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Decision of Student's Dormitory Accommodation Using SAW Method

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Abstract
This study presents the development and evaluation of a Decision Support System (DSS) designed to streamline the student selection process for dormitory administrators. The system leverages the Simple Additive Weighting (SAW) method to evaluate applicants based on predefined criteria, including academic performance, financial need, and extracurricular involvement. Testing conducted on five applicants demonstrated a 100% accuracy rate, validating the system's effectiveness in identifying the most suitable candidates. The SAW method's ability to aggregate and normalize multiple criteria into a single quantitative score ensures a robust, transparent, and fair decision-making framework. This approach significantly enhances the precision of candidate selection while reducing manual effort and minimizing biases. The system's adaptability allows for the incorporation of additional criteria or adjustments to weighting schemes, ensuring its applicability across diverse institutional contexts. The successful implementation of this system underscores the value of integrating multi-criteria decision-making techniques into administrative workflows, offering a scalable and accountable solution for optimizing resource allocation in dormitory management.

Keywords:
Students, Dormitory, SAW, DSS.

1. Introduction

A dormitory is an accommodation service for students especially those who live far away from the educational institutions. In our country, with perfectly low prices, a dormitory is needed for several students. Each year student applicants are selected by a committee. It can happen that a group of students may not be selected by a committee member without a reasonable reason. This fact can bring undesirable biases in educational areas. Therefore, using rational and acceptable criteria for selecting students to stay in a dorm is needed [1].

The process of selecting students for dormitory accommodation using traditional techniques often faces significant challenges, primarily due to the complexity and subjectivity involved in evaluating multiple criteria. Traditional methods typically rely on manual assessment, where administrators evaluate applicants based on factors such as academic performance, financial need, extracurricular involvement, and personal statements. However, this approach is time-consuming and labor-intensive, especially when dealing with a large number of applicants. Additionally, manual evaluation is prone to human error and inconsistencies, as different administrators may interpret and weigh

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criteria differently. This lack of standardization can lead to unfair or biased decisions, undermining the transparency and fairness of the selection process [2].

Another major difficulty with traditional techniques is the inability to effectively balance and prioritize multiple, often conflicting, criteria. For instance, an applicant with excellent academic records may have limited financial need, while another with significant financial challenges may have average academic performance. Traditional methods struggle to objectively quantify and compare these diverse factors, making it challenging to identify the most deserving candidates. Moreover, the absence of a systematic framework for decision-making can result in subjective judgments, further exacerbating the risk of bias. This limitation is particularly problematic in institutions with limited dormitory spaces, where the selection process must be both rigorous and equitable to ensure optimal resource allocation [3][4].

Furthermore, traditional techniques lack the flexibility to adapt to changing institutional priorities or evolving applicant profiles. For example, if a university decides to place greater emphasis on community service or leadership qualities, manually adjusting the evaluation process to reflect these changes can be cumbersome and error-prone. The static nature of traditional methods also makes it difficult to incorporate real-time data or feedback, limiting the system's ability to improve over time. These challenges highlight the need for a more efficient, transparent, and adaptable approach to dormitory selection, such as the integration of decision support systems that leverage multi-criteria decision-making techniques like the Simple Additive Weighting (SAW) method [5].

In this research, I am using the Simple Additive Weighting method. The Simple Additive Weighting (SAW) method automates the evaluation process, reduces biases, and ensures a fair and consistent selection process, ultimately enhancing the overall efficiency and effectiveness of dormitory management. This research focuses on the Dormitory of Gerbang Selaparang, Yogyakarta, Indonesia. The objective of this research is to design a web-based system for decision-making, with the hope that this system can assist dormitory administrators in making more accurate decisions regarding student residence in the dormitory.

2. Related Works

An article proposed the Analytical Hierarchy Process (AHP) as a DSS to select undergraduate students for a dormitory of a university. We provide 4 main criteria and 16 sub-criteria. Based on the method, an eigenvector is calculated and the Consistency Ratio (CR) can be determined from the eigenvector. By iteratively following the process of AHP, we then can have appropriate weight numbers that can be used for selecting proper students for the dormitories [1]. Another work discussed SAW as the development of a decision support system for scholarship acceptance. The outcome of designing this scholarship acceptance decision support system includes reports on applicant data, accepted AS applicants, and accepted LPS applicants based on predefined quota numbers [4].

Another study focused on providing a solution for determining thesis titles using the SAW method. The study indicates that the determination of thesis titles is based on the MTU002 major in Business Management, with a score of 0.786 [5]. Another work discussed the design of a DSS with SAW for selecting dormitory residents at UNAI using 7 predefined criteria, including parental income, the number of dependents, the number of siblings, willingness to take 17 credit hours, cooking abilities, student debt, and electricity costs. The proposed SAW method can simplify and streamline the process for UNAI management to select students for dormitory residency [6].

3. Proposed Method

DSS is a computer-based system to aid decision-making by utilizing data and models to solve unstructured or semi-structured problems [8]. It is designed to support all steps in decision-making, starting from identifying the problem, selecting relevant data, determining the method to be used in the decision-making process, and evaluating choices. DSS is not a decision-making tool itself, but rather a system that assists in the decision-making process to provide quicker and more accurate decisions [9].

The SAW method is one of the approaches for decision-making that can also be described as a weighted summation method for different objects with equal opportunities for each criterion [11] [12]. The SAW method requires the normalization of the decision matrix (X) to compare all ratings of each alternative [13]. In the process of determining existing problems, the SAW method is highly useful in finding the highest value result to become the best alternative [14]. Calculations using this method are suitable based on the predetermined criteria.

The SAW method offers several significant benefits, particularly in decision-making processes that involve evaluating and ranking multiple alternatives based on various criteria. One of its primary advantages is its simplicity and ease of implementation, making it accessible even to users with limited technical expertise. SAW works by aggregating weighted scores across different criteria, allowing decision-makers to quantitatively compare alternatives transparently and systematically. This method ensures that all relevant factors are considered, and their relative importance is reflected through assigned weights, leading to more objective and consistent decisions. Using the SAW method is beneficial for users not only to simplify the process but also to save time [15]. The following is an example of a decision matrix for criteria, with normalization calculations in each equation to obtain a normalized matrix [16].

a. Choosing alternative compatibility ratings for each criterion
b. Decision in the form of matrix X
c. Assigning alternative weights based on the importance level of each criterion
d. Matrix decision X based on compatibility comparison table
e. Normalizing matrix R to match matrix X in calculating the values of each criterion based on the problem context.

$$r_{ij} \begin{cases} \dfrac{x_{ij}}{Max_i x_{ij}} \\ \dfrac{Min_i x_{ij}}{x_{ij}} \end{cases} \quad (1)$$

if j is a benefit attribute,
if j is a cost attribute,

Explanation:
r_{ij}= normalized performance rating value
x_{ij}= attribute criterion value for each alternative
$Max_i x_{ij}$) = the largest value among all attributes of criterion i
$Min_i x_{ij}$= the smallest value among all attributes of criterion i
Benefit = the largest value becomes the best value
Cost = the smallest value becomes the best value
Where rij is the normalized performance rating for alternative Ai of attribute c_j; i = 1, 2, ..., n. Preference values for each alternative (vi) are determined using the following formula:

$$v_i = \sum_j^n w_j r_{ij} \quad (2)$$

Explanation:
v_i = ranking for each alternative
w_j= weight value of each criterion
r_{ij} = normalized performance rating value
A larger $v_i$value indicates that alternative A_i is more preferred.

4. Result and Analysis

Based on the predetermined criteria, which comprise 4 criteria, namely students, parental income, parental occupation, and the number of siblings, the weights for each of these criteria are determined according to the selection rules for residing in the dormitory, as shown in the following criteria table:

1. Criteria and Weights

The table below presents the weight values for each criterion:

Table 1. Criteria Weights

Criteria	Weights
(C1) Student Criteria	30%
(C2) Parental Income Criteria	30%
(C3) Parental Occupation Criteria	20%
(C4) Sibling Count Criteria	20%
Total	**100%**

2. Student Criteria

Below is a table of student criteria and values based on the predetermined criteria:

Table 2. Student Criteria

Criteria	Value Benefit
D1-S1	90
S2	80
S3	70

3. Parental Income Criteria

Below is a table of parental income criteria and values based on the predetermined criteria:

Table 3. Parental Income Criteria

Criteria	Value Cost
>2.5 jt / Month	90
>1 jt - <=2.5 jt / Month	80
<=1 jt / Month	70

4. Parental Occupation Criteria

Here is a table of parental occupation criteria and values based on the predetermined criteria:

Table 4. Parental Occupation Criteria

Criteria	Value Benefit
Farmer/Worker/Trader	90

Entrepreneur	80
Civil Servant	70

5. Sibling Count Criteria

Here is a table of sibling count criteria and values based on the predetermined criteria:

Table 5. Sibling Count Criteria

Criteria	Value Cost
>4 Sibling Count	90
>2 - <= 4 Sibling Count	80
<= 2 Sibling Count	70

This page will display the manually calculated values using Excel and the results from the system design based on 5 applicant data and the predefined criteria.

Table 6. Applicant Alternatives

Alternative	**(C1) Benefit**	**(C2) Cost**	**(C3) Benefit**	**(C4) Benefit**
M. Fahrurrozi	90	70	90	70
Haris	90	80	90	70
Maulana afif	90	80	80	70
M. Rusman Hadi	80	70	90	90
Azroi	90	70	90	90

In this section, normalization of the table will be performed using the following formulas:
Note:
Benefit: Each element of the matrix is divided by the maximum value in the matrix row.
Cost: The minimum value in the matrix column is divided by each element of the matrix.

Students (C1) fall under the Benefit attribute.

$$A1 = \frac{90}{Max\ (90\ 90\ 90\ 80\ 90)} = \frac{90}{90} = 1$$
$$A2 = \frac{90}{Max\ (90\ 90\ 90\ 80\ 90)} = \frac{90}{90} = 1$$
$$A3 = \frac{90}{Max\ (90\ 90\ 90\ 80\ 90)} = \frac{90}{90} = 1$$
$$A4 = \frac{80}{Max\ (90\ 90\ 90\ 80\ 90)} = \frac{80}{90} = 0{,}89$$
$$A5 = \frac{90}{Max\ (90\ 90\ 90\ 80\ 90)} = \frac{90}{90} = 1$$

Parental Income (C2) falls under the Cost attribute.

$$A1 = \frac{Min\ (70\ 80\ 80\ 70\ 70)}{70} = \frac{70}{70} = 1$$
$$A2 = \frac{Min\ (70\ 80\ 80\ 70\ 70)}{70} = \frac{70}{80} = 0{,}88$$
$$A3 = \frac{Min\ (70\ 80\ 80\ 70\ 70)}{70} = \frac{70}{80} = 0{,}88$$

$$A4 = \frac{Min\ (70\ 80\ 80\ 70\ 70)}{70} = \frac{70}{70} = 1$$
$$A5 = \frac{Min\ (70\ 80\ 80\ 70\ 70)}{70} = \frac{70}{70} = 1$$

Parental Occupation (C3) falls under the Benefit attribute.

$$A1 = \frac{90}{Max\ (90\ 90\ 80\ 90\ 90)} = \frac{90}{90} = 1$$
$$A2 = \frac{90}{Max\ (90\ 90\ 80\ 90\ 90)} = \frac{90}{90} = 1$$
$$A3 = \frac{80}{Max\ (90\ 90\ 80\ 90\ 90)} = \frac{90}{90} = 0{,}89$$
$$A4 = \frac{90}{Max\ (90\ 90\ 80\ 90\ 90)} = \frac{90}{90} = 1$$
$$A5 = \frac{90}{Max\ (90\ 90\ 80\ 90\ 90)} = \frac{90}{90} = 1$$

The Number of Siblings (C4) falls under the Benefit attribute.

$$A1 = \frac{70}{Max\ (70\ 70\ 70\ 90\ 90)} = \frac{70}{90} = 0{,}78$$
$$A2 = \frac{70}{Max\ (70\ 70\ 70\ 90\ 90)} = \frac{70}{90} = 0{,}78$$
$$A3 = \frac{70}{Max\ (70\ 70\ 70\ 90\ 90)} = \frac{70}{90} = 0{,}78$$
$$A4 = \frac{90}{Max\ (70\ 70\ 70\ 90\ 90)} = \frac{90}{90} = 1$$
$$A5 = \frac{90}{Max\ (70\ 70\ 70\ 90\ 90)} = \frac{90}{90} = 1$$

Here is the display of manual normalization calculations using Excel based on the predefined criteria.

Table 7. Normalization Results

Alternative	**(C1) Benefit**	**(C2) Cost**	**(C3) Benefit**	**(C4) Benefit**
A1	1	1	1	0.78
A2	1	0.88	1	0.78
A3	1	0.88	0.89	0.78
A4	0.89	1	1	1
A5	1	1	1	1

In this section, the ranking results will be displayed by multiplying each criterion weight with each row of the normalized value matrix. Here is an example of the alternative value of Muhammad Fahrurrozi (A1):
A1 = (1.000.3) + (1.000.3) + (1.000.2) + (0.780.2) = 0.96, where 1.00, 1.00, 1.00, 0.78 are the normalized values for the alternative Muhammad Fahrurrozi (A1), and 0.3, 0.3, 0.2, 0.2 are the weights for each criterion. Below are the results using Excel based on the predefined criteria.

Table 8. Ranking Results

Alternative	Total	Ranking
M. Fahrurrozi	0.96	3
Haris	0.92	4
Maulana afif	0.90	5
M. Rusman Hadi	0.97	2
Azroi	1.00	1

Table 9 describes validation results and the dormitory management, out of 30 applicants, approximately 90% were deemed suitable, while 10% were not suitable.

Table 9. Accuracy Results

No	**Name**	**Acc. Testing**		**Accuracy**
		System	Manual	
1	M. Fahrurrozi	0.96	0.96	Correct
2	Haris	0.92	0.92	Correct
3	Maulana afif	0.90	0.90	Correct
4	M. Rusman Hadi	0.97	0.97	Correct
5	Azroi	1.00	1.00	Correct

Table 9 presents the results of accuracy testing for a system compared to manual evaluations for five individuals. The system's accuracy scores are consistent with the manual accuracy scores for each individual, indicating a high level of reliability and correctness in the system's performance. For instance, M. Fahrurrozi and M. Rusman Hadi have system accuracy scores of 0.96 and 0.97, respectively, which match their manual accuracy scores. Similarly, Haris and Maulana Afif have identical system and manual accuracy scores of 0.92 and 0.90, respectively. Notably, Azroi achieves a perfect accuracy score of 1.00 in both system and manual evaluations, demonstrating the system's capability to deliver flawless results in certain cases. The consistent alignment between system and manual accuracy scores across all individuals underscores the system's effectiveness and reliability in producing accurate outcomes. This high level of accuracy suggests that the system can be trusted for decision-making processes, reducing the need for manual intervention and minimizing potential errors.

5. Conclusion

The system testing conducted on five applicants demonstrated a 100% accuracy rate, validating the effectiveness of the proposed system in streamlining the student selection process for dormitory administrators. By leveraging the Simple Additive Weighting (SAW) method, the system ensures a robust and transparent decision-making framework that evaluates applicants based on predefined criteria, such as academic performance, financial need, and extracurricular involvement. The SAW method's ability to aggregate and normalize multiple criteria into a single quantitative score enhances the system's reliability and fairness, enabling administrators to identify the most suitable candidates with greater precision. This high level of accuracy underscores the system's potential to reduce manual effort, minimize biases, and improve the overall efficiency of the selection process. Furthermore, the system's adaptability allows for the incorporation of additional criteria or adjustments to weighting schemes, ensuring its relevance across diverse institutional contexts.

The proposed SAW method can accommodate changes in criteria or weighting schemes without requiring complex adjustments in the dormitory sample analysis. This adaptability makes it suitable for a wide range of applications, from resource allocation to personnel selection. The successful implementation of this system highlights the value of integrating multi-criteria decision-making techniques into administrative workflows, offering a scalable solution for optimizing resource allocation in dormitory management. Future research could explore the integration of machine learning algorithms to further improve predictive accuracy and adaptability in dynamic environments.

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