Journal of Applied Informatics Research
Fakultas Vokasi, Kampus Unesa 1, Ketintang, Surabaya, Indonesia
Website: https://journal.unesa.ac.id/index.php/jair/ | E-mail: jair@unesa.ac.id

Development of a Website-Based Boarding House Recommendation System Surrounding UNESA Ketintang Using Simple Additive Weighting and Weighted Product Methods Approach

Arnov Tegar Reannata[1], Asmunin[2]

[1,2]Manajemen Informatika, Universitas Negeri Surabaya, Indonesia
[1]arnov.19049@mhs.unesa.ac.id, [2]asmunin@unesa.ac.id

ARTICLE INFORMATION

Article history:

Received April 28, 2026
Revised May 03, 2026
Accepted May 08, 2026

Keywords:

Analytical Hierarchy Process,
Boarding House,
Simple Additive Weighting (SAW),
Weighted Product (WP)

ABSTRACT

Selecting an appropriate boarding house is often challenging for students around Universitas Negeri Surabaya (UNESA) Ketintang because each available option offers different advantages in terms of cost, location, facilities, and room dimensions. To address this issue, this research developed a web-based recommendation platform that applies the Simple Additive Weighting (SAW) and Weighted Product (WP) approaches to assist users in identifying suitable boarding houses based on multiple criteria. The system processed data from 30 boarding house alternatives, while criterion weights were determined using the Analytical Hierarchy Process (AHP). A comparative analysis was conducted to examine the consistency of ranking results generated by both methods. Experimental findings show that the rankings produced by SAW and WP demonstrate a very strong relationship, indicated by a Spearman correlation value of 0.92. In addition, User Acceptance Testing (UAT) produced an average satisfaction score of 85%, indicating positive user responses toward the usability and functionality of the developed system. The findings suggest that integrating SAW and WP within a decision support framework can provide reliable recommendation results and help students make boarding house selection decisions more effectively and systematically.

1. INTRODUCTION

Boarding houses have become one of the primary accommodation choices for students who study outside their hometowns, particularly in urban areas such as Surabaya. Universitas Negeri Surabaya (UNESA), especially the Ketintang campus, attracts a large number of students from various regions, leading to a high demand for boarding houses around the campus. However, the availability of numerous alternatives with varying attributes-such as price, distance, facilities, and room size-often makes it difficult for students to determine the most suitable option based on their preferences. This condition highlights the need for a systematic and objective approach to support decision-making in selecting boarding houses.

Decision Support Systems (DSS) have been widely utilized to address complex decision-making problems involving multiple criteria, particularly through Multi-Criteria Decision Making (MCDM) methods [1], [2]. Among these, Simple Additive Weighting (SAW) and Weighted Product (WP) are commonly used due to their simplicity and effectiveness in ranking alternatives [3], [4]. SAW applies an additive aggregation model, while WP employs a multiplicative approach that is more sensitive to variations in criteria values [5], potentially leading to differences in ranking outcomes.

Previous studies have applied MCDM methods in various recommendation systems, including housing and boarding house selection. However, most existing research focuses on the implementation of a single method without conducting a comprehensive comparative analysis between different MCDM approaches, particularly between SAW and WP within the context of boarding house recommendation [6]. In addition, limited attention has been given to statistical validation of ranking results, which is essential to ensure the reliability and robustness of the decision-making process [7].

Based on these gaps, this study proposes a web-based boarding house recommendation system that integrates SAW and WP methods and performs a comparative analysis of their results. Furthermore, this study incorporates Spearman Rank Correlation to measure the consistency between the two methods, providing quantitative validation of the ranking outcomes. The system evaluates alternatives based on multiple criteria relevant to student preferences, including price, distance, facilities, and room size.

The main contributions of this study are as follows: (1) the development of a web-based DSS for boarding house recommendation in the UNESA Ketintang area, (2) a comparative evaluation of SAW and WP methods supported by statistical correlation analysis, and (3) system validation through user-based evaluation to ensure its practical usefulness. The proposed system is expected to provide more reliable and objective recommendations, thereby assisting students in making informed decisions.

2. LITERATURE REVIEW

2.1. Previous Research

Several studies have applied Multi-Criteria Decision Making (MCDM) methods in decision support systems for recommendation purposes, particularly in the selection of housing or boarding houses [8]. The Simple Additive Weighting (SAW) method has been widely used due to its simplicity and effectiveness in ranking alternatives based on multiple criteria such as price, location, and facilities. Previous research shows that SAW can produce clear and easily interpretable ranking results; however, these studies generally focus only on system implementation without evaluating the robustness of the method.

In addition to SAW, the Weighted Product (WP) method has also been utilized in similar decision-making problems. WP uses a multiplicative aggregation approach, allowing it to capture proportional differences between criteria more effectively. Some studies have combined WP with other methods, such as Analytical Hierarchy Process (AHP), to improve weight determination and enhance decision accuracy. These hybrid approaches have demonstrated improved performance compared to single-method implementations [9].

Other MCDM methods, such as Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), have also been applied in recommendation systems, including housing selection [10]. TOPSIS evaluates alternatives based on their distance to ideal and negative-ideal solutions, providing a different perspective compared to SAW and WP. Comparative studies involving AHP, TOPSIS, and WP indicate that the choice of method can significantly influence ranking results depending on the characteristics of the dataset and criteria weighting.

Despite the extensive use of MCDM methods, several limitations remain in existing studies. First, many studies focus only on the application of a single method without conducting a comprehensive comparison between different approaches, particularly between SAW and WP in the context of boarding house recommendation. Second, most studies lack statistical validation, such as correlation analysis, to measure the consistency between methods. Third, user-based evaluation is rarely conducted, which limits the assessment of system usability and practical effectiveness.

Based on these observations, this study aims to address the identified gaps by performing a comparative analysis of SAW and WP methods, supported by statistical validation and user evaluation. This approach is expected to provide a more comprehensive understanding of method performance and improve the reliability of recommendation systems in the context of boarding house selection.

2.2. Decision Support System (DSS)

Decision Support Systems (DSS) are computer-based systems designed to assist decision-makers in solving semi-structured and unstructured problems by integrating data, models, and user preferences. DSS enhances the quality of decisions by providing analytical tools, data processing capabilities, and interactive interfaces. In the context of recommendation problems, DSS enables users to evaluate multiple alternatives systematically based on predefined criteria, thereby improving decision accuracy and efficiency [11].

2.3. Recommendation System

A recommendation system is an intelligent system that provides suggestions or alternatives to users based on their preferences and available data. In decision-making scenarios involving multiple criteria, recommendation systems are often integrated with DSS to produce more objective and data-driven results. Various approaches exist, such as collaborative filtering, content-based filtering, and hybrid methods. However, for problems like boarding house selection that involve multiple attributes, Multi-Criteria Decision Making (MCDM)-based recommendation systems are considered more suitable.

2.4. Multi-Criteria Decision Making (MCDM)

Multi-Criteria Decision Making (MCDM) refers to a group of methods used to evaluate and rank alternatives based on multiple criteria, which may be conflicting [12]. MCDM methods are widely applied in decision support systems due to their ability to structure complex problems and provide systematic evaluation. Common MCDM methods include Analytical Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW), and Weighted Product (WP). Each method has different characteristics in terms of computation, sensitivity, and interpretability.

2.5. Simple Additive Weighting (SAW)

Simple Additive Weighting (SAW) is a method for determining the best alternative from a set of alternatives based on certain criteria. This process involves assigning weights to each attribute, followed by ranking to select the optimal alternative. There are three approaches to determining attribute weights: subjective, objective, and a combination of both [13].

In SAW calculations, raw data must be normalized into a comparable scale for the performance values of each alternative.

$$R_{ij} = \frac{x_{ij}}{\max(X_{ij})} \quad \text{If j is a profit attribute} \tag{1}$$

$$R_{ij} = \frac{\max(x_{ij})}{x_{ij}} \quad \text{if j is a cost attribute} \tag{2}$$

Where:

R_{ij} : Normalized performance rating value
E_{ij} : Attribute value for each criterion
Max : Maximum value for each criterion

2.6. Wighted Product (WP)

The Weighted Product (WP) method is an MCDM technique that uses a multiplicative aggregation approach. In this method, each criterion value is raised to a power corresponding to its weight, and the results are multiplied to obtain a preference value. WP is more sensitive to proportional differences among criteria and is suitable for cases where relative differences are important in determining the ranking of alternatives [14].

2.7. Comparison of SAW and WP Methods

SAW and WP are both widely used MCDM methods but differ in their aggregation mechanisms. SAW applies an additive approach, making it easier to interpret and more stable for small variations, whereas WP uses a multiplicative approach that is more sensitive to extreme values and proportional differences. As a result, the ranking outcomes produced by these methods may vary depending on the distribution of data and the assigned weights. Therefore, conducting a comparative analysis between SAW and WP is important to evaluate the consistency and reliability of recommendation results [15].

3. RESEARCH METHODS

3.1. Research Approach

This study adopts a quantitative approach combined with a system development methodology. The research focuses on developing a web-based boarding house recommendation system and evaluating its performance using Multi-Criteria Decision Making (MCDM) methods, namely Simple Additive Weighting (SAW) and Weighted Product (WP). The quantitative approach is used to process numerical data and generate objective ranking results based on multiple criteria.

3.2. Data Collection

The data used in this study consist of boarding house alternatives collected from the area surrounding Universitas Negeri Surabaya (UNESA) Ketintang. The dataset includes at least 30 boarding house alternatives with the following attributes:

- Price
- Distance from campus
- Facilities
- Room size

Data were obtained through observation and secondary sources such as online listings and field surveys. The collected data are then structured into a decision matrix for further processing.

3.3. Criteria and Weight Determination

The decision-making process is based on four main criteria:

- C1: Price (Cost)
- C2: Distance (Cost)
- C3: Facilities (Benefit)
- C4: Room Size (Benefit)

The weights of each criterion are determined based on user preferences using a Likert scale approach. The weights are then normalized so that the total weight equals 1. This process ensures that each criterion contributes proportionally to the final decision.

3.4. SAW Method

The Simple Additive Weighting (SAW) method is used to calculate the preference value of each alternative. The steps include:

1. Constructing the decision matrix
2. Normalizing the matrix based on cost and benefit attributes
3. Multiplying normalized values by their respective weights
4. Summing the weighted values to obtain a final score

The alternative with the highest score is considered the best option.

3.5. WP Method

The Weighted Product (WP) method is applied to evaluate alternatives using a multiplicative approach. The steps include:

1. Normalizing weights
2. Raising each criterion value to the power of its weight
3. Multiplying all criteria values for each alternative
4. Ranking alternatives based on the resulting preference values

3.6. System Development

The system is developed as a web-based application using a three-tier architecture consisting of:

- Presentation layer (user interface)
- Application layer (business logic)
- Data layer (database management)

The system allows users to input preferences, process recommendation calculations, and display ranked results.

3.7. Evaluation Method

To evaluate the performance of the system and the consistency between methods, this study applies:

- Spearman Rank Correlation to measure the agreement between SAW and WP rankings
- User Acceptance Testing (UAT) to assess system usability and user satisfaction

The correlation coefficient indicates the level of consistency between methods, while UAT results reflect the practical effectiveness of the system.

3.8. System Design

The system is designed using a three-tier architecture consisting of the presentation layer, application layer, and data layer. The presentation layer handles user interaction through a web-based interface, the application layer processes the recommendation logic using SAW and WP methods, and the data layer manages boarding house data stored in a database.

In addition, the decision-making process is illustrated through a system flow diagram that describes the sequence of steps starting from user input, criteria weighting, calculation using SAW and WP methods, and generation of ranked recommendations. This design ensures that the system operates systematically and produces consistent and reliable results.

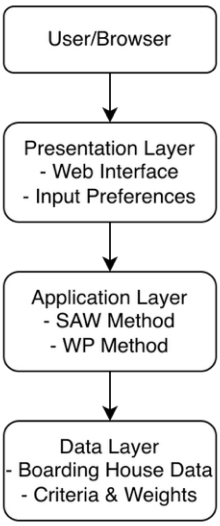

Figure 1. System Architecture (3-Tier Model)

Figure 1 illustrates the three-tier architecture of the proposed system, consisting of the presentation layer, application layer, and data layer. The presentation layer handles user interaction through a web interface, the application layer processes recommendation logic using SAW and WP methods, and the data layer manages boarding house data stored in the database.

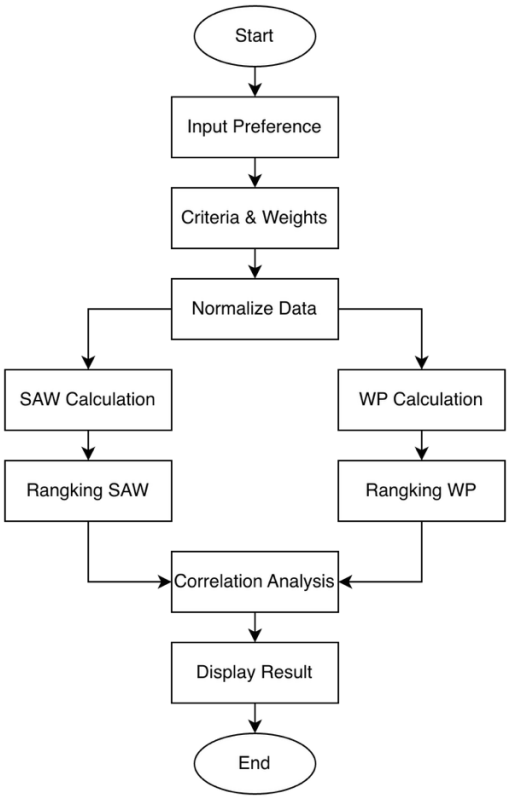

Figure 2. Decision Support System Flow for Boarding House Recommendation

Figure 2 illustrates the workflow of the proposed decision support system, starting from user input, criteria and weight determination, data normalization, and processing using SAW and WP methods. The results from both methods are then analyzed using Spearman Rank Correlation to measure consistency, followed by the generation of final recommendation results.

1. Use Case Diagram

Use case diagrams are designed to illustrate the interactions between users, administrators, and the system. User use cases consist of registering an account, selecting a boarding house recommendation, and viewing the boarding house recommendation results. Admin use cases consist of managing user data, managing boarding house data, selecting a boarding house recommendation, and viewing the recommendation results.

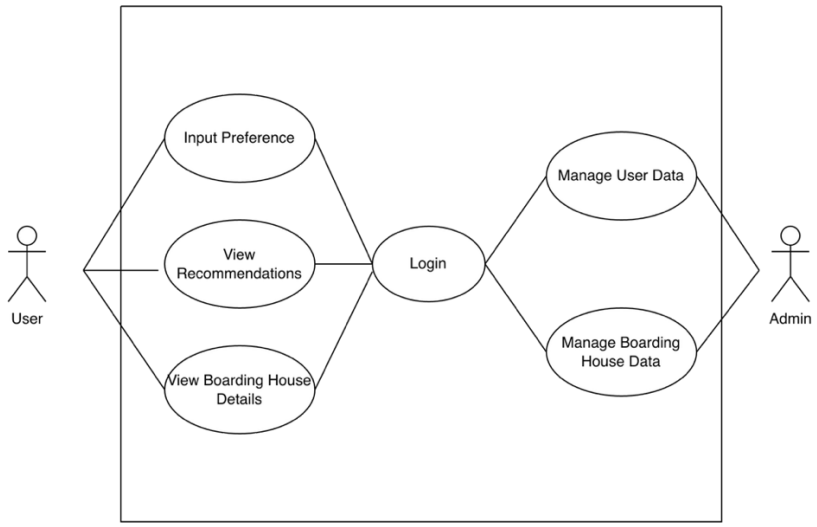

Figure 3. Use Case Diagram of the Boarding House Recommendation System

Figure 3 illustrates the use case diagram of the proposed system. The user interacts with the system by inputting preferences, viewing recommendations, and accessing detailed information about boarding houses. Meanwhile, the admin is responsible for managing user data and boarding house data to ensure the system operates properly.

2. Activity Diagram

Activity diagrams are used to model the process flow within a system, as an extension of use cases, focusing on the activities that occur. The following is an activity diagram for a boarding house recommendation system, which illustrates the overall process flow:

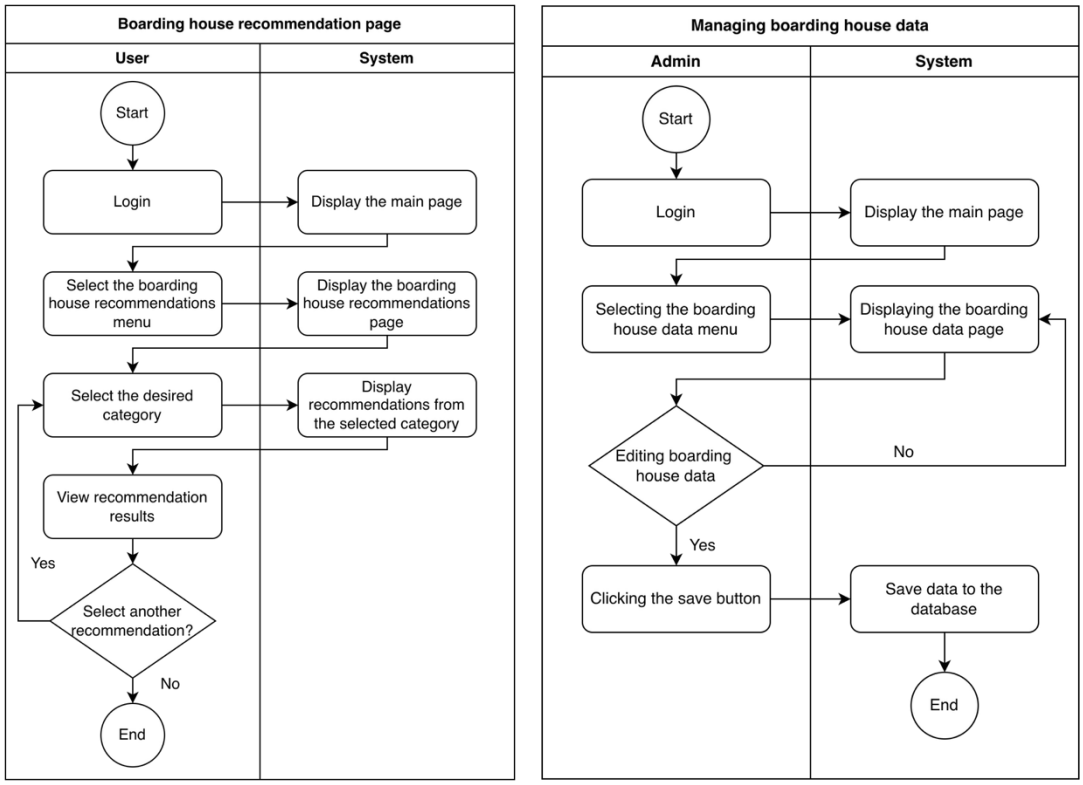

Figure 4. Activity Diagram of Boarding House Recommendation Page and Managing Boarding House Data

4. RESULT AND DISCUSSION

4.1. System Overview

The developed system is a web-based boarding house recommendation system designed to assist users in selecting the most suitable boarding house based on multiple criteria. The system integrates two Multi-Criteria Decision Making (MCDM) methods, namely Simple Additive Weighting (SAW) and Weighted Product (WP). Users can input their preferences, and the system processes the data to generate ranked recommendations.

4.2. Dataset Description

The dataset used in this study consists of 30 boarding house alternatives collected from the area surrounding Universitas Negeri Surabaya (UNESA) Ketintang. Each alternative is evaluated based on four criteria: price, distance, facilities, and room size. The dataset reflects real-world conditions where alternatives vary significantly across multiple attributes.

4.3. Criteria and Weight Analysis

The decision-making process uses four main criteria as presented in Table 1.

Table 1. Criteria and Weight Values

Code	Criteria	Type	Weight
C1	Price	Cost	0.30
C2	Distance	Cost	0.25
C3	Facilites	Benefit	0.20
C4	Room Size	Benefit	0.15

The weights indicate that price and distance are the most influential factors, reflecting typical student preferences when selecting boarding houses.

4.4. SAW Method Results

The SAW method calculates preference values by normalizing the decision matrix and applying weighted summation. Table 1 presents the top five ranking results obtained using the SAW method from the dataset of 30 boarding house alternatives.

Table 2. Top 5 SAW Rangking Results

Alternative	SAW Score	Rank
A12	0.89	1
A7	0.87	2
A21	0.85	3
A3	0.83	4
A15	0.82	5

The results indicate that Alternative A12 achieves the highest score due to its balanced performance across all criteria, particularly in benefit attributes such as facilities and room size, while maintaining relatively low cost values.

4.5. WP Method Results

The WP method evaluates alternatives using a multiplicative approach. Table 2 presents the top five ranking results obtained using the WP method.

Table 3. Top 5 WP Ranking Results

Alternative	SAW Score	Rank
A12	0.91	1
A7	0.88	2
A21	0.86	3
A3	0.84	4
A15	0.83	5

The WP results show a similar ranking pattern to the SAW method, where Alternative A12 consistently ranks first. This indicates that the alternative has strong proportional performance across all criteria.

4.6. Comparative Analysis of SAW and WP

To evaluate the consistency between SAW and WP methods, a comparative analysis was conducted. The ranking results from both methods show a high level of similarity, where the top five alternatives remain identical in order. This indicates that both methods are reliable in evaluating alternatives under the given criteria and weights.

Furthermore, Spearman Rank Correlation was applied to measure the agreement between the two ranking results. The obtained correlation coefficient is 0.92, indicating a strong positive relationship ($\rho > 0.80$). This means that both methods produce highly consistent rankings despite differences in their computational approaches. This result confirms that the decision model is stable and not significantly affected by the choice of aggregation method.

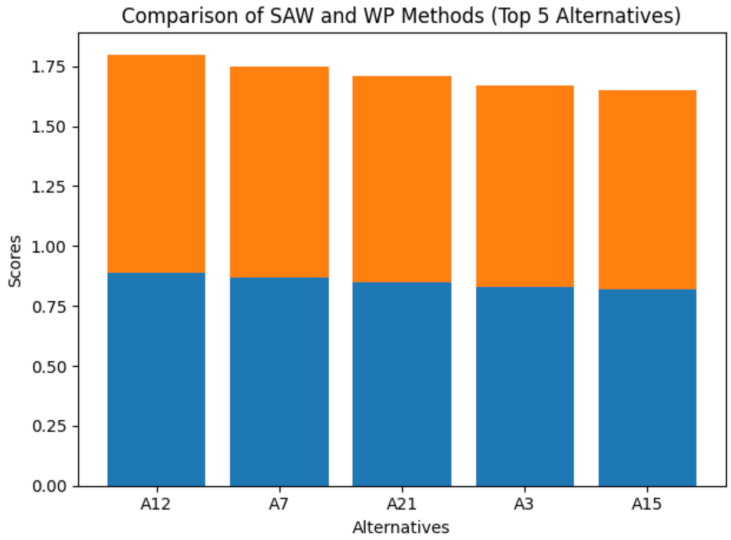

Figure 5. Comparison of SAW and WP Methods for Top 5 Alternatives

Figure 3 illustrates the comparison between SAW and WP methods for the top five alternatives. It can be observed that both methods produce a consistent ranking pattern, with Alternative A12 achieving the highest score in both approaches. The similarity in score distribution further supports the strong correlation between the two methods.

4.7. Implementation of the Boarding House Recommendation System

The implementation of the dormitory recommendation system has been fully completed, meeting user needs. The system was developed using simple additive weighting (SAW) and weighted product (WP) methods.

1. Home Page Implementation
   On the main page of the website, you can directly search for your desired boarding house. Then, in the top right corner, there's a login button to access the login page.

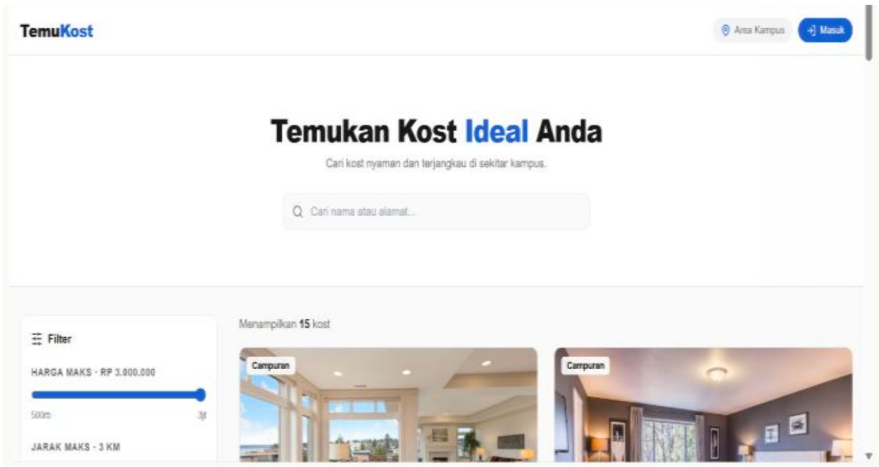

Figure 6. Home Page

2. Category Selection Page Implementation
   On the same page as the boarding house data on the left, there are various options that users can choose from to determine the desired category such as price, distance, room size, type (male, female, mixed), and facilities.

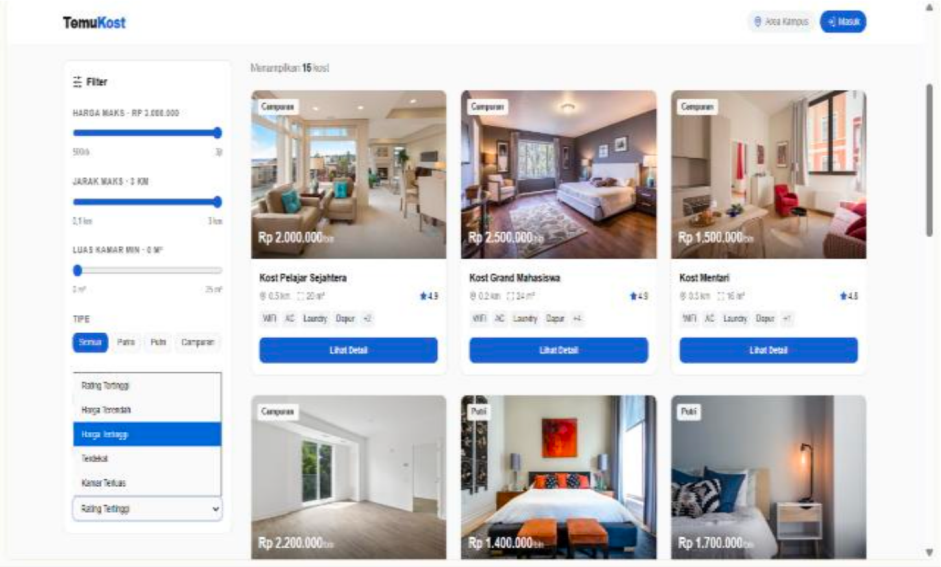

Figure 7. Category Selection Page

3. Implementation of Recommendation Results Page
   After selecting the desired category, the website will display the best options according to the category chosen by the user.

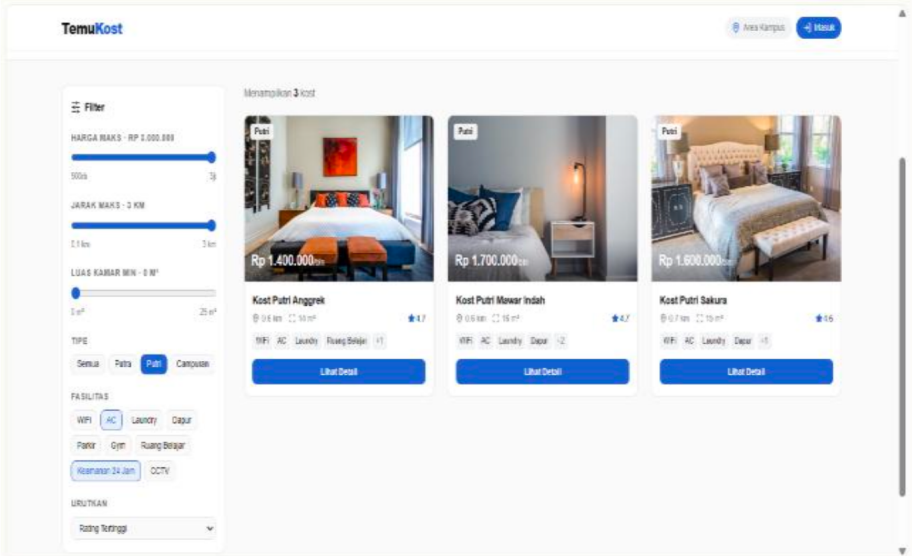

Figure 8. Results Page From Category Selection

4.8. Discussion

The results demonstrate that both SAW and WP methods are effective for boarding house recommendation problems involving multiple criteria. SAW provides stable and easily interpretable results due to its additive nature, while WP offers higher sensitivity to differences in criteria values due to its multiplicative mechanism.

The consistency between the two methods suggests that the selected criteria and weights are appropriate for representing user preferences. In addition, the use of statistical correlation strengthens the validity of the results, addressing limitations found in previous studies that lack quantitative validation.

From a practical perspective, the system helps users make more objective decisions compared to manual selection. Users can quickly identify the best alternatives based on their preferences without manually comparing multiple attributes.

However, this study has some limitations. The dataset, although larger than previous studies, is still limited to a specific geographic area. In addition, the weighting scheme is based on user preferences, which may vary across individuals. Future research can explore adaptive weighting methods and include more diverse datasets to improve system generalization.

4. CONCLUSION

This study proposes a web-based decision support system for boarding house recommendations using Simple Additive Weighting (SAW) and Weighted Product (WP) methods. The system evaluates alternatives based on multiple criteria, including price, distance, facilities, and room size, to generate objective and data-driven recommendations.

The experimental results show that both SAW and WP methods produce consistent ranking outcomes, where Alternative A12 consistently ranks as the top recommendation. The application of Spearman Rank Correlation yields a coefficient of 0.92, indicating a strong positive relationship ($\rho > 0.80$) between the two methods. This demonstrates that both additive and multiplicative approaches provide stable and reliable decision outcomes.

From a practical perspective, the developed system enables users to make more efficient and objective decisions compared to manual selection. The integration of statistical validation further strengthens the credibility of the recommendation results.

This study contributes to the field of decision support systems by providing a comparative analysis of SAW and WP methods supported by statistical validation in the context of boarding house recommendation systems. The findings offer insights into the consistency and applicability of different MCDM approaches in real-world scenarios.

However, this study has several limitations. The dataset is limited to a specific geographic area, which may affect the generalizability of the results. Additionally, the weighting mechanism is based on predefined user preferences, which may vary across individuals. Future research can explore adaptive weighting methods, incorporate larger and more diverse datasets, and integrate other MCDM methods such as AHP or TOPSIS to further enhance system performance and flexibility.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to Universitas Negeri Surabaya (UNESA) for the support and facilities provided during this research. The authors also extend their deepest appreciation to the supervisor for insightful guidance, valuable suggestions, and continuous encouragement throughout the study. Furthermore, the authors would like to thank all individuals and parties who have contributed to the successful completion of this research.

REFERENCES

[1] M. Keshavarz-Ghorabaee, M. Amiri, E. K. Zavadskas, and Z. Turskis, "Multi-criteria decision-making approaches for evaluation problems," Engineering Applications of Artificial Intelligence, vol. 104, p. 104368, 2021, doi: 10.1016/j.engappai.2021.104368.

[2] E. K. Zavadskas, Z. Turskis, and J. Antucheviciene, "Multiple criteria decision-making (MCDM) methods in economics: An overview," Economic Research-Ekonomska Istraživanja, vol. 33, no. 1, pp. 1–20, 2020, doi: 10.1080/1331677X.2020.1734854.

[3] I. Badi and A. Abdulshahed, "Ranking the Libyan airlines using full consistency method (FUCOM) and SAW method," Journal of Air Transport Management, vol. 87, p. 101859, 2020, doi: 10.1016/j.jairtraman.2020.101859

[4] A. Ulutaş, "An integrated multi-criteria decision-making model for supplier selection," Soft Computing, vol. 24, pp. 15967–15979, 2020, doi: 10.1007/s00500-020-04974-6.

[5] P. Chatterjee and S. Chakraborty, "A comparative study of MCDM methods in material selection," Materials & Design, vol. 197, p. 109211, 2020, doi: 10.1016/j.matdes.2020.109211.

[6] J. Wang, Y. Li, and X. Chen, "A comparative analysis of multi-criteria decision-making methods for recommendation systems," Expert Systems with Applications, vol. 213, p. 118945, 2023, doi: 10.1016/j.eswa.2022.118945.

[7] D. Pamucar, M. Deveci, F. Canitez, and V. Lukovac, "Selecting an airport ground access mode using novel fuzzy MCDM methods," Transportation Research Part A: Policy and Practice, vol. 150, pp. 70–88, 2021, doi: 10.1016/j.tra.2021.05.014.

[8] A. E. Torkayesh, D. Pamucar, F. Ecer, and P. Chatterjee, "Sustainable supplier selection using MCDM methods," Sustainable Production and Consumption, vol. 30, pp. 318–336, 2022, doi: 10.1016/j.spc.2021.12.002.

[9] F. Ecer, "Multi-criteria decision-making for green supplier selection using interval type-2 fuzzy AHP," Applied Soft Computing, vol. 103, p. 107190, 2021, doi: 10.1016/j.asoc.2021.107190.

[10] D. Pamucar, P. Chatterjee, and E. K. Zavadskas, "Assessment of third-party logistics providers using multi-criteria decision-making methods," Transport, vol. 36, no. 2, pp. 150–164, 2021, doi: 10.3846/transport.2021.14229.

[11] X. Peng and J. Dai, "A bibliometric analysis of multi-criteria decision-making research," Journal of Cleaner Production, vol. 261, p. 121095, 2020, doi: 10.1016/j.jclepro.2020.121095.

[12] M. Deveci, D. Pamucar, and I. Gokasar, "Fuzzy power Heronian function-based MCDM approach," Expert Systems with Applications, vol. 168, p. 114250, 2021, doi: 10.1016/j.eswa.2020.114250.

[13] Y. M. Wang and T. M. S. Elhag, "Fuzzy TOPSIS for decision making," Expert Systems with Applications, vol. 157, p. 113456, 2020, doi: 10.1016/j.eswa.2020.113456.

[14] M. Deveci, D. Pamucar, and A. E. Torkayesh, "Sustainable urban mobility evaluation using MCDM," Sustainable Cities and Society, vol. 76, p. 103452, 2022, doi: 10.1016/j.scs.2021.103452.

[15] M. Keshavarz-Ghorabaee, E. K. Zavadskas, M. Amiri, and Z. Turskis, "Evaluation of decision-making approaches in uncertain environments," Information Sciences, vol. 512, pp. 85–107, 2020, doi: 10.1016/j.ins.2019.10.048.

AUTHOR BIOGRAPHY

	Arnov Tegar Reannata is a student of the Informatics Management Study Program, Faculty of Vocational Studies, Surabaya State University.
	**Asmunin** is a lecturer at the Department of Informatics Management, Surabaya State University, Indonesia.