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Decision Support System for Priority Calculation of Travel Routes using Analytical Hierarchy Process

Rahadian Muhammad Izha [1,*] and Yogi Ramadhani [2]

[1,2] University of Jenderal Soedirman, Purwokerto, Banyumas, Jawa Tengah, Indonesia
[1] rahadian.izha@mhs.unsoed.ac.id*; [2] Yogi.ramadhani@gmail.com
*corresponding author

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Abstract

Currently, selecting a route to reach a specific destination has become more convenient due to map and navigation services such as Google Maps, Apple Maps, Bing Maps, OpenStreetMap, and many more. These services provide users with the most efficient routes using their own algorithms. However, we believe that users would obtain more convincing results if they could choose a route based on their own criteria. This paper proposes a method for selecting a route using the Analytical Hierarchy Process (AHP). AHP allows users to choose criteria, whether subjective or objective, to compare values and calculate priorities, resulting in more convincing results for users. By using AHP, users can determine the most suitable route according to their preferences and needs, providing a more personalized and satisfactory experience. This method could be expanded in the future by integrating machine learning algorithms and real-time traffic data to further improve the accuracy of the selected route.

Keywords: DSS, MCDM, AHP

1. Introduction

In today's fast-paced world, where time is of the essence, efficient travel planning has become increasingly essential. People often face the challenge of choosing the best travel route among the numerous available options. A decision support system (DSS) can be an effective tool to aid decision-making in such situations. The Analytical Hierarchy Process (AHP) is a popular method used in DSS for prioritising alternatives based on specific criteria.

Despite the numerous mapping and navigation services available today, users often face difficulties in selecting the best travel route based on their preferences and priorities. These services generally provide the shortest travel distance or time, which may not always align with a user's individual needs, such as safety, cost-effectiveness, or scenic value. Therefore, there is a need for a DSS that can incorporate user preferences and calculate the priority of travel routes based on specific criteria. This study proposes a DSS for priority calculation of travel routes using the Analytical Hierarchy Process (AHP) to help users make more informed travel decisions.

The initial definitions of a Decision Support System (DSS) identified it as a tool designed to aid managerial decision-makers in situations where decisions are semi-structured. DSS were intended to be a supplement to decision-makers, providing them with additional capabilities while not replacing their judgement. They were targeted at decisions where human judgement was necessary or at decisions that could not be completely supported by algorithms [1]. A DSS collects and analyses data, synthesises it, and produces comprehensive information reports. The DSS can be completely automated or powered by human input, or a combination of both. Ideally, the system should analyze information and make decisions for the user. At the very least, it should help human users make more informed decisions quickly [2]. Among many DSS systems, the Analytical Hierarchy Process (AHP) is well known for its simplicity in decision-making.

The Analytical Hierarchy Process (AHP) (Forman and Selly, 2001; Saaty, 1999) is an excellent technique for selecting competing activities based on distinct criteria. The criteria can be quantitative or qualitative, and even quantitative criteria are evaluated based on a decision maker's preference structure rather than numerically [3,4]. AHP was first developed by Thomas L. Saaty in the 1970s and has been refined since then. AHP consists of three parts: the ultimate goal or problem to be solved, all of the possible solutions (alternatives), and the criteria used to evaluate the alternatives. AHP provides a logical framework for making decisions by quantifying the criteria and alternative options and relating them to the overall goal [5].

Well-known map services, such as Google Maps, essentially use two graph algorithms – Dijkstra's algorithm and A* algorithm – to determine the shortest distance between two points, typically a source and a destination [6]. These map services now offer various useful features, including place recommendations, travel planning tools, real-time traffic updates, and many more. However, AHP could also be used to choose a route. AHP has some advantages because it takes a more personalized approach to the chosen criteria, and the values of alternatives are entirely determined by the user's decisions. As a result, the output is more likely to reflect the user's ideal choice. This paper describes a method that uses the user's subjective preferences to calculate the priorities of the provided alternatives.

2. Literature Review

Analytic Hierarchy Process (AHP) is a decision-making framework developed by Dr. Thomas L. Saaty in the 1970s. It is a systematic and structured approach to prioritize and select alternatives based on a set of criteria and their relative importance. AHP is widely used in many fields, including business, engineering, healthcare, and public policy [7].

The AHP method involves breaking down a complex decision problem into a hierarchical structure consisting of a goal, criteria, and alternatives. The goal is the ultimate objective of the decision, while the criteria are the factors that must be considered in achieving the goal. The alternatives are the possible solutions to the decision problem. The hierarchical structure allows decision-makers to analyze the decision problem at different levels of detail.

The AHP process involves assigning weights to the criteria and alternatives based on their relative importance. The weights are determined through pairwise comparisons, where each criterion and alternative is compared to every other criterion and alternative in terms of their importance. The comparisons are done using a numerical scale ranging from 1 (equal importance) to 9 (extreme importance) [8].

Once the pairwise comparisons are completed, AHP calculates a priority score for each alternative based on the weights assigned to the criteria and the importance of each criterion. The alternative with the highest priority score is considered the best solution to the decision problem. A sensitivity analysis can be performed to determine the robustness of the decision by testing the results under different scenarios [9].

AHP has several advantages over other decision-making methods. It provides a structured approach to decision-making, ensuring that all factors are considered and weighted appropriately. AHP also allows decision-makers to incorporate their subjective judgments into the decision-making process, making it more flexible and responsive to changes. Additionally, AHP can handle both quantitative and qualitative data, making it suitable for complex and diverse decision problems [10].

AHP is a powerful decision-making tool that can be used to make informed and effective decisions in a wide range of fields. Its structured approach and flexibility make it an ideal choice for decision-makers who need to consider multiple criteria and alternatives. By using AHP, decision-makers can make well-informed decisions that are based on a comprehensive analysis of the decision problem [11].

Geographic Information System (GIS) is a powerful tool used to collect, analyze, and present geographic data. It is a computer-based system that is designed to capture, store, manipulate, analyze, and display spatial or geographical data. The system is capable of analyzing large amounts of data to identify patterns, relationships, and trends that can be used to make informed decisions. GIS technology is widely used in fields such as urban planning, resource management, environmental monitoring, and emergency response [12].

The GIS system is composed of hardware, software, data, and people. The hardware includes computers, printers, scanners, and other devices used to collect, store, and process data. The software includes GIS applications that are used to manipulate and analyze data, such as ESRI's ArcGIS, QGIS, and Google Earth. The data includes maps, satellite images, aerial photographs, and other geographic information. The people include GIS professionals, such as analysts, developers, and managers, who use the system to solve complex problems [13].

GIS technology uses a variety of methods to collect data, including remote sensing, global positioning systems (GPS), and field surveys. Once the data is collected, it is stored in a database where it can be accessed and analyzed. The GIS system allows users to create maps and other visual representations of data, which can be used to identify patterns and relationships. The system also allows users to create simulations, which can be used to test scenarios and evaluate the impact of different decisions [14].

GIS technology has a wide range of applications in different fields. In urban planning, GIS is used to develop land-use plans, identify transportation networks, and assess the impact of development on the environment. In resource management, GIS is used to manage forests, water resources, and wildlife habitats. In environmental monitoring, GIS is used to track the spread of pollution, monitor weather patterns, and predict natural disasters. In emergency response, GIS is used to identify the location of emergency services and provide real-time updates to emergency personnel [15].

In conclusion, Geographic Information System (GIS) is a powerful tool that allows users to collect, analyze, and present geographic data. The system is composed of hardware, software, data, and people, and uses a variety of methods to collect data. GIS technology has a wide range of applications in different fields, including urban planning, resource management, environmental monitoring, and emergency response. With its ability to analyze large amounts of data and identify patterns and trends, GIS is an essential tool for making informed decisions.

Technology has revolutionized the way we gather information. With the advent of the internet and powerful search engines, collecting data has become a lot easier. However, decision-making has become more challenging as we are faced with a vast amount of information. Human beings are not naturally equipped to handle complex decisions that involve multiple factors, particularly when it comes to making decisions as a whole organization or company [16].

The Analytic Hierarchy Process (AHP) is a powerful yet simple method for decision-making that allows users to rate criteria based on their preferences. Many studies have explored the use of map-based AHP integrated with Geographic Information System (GIS) to help make decisions in a variety of fields, including renewable energy, agriculture, urban development, and groundwater prospecting [17].

Despite the many successful applications of AHP, there are few studies on its use for choosing travel routes. One reason for this is that AHP does not support navigation features, and it can only be used by users who are already familiar with the routes they want to take. This study aims to explore the implementation of AHP for choosing the most suitable travel route [18]. The researchers believe that AHP can be applied to the problem of choosing travel routes, particularly for users who have multiple destinations and need to prioritize their options based on different criteria, such as distance, time, and cost. The study will evaluate the effectiveness of using AHP for choosing travel routes by comparing the results with those obtained from traditional methods. The researchers hope that their findings will encourage the adoption of AHP in the field of transportation and inspire further research on the use of AHP for decision-making in other domains.

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3. Method

The Analytical Hierarchy Process (AHP) is a decision-making method that allows users to compare and prioritize multiple criteria based on their relative importance. AHP is based on the principle that complex decisions can be broken down into smaller, more manageable components, and that these components can be compared and weighted according to their relative importance [19]. In this study, the problem presented is to decide the best route a student should take from the administration office of the University of Jenderal Soedirman (point A) to the Engineering faculty of University of Jenderal Soedirman (point B). There are four main routes available, and the goal is to determine the most efficient and effective route. There will be 4 main routes available on this study, as shown in figure 1.

To use AHP, the first step is to identify the criteria that will be used to evaluate the different routes. These criteria could include factors such as distance, travel time, safety, and ease of navigation. Once the criteria are identified, they are ranked in order of importance using pairwise comparisons. For example, the user might compare distance and travel time and decide that distance is more important. Next, a decision matrix is created to evaluate each route based on the identified criteria [20-22]. The matrix includes the different routes as columns and the identified criteria as rows. The user then compares each route to the others for each criterion, assigning a numerical score that reflects the relative performance of each route. Using the scores in the decision matrix, the AHP algorithm calculates the relative importance of each criterion and generates a weighted score for each route. The route with the highest weighted score is considered the best choice.

Finally, the results are presented and interpreted. In this study, the AHP analysis may reveal that the shortest route is not necessarily the best route based on other criteria such as travel time and safety. The results can be used to make informed decisions and improve decision-making processes in a wide range of applications.

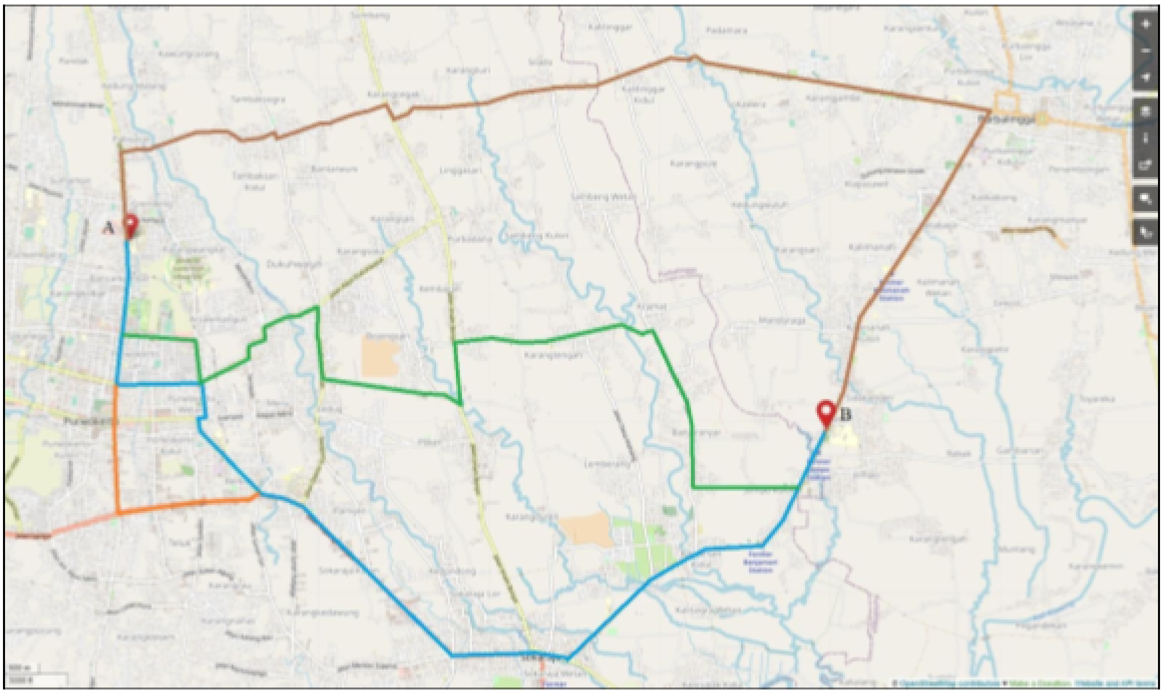

Figure 1. Map showing alternatives route shown in colours of blue, orange, green and green (picture taken from OpenStreetMap)

The passage you provided describes the application of the Analytic Hierarchy Process (AHP) to weigh solutions based on multiple criteria. AHP is a decision-making technique that allows decision-makers to prioritize and evaluate multiple options based on a set of criteria. In this particular case, the goal is to determine the best route to take for a given trip. The criteria for evaluating the alternatives are distance, road conditions, petrol cost, traffic at seven in the morning, and traffic at four in the afternoon. The alternatives are the four routes shown in Fig 1: Sokaraja, Andhang-pangrenan, Dukuhwaluh, and Padamara.

The AHP process starts with defining the goal and alternatives. In this case, the goal is to find the best route, and the alternatives are the four routes mentioned above. The next step is to define the problem and decision criteria. The problem is how to select the best route, and the criteria are distance, road conditions, petrol cost, traffic at seven in the morning, and traffic at four in the afternoon.

After the criteria have been defined, the relative value or priority of each criterion is assessed. This involves comparing each criterion against every other criterion to determine their relative importance. For example, the importance of distance compared to road conditions, or petrol cost compared to traffic at seven in the morning. Once the priorities of the criteria have been established, the weights of the criteria and alternative's priorities are calculated. This involves assigning a numerical weight to each criterion based on its relative importance, and then using those weights to calculate the overall priority of each alternative. Finally, the inconsistency of judgments is analyzed to ensure that the decision-making process is consistent and logical. This involves checking for inconsistencies in the pairwise comparisons made during the assessment of the criteria's priorities.

In summary, the passage describes the application of the AHP technique to weigh solutions based on multiple criteria. This process involves defining the goal and alternatives, defining the problem and decision criteria, assessing the relative value or priority of each criterion, calculating the weights of the criteria and alternative's priorities, and analyzing the consistency of judgments.

4. Results and Discussion

4.1. Definition of goal and criterias

The study aims to use the Analytic Hierarchy Process (AHP) to help make a decision regarding route selection. AHP is a decision-making method that prioritizes criteria and alternatives by breaking down a problem into a hierarchy of criteria and sub-criteria, then comparing and weighing them to determine the best option. In this case, the decision is regarding the best route to take from the administration office of the University of Jenderal Soedirman to the Engineering faculty of the same university.

To determine the best route, the study considered five criteria: distance, road conditions, petrol cost, traffic at 7 am, and traffic at 4 pm. Each criterion was assigned a weight based on its importance in the decision-making process. For example, if distance was deemed more important than road conditions, it would have a higher weight. The weights are usually determined through a pairwise comparison, where each criterion is compared to every other criterion to determine its relative importance.

After the criteria were weighted, the study evaluated each route option based on the criteria. For example, the distance of each route was measured, the road conditions were evaluated, and the estimated petrol cost was calculated. The study also considered the traffic at 7 am and 4 pm by examining historical traffic patterns and predicting congestion levels.

Using the AHP method, the study was able to compare and weigh each criterion and alternative, ultimately determining the best route to take from the administration office to the Engineering faculty. By considering multiple criteria and assigning weights to them, the AHP method helps to make informed decisions that take into account the different factors that contribute to a decision. In this case, the AHP method helped the student from the administration office of the University of Jenderal Soedirman to choose the best route to reach the Engineering faculty, taking into account important factors such as distance, road conditions, petrol cost, and traffic patterns.

4.2. Comparison of the decision criterion based on pairwise comparison

The process described in the statement is known as pairwise comparison, which is a decision-making technique used to determine the relative importance or priority of different criteria or options. In this case, the objective is to compare five criteria, and pairwise comparison is used to gain the priorities of each criterion. Pairwise comparison involves creating a matrix that allows the user to judge and scale each criterion to each other criterion. The user needs to assign a numerical value to each comparison in the matrix, which indicates the dominance of one element compared to another. The scale ranges from 1 to 9, with 1 indicating equal importance and 9 indicating extreme importance.

Table 1 below is an example of a pairwise comparison decision matrix. The rows and columns of the matrix represent the five criteria being compared. The numbers in the cells of the matrix represent the importance or priority of one criterion over another. For example, if the user believes that criterion A is more important than criterion B, they would enter a higher number in the cell where row A and column B intersect. Once the pairwise comparison matrix is completed, the next step is to calculate the priorities of each criterion. This is done by summing the values in each row of the matrix and dividing by the total number of criteria being compared. The resulting values represent the relative priorities of each criterion, with higher values indicating greater importance.

Pairwise comparison is a useful tool for decision-making because it allows users to objectively compare different criteria or options based on their relative importance. By using a systematic approach to decision-making, users can make informed choices that are based on sound reasoning and analysis. However, it is important to note that the results of pairwise comparison are dependent on the judgments and values of the user, and may not be applicable in all situations.

Table 1. Pairwise decision matrices of the criteria

	Distance	**Road conditions**	**Petrol cost**	**Traffic at 7 am**	**Traffic at 4 pm**
Distance	1	0,142857	2	3	0,5
Road conditions	7	1	6	5	5
Petrol cost	0,5	0,166667	1	0,5	0,5
Traffic at 7 am	0,333333	0,2	2	1	1
Traffic at 4 pm	2	0,2	2	1	1
Total value	10,83333	1,709524	13	10,5	8

4.3. Calculation of the relative value or priority of each decision criterion

In multi-criteria decision-making, pairwise comparison is a commonly used method to evaluate the relative importance of different criteria. The result of the pairwise comparison is a decision matrix, which lists the pairwise comparisons of each criterion against every other criterion. Table 1 represents a pairwise decision matrix of the criteria. Each cell in the matrix shows the relative importance of the criterion in the row compared to the criterion in the column. For example, in the first row and second column, the value of 5 indicates that the first criterion is considered more important than the second criterion.

After constructing the decision matrix, the next step is to normalize the values to eliminate any bias introduced by the scale of the criteria. Normalization is achieved by dividing each value in the matrix by the total of the column, which ensures that the weights of each criterion add up to 1. Table 2 represents the result of normalizing the numbers in Table 1. To obtain the normalized value for each cell, the value in the cell is divided by the sum of the column. For example, the normalized value in the first row and second column is 0.45, which is calculated by dividing 5 by the sum of the column. The normalized decision matrix is useful in determining the relative importance of each criterion in the decision-making process. The normalized values can be used to calculate the weighted sum of each criterion, which is a measure of its overall importance in the decision-making process.

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Overall, normalizing the decision matrix helps to eliminate any bias that may arise due to differences in the scale of the criteria, and it ensures that each criterion is given an appropriate weight in the decision-making process.

Table 2. Normalisation on each value of the criterias

	Distance	**Road conditions**	**Petrol cost**	**Traffic at 7 am**	**Traffic at 4 pm**
Distance	0,092308	0,083565	0,153846	0,285714	0,0625
Road conditions	0,646154	0,584958	0,461538	0,47619	0,625
Petrol cost	0,046154	0,097493	0,076923	0,047619	0,0625
Traffic at 7 am	0,030769	0,116992	0,153846	0,095238	0,125
Traffic at 4 pm	0,184615	0,116992	0,153846	0,095238	0,125

Then, perform an eigenvector calculation on each criteria to determine the priority by adding all the criteria values across the rows of the table and calculate the average. The result is shown on Table 3 below.

Table 3. Eigenvector calculation of the criterias

	Distance	**Road conditions**	**Petrol cost**	**Traffic at 7 am**	**Traffic at 4 pm**
Priorities	0,135587	0,558768	0,066138	0,104369	0,135138
Rank	2	1	5	4	5

Lastly, check whether the judgement scale is consistent using Consistency Ratio. We will use Saaty's original consistency ratio (CR) calculation:

$$CR = \frac{\lambda max - n}{(n-1)RI_n} \quad (1)$$

Where:
λmax : Principal eigenvalue
n : Size of comparison matrix
RI : Random consistency index

In order to find CR, firstly the principal eigenvalue is obtained from the summation of products between each element of the eigenvector and the sum of column of pairwise decision matrices of the criterias.

$$\lambda max = 10,83(0,0,135587) + 1,71(0,558768) + 13(0,066138) + 10,5(0,104369) + 8(0,135138) \quad (2)$$
$$\lambda max = 5,5538 \quad (3)$$

Random consistency index is used to see whether the CR is about 10% or less. The average random consistency index of sample size 500 is shown in Table 4. below.

Table 4. Pairwise decision matrices of the criteria

n	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
RI	0	0	0,58	0,9	1,12	1,24	1,32	1,41	1,45	1,49

Now the consistency ratio (CR) is able to be calculated. If the value of Consistency Ratio is smaller or equal to 10%, the inconsistency is acceptable. If the Consistency Ratio is greater than 10%, then need to revise the subjective judgement [13].

$$CR = \frac{\lambda max - n}{(n-1)RI_n} \quad (1)$$
$$CR = \frac{5,5538-5}{(5-1)1,12} \quad (4)$$
$$CR = \sim 10\% \leq 10\% \quad (5)$$

4.4. Comparison of the alternatives based on pairwise comparison

The given statement refers to a decision-making process that involves comparing four alternative routes: Sokaraja, Andhang-pangrenan, Dukuhwaluh, and Padamara. These routes are shown in Figure 1. The purpose of the comparison is to determine which route is the most suitable option based on various criteria or factors. To perform this comparison, a criteria comparison approach is used. This approach involves comparing each alternative to another based on each criterion. For example, the first criterion could be distance, and the alternatives will be compared based on the distance between each pair of routes. Similarly, other criteria such as road condition, traffic flow, and scenery could be used to compare the alternatives.

To compare the alternatives, pairwise decision matrices are used. These matrices allow for a side-by-side comparison of each pair of alternatives based on a specific criterion. For example, Table 5 could be the pairwise decision matrix for the distance criterion. Each cell in the matrix will represent the relative distance between a pair of routes, such as the distance between Sokaraja and Andhang-pangrenan. The comparison process involves assigning scores or weights to each alternative based on how well they meet each criterion. For example, if the distance criterion is essential, a higher weight could be given to the alternative that has the shortest distance. Once the scores are assigned, they are used to calculate a final score for each alternative, which represents their overall suitability.

By using this approach, decision-makers can make an informed choice based on a comprehensive evaluation of each alternative. They can also identify the strengths and weaknesses of each route and take steps to mitigate any potential issues. Ultimately, the goal is to select the route that is the most efficient, safe, and cost-effective, while also meeting other criteria such as environmental impact and community concerns.

Table 5. Pairwise decision matrices of alternatives based on distance

	Sokaraja route	**Andhang-pangrenan route**	**Dukuhwaluh route**	**Padamara route**
Sokaraja route	1	2	0,333333	4
Andhang-pangrenan route	0,5	1	0,25	5
Dukuhwaluh route	3	4	1	6
Padamara route	0,25	0,2	0,166667	1
Total value	4,75	7,2	1,75	16

Table 6. Pairwise decision matrices of alternatives based on road conditions

	Sokaraja route	**Andhang-pangrenan route**	**Dukuhwaluh route**	**Padamara route**
Sokaraja route	1	1	0,333333	2
Andhang-pangrenan route	1	1	0,333333	2
Dukuhwaluh route	3	3	1	4
Padamara route	0,5	0,5	0,25	1
Total value	5,5	5,5	1,916666	9

Table 7. Pairwise decision matrices of alternatives based on petrol cost

	Sokaraja route	**Andhang-pangrenan route**	**Dukuhwaluh route**	**Padamara route**
Sokaraja route	1	3	0,5	3
Andhang-pangrenan route	0,333333	1	0,25	2
Dukuhwaluh route	2	4	1	5
Padamara route	0,333333	0,5	0,2	1

Total value	3,666666	8,5	1,95	11

Table 8. Pairwise decision matrices of alternatives based on traffic at 7 am

	Sokaraja route	**Andhang-pangrenan route**	**Dukuhwaluh route**	**Padamara route**
Sokaraja route	1	2	0,333333	4
Andhang-pangrenan route	0,5	1	0,25	4
Dukuhwaluh route	3	4	1	5
Padamara route	0,25	0,25	0,2	1
Total value	4,75	7,2	1,783333	15

Table 9. Pairwise decision matrices of alternatives based on traffic at 4 pm

	Sokaraja route	**Andhang-pangrenan route**	**Dukuhwaluh route**	**Padamara route**
Sokaraja route	1	3	0,333333	5
Andhang-pangrenan route	0,333333	1	0,25	4
Dukuhwaluh route	3	4	1	9
Padamara route	0,2	0,25	0,111111	1
Total value	5,533333	8,25	1,611111	19

4.5. Calculation of the relative value or priority of each alternatives set

The method described is a commonly used approach in multi-criteria decision making (MCDM) that employs the Analytic Hierarchy Process (AHP) methodology. AHP is a decision-making technique that evaluates and prioritizes multiple criteria and alternatives by breaking down complex decisions into simpler, more manageable parts. to calculate priority, the first step is to normalize the numbers in each column of the decision matrix. This is done by dividing each value in the column by the total of that column. Normalization ensures that all criteria are given equal weight and allows for meaningful comparison between criteria. Next, an eigenvector calculation is performed on each alternative in the decision matrix. Eigenvectors are mathematical calculations that represent the relative importance of each criterion in the decision-making process. The eigenvector calculation is done by adding up all the alternative values across the rows of the table and then calculating the average.

Once the eigenvectors for each alternative have been calculated, the next step is to find the eigenvalue for each criterion. The eigenvalue represents the degree of consistency between the criteria and is calculated by multiplying the eigenvector value for each alternative by the corresponding normalized criteria weight. Finally, the consistency ratio (CR) is calculated by dividing the consistency index by the random consistency index. The CR is a measure of how consistent the decision-making process is, with a lower value indicating greater consistency. The results of this process are typically presented in a consolidated table that shows the priority of each alternative based on the calculated eigenvectors and eigenvalues. The AHP methodology is a useful tool for decision-making processes that involve multiple criteria and alternatives, as it allows decision-makers to consider all relevant factors and make informed decisions based on a structured and systematic approach.

The method to calculate priority is the same as before. First normalisation of the numbers by dividing each value by the total of the column. Then, perform an eigenvector calculation on each alternative to determine the priority by adding all the alternative values across the rows of the table and calculate the average. Last is to find the eigenvalue to calculate the consistency ratio (CR). The results will be shown in the consolidated table for each of the alternatives set below.

Table 10. Calculation of alternatives to determine priority based on distance criterion

	Sokaraja route	**Andhang-pangrenan route**	**Dukuhwaluh route**	**Padamara route**
Sokaraja route	0,210526	0,277778	0,190476	0,25
Andhang-pangrenan route	0,105263	0,138889	0,142857	0,3125
Dukuhwaluh route	0,631579	0,555556	0,571429	0,375
Padamara route	0,052632	0,027778	0,095238	0,0625
Eigenvector or Priority	0,232195	0,174877	0,533391	0,059537
Rank	2	3	1	4
Eigenvalue	4,248067317			
Consistency Ratio	0,091876784 = 9,18%			

Table 11. Calculation of alternatives to determine priority based on road conditions criterion

	Sokaraja route	**Andhang-pangrenan route**	**Dukuhwaluh route**	**Padamara route**
Sokaraja route	0,181818	0,181818	0,173913	0,222222
Andhang-pangrenan route	0,181818	0,181818	0,173913	0,222222
Dukuhwaluh route	0,545455	0,545455	0,521739	0,444444
Padamara route	0,090909	0,090909	0,130435	0,111111
Eigenvector or Priority	0,189943	0,189943	0,514273	0,105841
Rank	2	3	1	4
Eigenvalue	4,027630921			
Consistency Ratio	0,010233674 = 1,02%			

Table 12. Calculation of alternatives to determine priority based on petrol cost criterion

	Sokaraja route	**Andhang-pangrenan route**	**Dukuhwaluh route**	**Padamara route**
Sokaraja route	0,272727	0,352941	0,25641	0,272727
Andhang-pangrenan route	0,090909	0,117647	0,128205	0,181818
Dukuhwaluh route	0,545455	0,470588	0,512821	0,454545
Padamara route	0,090909	0,058824	0,102564	0,090909
Eigenvector or Priority	0,288702	0,129645	0,495852	0,085801
Rank	2	3	1	4
Eigenvalue	4,07128079			
Consistency Ratio	0,026400293 = 2,64%			

Table 13. Calculation of alternatives to determine priority based on traffic at 7 am criterion

	Sokaraja route	**Andhang-pangrenan route**	**Dukuhwaluh route**	**Padamara route**
Sokaraja route	0,210526	0,275862	0,186916	0,285714
Andhang-pangrenan route	0,105263	0,137931	0,140187	0,285714
Dukuhwaluh route	0,631579	0,551724	0,560748	0,357143
Padamara route	0,052632	0,034483	0,11215	0,071429

Eigenvector or Priority	0,239755	0,167274	0,525298	0,067673
Rank	2	3	1	4
Eigenvalue	4,235775447			
Consistency Ratio	0,08732424 = 8,73%			

Table 14. Calculation of alternatives to determine priority based on traffic at 4 pm criterion

	Sokaraja route	**Andhang-pangrenan route**	**Dukuhwaluh route**	**Padamara route**
Sokaraja route	0,220588	0,363636	0,196721	0,263158
Andhang-pangrenan route	0,073529	0,121212	0,147541	0,210526
Dukuhwaluh route	0,661765	0,484848	0,590164	0,473684
Padamara route	0,044118	0,030303	0,065574	0,052632
Eigenvector or Priority	0,261026	0,138202	0,552615	0,048156
Rank	2	3	1	4
Eigenvalue	4,174834805			
Consistency Ratio	0,064753631 = 6,47%			

4.6. The final result with consolidated priorities

The excerpt you provided refers to the Analytic Hierarchy Process (AHP) method, which is a decision-making tool used to evaluate and prioritize alternatives based on a set of decision criteria. In this case, the AHP method was used to evaluate four different routes and determine which one should be selected based on certain criteria. The excerpt explains that the priorities of decision criteria and alternatives have been determined using the AHP method.

To make the results of the AHP method easier to understand, the priorities are gathered in one place, which is shown in Table 15. The table presents the results of the study in a clear and concise way, making it easy for decision-makers to see which route is the best choice based on the criteria that were evaluated. According to the results presented in Table 15, the Dukuhwaluh route ranked first with a priority of 52.42%, meaning that it was the best route based on the decision criteria evaluated. The Sokaraja route ranked second with a priority of 24.23%, followed by the Andhang-pangrenan route with a priority of 15.99%. The Padamara route ranked last with a priority of 7.34%.

Overall, the excerpt highlights how the AHP method can be used to make informed decisions by evaluating alternatives based on a set of decision criteria. By gathering the priorities in one place and presenting the results in a clear and concise way, decision-makers can easily see which alternative is the best choice based on the criteria evaluated.

Table 15. AHP result with consolidated priorities

Travel route from the administration office of the University of Jenderal Soedirman to the Engineering faculty of University of Jenderal Soedirman					
Decision	***Priority***	***Alternatives***			
		Sokaraja route	***Andhang-pangrenan route***	***Dukuhwaluh route***	***Padamara route***
Distance	13,55%	23,21%	17,48%	53,33%	5,95%
Road conditions	55,87%	18,99%	18,99%	51,42%	10,58%
Petrol cost	6,61%	28,87%	12,96%	49,58%	8,58%
Traffic at 7 am	10,43%	23,97%	16,72%	52,52%	6,76%
Traffic at 4 pm	13,51%	26,10%	13,82%	55,26%	4,81%
Average		24,23%	15,99%	52,42%	7,34%

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5. Conclusion

The Analytical Hierarchy Process (AHP) is a decision-making tool that allows for the ranking of alternatives based on a set of criteria. In this case, AHP was used to determine the best route for a student to take from the administration office to the Engineering faculty of the University of Jenderal Soedirman. The process involved the identification of relevant criteria, such as distance, travel time, and ease of navigation. Pairwise comparisons were then used to establish the relative importance of each criterion. For example, the student may have determined that travel time was more important than ease of navigation, and so assigned a higher weight to that criterion. The eigenvector and eigenvalue calculations were then used to combine the results of the pairwise comparisons and generate a priority ranking for each alternative.

In this case, the Dukuhwaluh route was identified as the best option, with a priority of 52.42%. This means that, according to the criteria identified by the student, the Dukuhwaluh route was the most desirable option for travelling between the two locations. However, it is important to note that AHP is not a navigation tool and does not take into account other factors such as road conditions or real-time traffic information. Therefore, it may not be the most effective way to make decisions about travel routes. On the other hand, AHP could be a useful tool for prioritizing alternatives when it comes to human matters, such as tourist spots or vacation destinations. For example, a person may use AHP to determine which tourist attractions to visit based on factors such as historical significance, cultural relevance, and personal interest. In conclusion, while AHP can be a useful decision-making tool for ranking alternatives based on specific criteria, it should be used in conjunction with other tools, such as map and navigation services, to make effective decisions about travel routes.

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