that matches their preferences. By assigning weights to each criterion and calculating scores based on the existing values, students can easily obtain recommendations for boarding houses that best suit their needs. In addition, this research also contributes to the managers of boarding houses and other related parties to understand the most important factors for students in choosing a place to live.

The main recommendation from this research is the further development of this SAW-based system, which can be integrated into a boarding house search application to make it easier for students to find suitable boarding houses. Additionally, boarding house managers can use the results of this research to improve the services and facilities offered to make them more attractive to potential residents. Overall, this research provides better insights into objective data-based decision-making and can serve as a reference for future studies related to criterion-based selection systems.

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