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Strategies to Improve Public Transportation Services for Students of The University of Bengkulu

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ABSTRACT

The choice of transportation mode is an important aspect in student mobility, especially in a higher education environment with a high level of activity. Students tend to choose transportation modes based on cost, travel time, convenience, accessibility, and safety. However, the high use of private vehicles among students has led to an increase in traffic congestion and traffic accidents, as seen in Bengkulu City. On the other hand, the suboptimal quality of public transportation services contributes to the low interest of students to use public transport. This study aims to analyze the factors that influence the choice of transportation mode of Bengkulu University students and evaluate the effectiveness of public transport services. The method used is binary logistic regression analysis combined with stated preference to understand mode preference based on a comparison of cost and travel time. The results of the mode choice model show that students prefer private vehicles unless public transportation offers more competitive costs and travel times. The study results show that cost and travel time are the most influential factors in mode choice. If public transportation is more affordable or offers shorter travel times, then students will be more likely to switch to public transportation. This study concludes that improving the quality of public transportation services, especially in terms of cost efficiency and timeliness, can increase students' interest in using public transportation, thus supporting a more sustainable transportation system.

KEYWORDS *mode choice, logistic regression, public transportation.*

INTRODUCTION

The choice of transportation mode is an important aspect of daily life, especially for students who have high mobility. Students' decisions in choosing a mode of transportation are influenced by various factors, such as convenience, cost, travel time, accessibility, and safety. With the increasing number of students in various universities, understanding their preferences in choosing modes of transportation is becoming increasingly relevant, both for the government, transportation service providers, and educational institutions. The transportation system consists of a service network consisting of facilities, infrastructure,

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management, and human resources. Eligibility, certification, signage, navigation, human resources, geography, and demographics are the main elements of the transportation system (Dodi & Nahdalina, 2019).

Students as a dynamic group of transportation users have complex patterns of density, especially in accessing campuses and other places of activity. Previous studies have shown that students tend to choose modes of transportation that are more efficient in terms of cost and time (Ilham et al., 2020). However, the high use of private vehicles among students can cause new problems, such as traffic congestion and an increase in the number of accidents. According to reports, as many as 73% of vehicles involved in traffic accidents are private vehicles in Bengkulu City. Data released by the National Police Corps in 2021 showed that as many as 103,645 traffic accidents occurred, with students and students as the most vulnerable group to accidents (Bengkulu City Lakantas Report).

Based on data until August 2024, there were 939 victims of traffic accidents in Bengkulu, with 362 victims coming from students and university students. The number of cases of this accident has increased by more than 30% compared to the previous year (Central Statistics Agency of Bengkulu City, 2023). The main factors that cause the high number of accidents among students include the lack of transportation infrastructure that supports safety, the use of private vehicles that do not meet standards, and low awareness of traffic safety (Philip et al., 2023).

Conversely, poor public transportation services are also one of the reasons for the low interest of students to switch to public transportation. Factors such as the uncertainty of departure schedules, lack of supporting facilities, and uncomfortable vehicle conditions make students prefer private vehicles to public transportation (Yumita et al., 2020). In fact, previous research has shown that with the improvement of the quality of public transportation services, the potential for the use of public transportation as a substitute for private vehicles can increase significantly (Ferdiansyah, 2009).

Efforts to improve public transportation services for students have been implemented in various regions, such as the provision of special student transportation or campus buses that can reduce dependence on private vehicles. For example, re- search at Gadjah Mada University shows that the implementation of a well scheduled campus bus system can increase students' interest in using public transportation by up to 45%. A similar policy can be implemented at the University of Bengkulu to increase the effectiveness of public transportation for students.

The purpose of this study is to see what influences the transportation choices of students at the University of Bengkulu and how well public transportation services are available. By knowing the needs and preferences of students, it is hoped that a more efficient and user-friendly public transportation plan can be made to reduce dependence on private vehicles and support more sustainable mobility.

This research, which uses a binary logit approach, is expected to provide deeper insights into student behavior when choosing a mode of transportation. The results of this research can also help related parties in designing transportation policies or services that are more in line with the needs of students. In addition, this research can also contribute to the literature related to mobility behavior and transportation mode selection, especially among students. This study is expected to produce policy

recommendations that can help University of Bengkulu students use public transportation more efficiently and attractively.

RESEARCH METHODS

Stated Preference

A preference statement is made as a sign of this method. Most Stated Preference (SP) methods use experimental designs to create and provide respondents with a variety of options through questionnaires. Therefore, the variables shown can change independently. Indirect utility, or indirect utility, is the basis of this established preference technique (Damayanti et al., 2023). The Stated Preference method was used in this study because it allowed the researcher to present predetermined variables and characteristics to the respondents. Using this method, respondents were given a choice regarding the conditions that best suited their preferences through questionnaires or interviews. In this way, the results can meet the needs and expectations of transportation mode users (Dhanayani & Nurlaela, 2022).

Research data variables

The mode selection model aims to analyze and predict the proportion of users who choose each available mode of transportation. In this study, the method used is a binary logit model, which compares two alternative modes, namely mode i and mode j. This model calculates the probability of a person choosing one of the modes based on factors such as travel time, cost, and convenience. (Miro, 2005). The selection of the type of transportation used is one of the very important elements in transportation planning. Choosing a mode is the most important step in transportation planning. Public and private transportation are the two ways that will be used. Public transportation is essential for various transportation policies. The use of public space for public transportation is more efficient than private transportation (Budiman et al., 2022).

Two categories of variables were used in this study, namely independent variables and bound variables. The purpose of the preparation of these variables is so that the questionnaire that is prepared can show the problems that exist in the research model to be carried out. This study used four main variables: travel time in the vehicle (X1), waiting time outside the vehicle (X2), walking time (X3), and travel cost (X4). Previous research conducted by Marisa, M. M., Rumayar, A. L. E., and Jefferson, L. (2020) also used this independent variable.

To find out individual preferences, the stated preference approach is used by asking respondents directly about their level of certainty in choosing a mode of transportation. Respondents were given several choice of answers, ranging from "definitely using fashion transportation" to "definitely not using fashion transportation." The dependent variable in this study is the respondent's choice category
(Y). To analyze the data quantitatively, respondents' responses can be converted into probabilities or converted to numerical scales by scoring points. This transformation allows for further analysis in statistical models to understand the patterns of preferences and elements that influence respondents' decisions. In research methods, it is important to describe the type of research and the reasons for choosing the

chosen method. The reason for choosing the method must be supported by references.

Table 1. Calculation points in numerical scale

No.	Respondents' perception choices	Point
1.	Definitely use the bus	0,9
2.	Maybe use the bus	0,7
3.	Hesitate to use	0,5
4.	Definitely use a motorcycle	0,3
5.	Possible use of a motorized vehicle	0,1

Sufficiency of sample data

By maintaining a balance between supply and travel demand, transportation plays a crucial role in driving economic growth. The three main aspects of transportation benefits are economic, social, and political. From an economic perspective, transportation supports the production, distribution, and exchange of wealth or produce that is accessible to society. From a social perspective, transportation facilitates social interaction by providing services for individuals and groups, enabling the exchange of information, and supporting recreational travel. In addition, a good transportation system also has political benefits because it can create unity and justice, ensure more equitable services, and improve the country's security from external threats (Andriansyah, 2015).

The sample in this study includes various elements that represent population characteristics. The subjects of the study were consumers who made purchases in 2014. Since the number of Customade shoe user population is already known, this study uses a probability sampling method with a simple random sampling technique to ensure that every individual in the population has an equal chance of being selected as a sample. (Pradana et al., 2016) Since the population in this study is known, the authors used Slovin to calculate the number of samples:

$$n = \frac{N}{1 + N\ e^2}$$

with n = sample size, N = population size
and e = percent of the allowance of inaccuracy due to sampling errors that are still tolerable. The reliability rate is 90%, then the inaccuracy relaxation rate is 10%.

Based on statistical data from the University of Bengkulu, the number of active students was recorded at 19,273 people. To determine the number of research samples, using the Slovin formula so that the required number of samples is about 100 people.

Data Analysis

1. Binary logit regression

Meanwhile, to find out the significance relationship between free and bound variables, logistic binary regression analysis was used. Furthermore, a regression model from the research conducted was made. (Rahardjo et al., 2023). The mode selection model, which consists of only two mode alternatives, is called the binary logit model. The two most common types of modes are the difference model and

the ratio model, both of which can be solved by the liner regression estimation method (Tamin, 2019). The quantitative parameter that is often used as the main determinant in the choice of mode is the cost of travel or travel time, the proportion of P1 for mode 1 is expressed in the formula:

$$P1 = \frac{1}{(1+\alpha(\frac{c1}{c2})^{\beta}}$$

with P1 = proportion of mode 1 selection, C1 = total combined cost in mode 1, C2 = total combined cost in mode 2, α = antilogarithmic of the intercept (A) at Y1= A + B X1 and β= The coefficient of the variable is free or equal to B.

2. Direct elasticity

Indirect elasticity is a function of the change in the unit value of the variable of the mode service in question, while direct elasticity is a function of the change in the unit value of the variable of the mode service variable in question (Ananda et al., 2023).

$$E = \frac{\partial F}{\partial X} \frac{X}{F} \quad (2.6)$$

with E = elasticity of Y to changes in X, Y = non-free variables, X = independent variables, ∂Y and ∂X = changes in variables Y and X.

Elasticity can be used to determine the effect of changes in travel attributes as an independent variable on the likelihood of choosing a mode. (Ristyanto and Supranoto, 2014). The formula for direct elasticity can be formulated as follows:
E = -β . (X bus-X personal motor). (1-Pbus)
with E = the elasticity of Y to the change X, X = the free variable and –β = the coefficient of the variable free or equal to B.

RESULTS AND DISCUSSION

One of the economic needs of the community is transportation (Azis and Asrul, 2014). The name "transport" comes from the Latin word "transportare", where "trans" means "to lift" or "carry". According to the Great Dictionary of the Indonesian Language (KBBI), transportation is the transportation of goods due to technological advances.

Transportation is the transportation of goods and people from the place of origin to the destination. The transportation process includes many things, including the goods to be transported, the availability of vehicles as a means of transportation, the depth of the road that can be traveled, the origin and destination terminals, human resources, and the institutions responsible for transportation operations (Nasution, 2008).

Research data analysis, in which prioritized techniques are defined, uses binary logit models to understand how individuals make decisions based on various

attributes of a product or service. This model allows researchers to use survey data to assess the factors that influence people's choices. In general, binary logit regression is a statistical method for showing the relationship between binary dependent variables (Y), and includes only two possible outcomes for one or more independent variables (X).

Time Value (VoT) Analysis

The value of travel time is essential to turn time into money. The purpose of estimating the value of travel time is to find out how much time can be saved in units of money, especially if traveling by private vehicle. Improved mobility efficiency and reduced travel costs can be attributed to reduced travel duration. In these conditions, the value of travel time refers to the maximum amount that a person is willing to spend to reduce travel time in a given situation. Therefore, this idea helps in assessing the economic benefits of lowering travel time and improving the efficiency of the transportation system (Parsaulian et al., 2021).

Table 2. Time value analysis (VoT)

Yes	Allowance (Rs)	Motor Vehicle Users (People)	Middle Value (Rs)	Total Pocket Money (Rs)
1	< IDR 500,000	42	250.000	10.500.000
2	IDR 500,000-800,000	19	650.000	12.350.000
3	IDR 800,000-1,000,000	18	900.000	16.200.000
4	IDR 1-1.5 million	16	1.300.000	20.800.000
5	>2 Million	5	2.500.000	12.500.000
Sum		100	-	72.350.000
Average amount of allowance per month				723.500
Time Value				91.35/min

Regression of cost ratio values

Transportation is a second need or a derivative need of the community's economic needs. The influence of transportation on the development of the region as a whole has been very large, especially on the relationship between regions (accessibility) (Azis and Azrul, 2014).

In this study, six travel scenarios were designed to evaluate individual preferences for modes of transportation based on a combination of independent variables, namely transportation cost, travel time in the vehicle, waiting time, and walking time.

- Scenario 1: the transportation fee is set at Rp 15,000 with a travel time in the vehicle of about 35 minutes, a waiting time of 5 minutes, and no walking time.
- Scenario 2: the transportation fee is set at Rp 15,000 with a travel time in the vehicle of about 30 minutes, a waiting time of 2 minutes, and no walking time.
- Scenario 3: the transportation cost is set at Rp 8,000 with a travel time in the vehicle of about 25 minutes, a waiting time of 10 minutes, and a walking time of 5 minutes.

- Scenario 4: the transportation cost is set at Rp 8,000 with a travel time in the vehicle of about 20 minutes, a waiting time of 8 minutes, and a walking time of 5 minutes.
- Scenario 5: the transportation fee is set at Rp 4,000 with a travel time in the vehicle of about 40 minutes, a waiting time of 5 minutes, and a walking time of 10 minutes.
- Scenario 6: the transportation fee is set at Rp 4,000 with a travel time in the vehicle of about 30 minutes, a waiting time of 2 minutes, and a walking time of 10 minutes.

Using the proportions and utilities contained in each mode, the logistics analysis model is a mathematical method used to determine the magnitude of the presentation of vehicle users in the transportation system for each mode. The results of the regression of the cost ratio value to bus and motorcycle modes can be seen in Table 3 and Table 4.

Table 3. Bus Proportions

Yes	C1/C2 W	Wβ	P = 1/(1+(α xWβ)
1.	1,52	1,53	24%
2.	1,04	1,04	32%
3.	0,53	0,53	48%
4.	0,41	0,40	54%
5.	0,34	0,33	59%
6.	0,25	0,24	66%

Table 4. Proportions of personal motors

Yes	C1/C2 W	Wβ	P
1.	1,52	0,65	76%
2.	1,04	0,96	68%
3.	0,53	1,90	52%
4.	0,41	2,49	46%
5.	0,34	3,00	41%
6.	0,25	4,15	34%

From tables 3 and 4 above, the proportion of passengers from the stated preference results is produced by producing 6 choices for the type of bus mode to be planned. The results of the calculation of the binary logit model have resulted in the proportion of bus mode selection between buses in each condition and the ratio of the total cost of buses to private motors. These proportions are depicted on the following S curve:

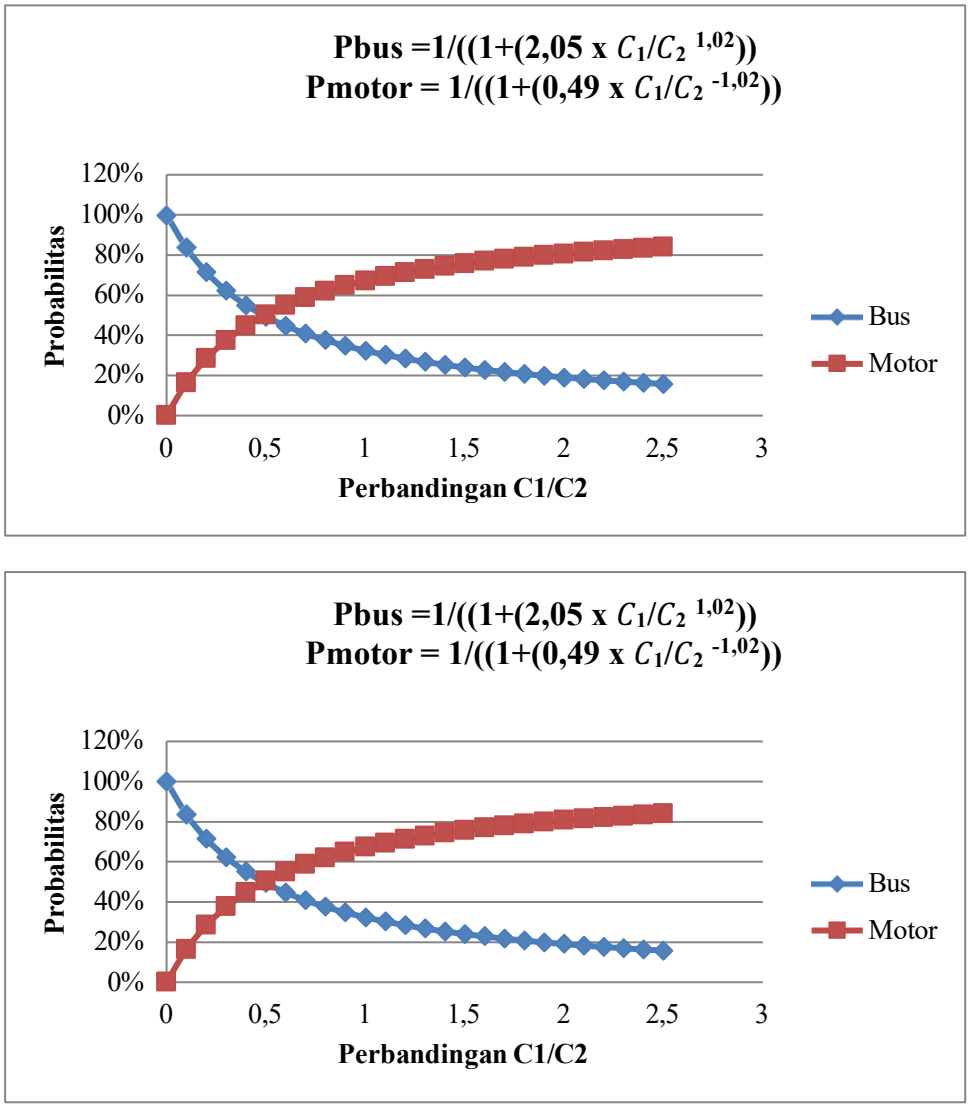

Figure 1. Cost comparison with Mode of Transportation

From the image above, almost all users choose buses when the cost ratio is close to zero (C1/C2 = 0). However, when the cost ratio increases to close to 1, the choice of buses and motorcycles becomes balanced. If the cost ratio continues to increase (C1/C2 > 1), the use of the motor increases significantly, while the bus decreases. If the cost ratio continues to increase (C1/C2 > 2.5), almost all users will switch to motors. This means that higher bus costs encourage people to choose private vehicles. With the right policies, it is expected that more and more users will switch to buses, to reduce the use of private motorcycles, reduce congestion, and improve the overall transportation system.

Regression of the modal time ratio value

In this study, six travel scenarios were designed to evaluate individual preferences for modes of transportation based on a combination of independent

variables, namely transportation cost, travel time in the vehicle, waiting time, and walking time.

Table 5. Bus proportions

Yes	Tbus T1	Per-son-ally. T2	Q1/Q2 W	Wß	P
1	40	25	1,60	0,42	36%
2	32	25	1,28	0,64	27%
3	40	20	2,00	0,28	46%
4	33	20	1,65	0,40	37%
5	55	15	3,67	0,09	72%
6	42	15	2,80	0,15	61%

Table 6. Proportions of personal motors

Yes	Tbus T1	Per-son-ally. T2	Q1/Q2 W	Wβ	P
1	40	25	1,60	2,37	64%
2	32	25	1,28	1,57	73%
3	40	20	2,00	3,56	54%
4	33	20	1,65	2,50	63%
5	55	15	3,67	10,80	28%
6	42	15	2,80	6,59	39%

From tables 5 and 6 above, the proportion of passengers from the stated preference results is produced by producing 6 choices for the type of bus mode to be planned. The results of the binary logit model calculation have resulted in the proportion of bus mode selection between buses in each condition and the ratio of the total bus time to the private motor. These proportions are depicted on the following S curve:

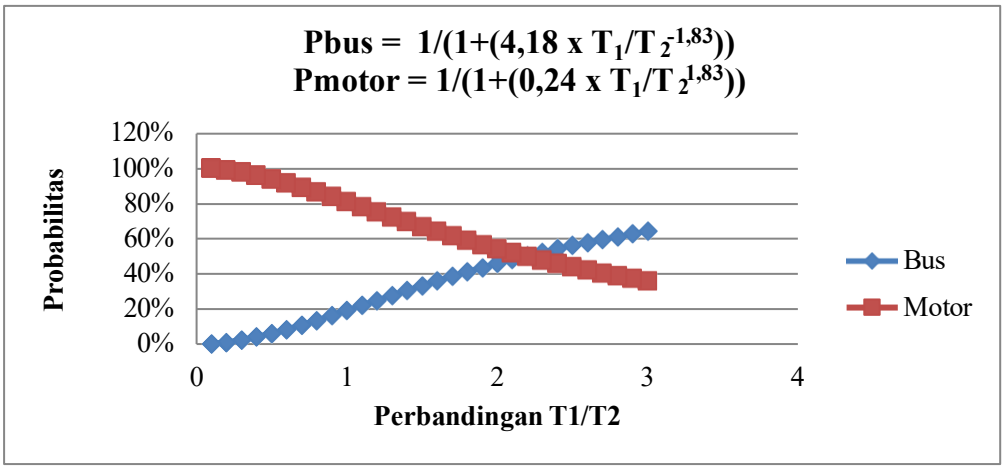

Figure 2. Comparison of Time of Mode 1 and Mode 2 to Probability

The figure above shows the relationship between the T1/T2 ratio and the probability of choosing a mode of transportation, namely buses and private motorcycles. When T1/T2 = 1, which means that the travel time of the two modes is the same, the majority of users prefer a personal motorcycle with a probability of 81%. However, when the bus travel time becomes three times faster than that of a motorcycle, the probability of choosing a bus increases to 64%. This shows that the speed of bus travel has a significant influence on users' decisions in choosing a mode of transportation. Thus, if in the future bus travel time can be reduced and become more competitive than private motorcycles, the possibility of people switching to public transportation will be even greater.

4.4 Direct elasticity analysis

To find out how much influence the free variable has on the probability of choosing modes, we can test the analysis of direct elasticity and indirect elasticity. However, in this study, it analyzed direct elasticity. The results of the direct analysis can be shown by Table 6.

Table 6. Direct Elasticity Analysis Results

No.	Research attributes	Average	β	P bus	P motor	Elasticity value
1.	Travel time	11,667	2,04	0,472	0,530	1,428
2.	Waiting time	5,333	2,04	0,472	0,530	0,6528
3.	Walking time	5,000	2,04	0,472	0,530	0,612
4.	Cost	-11,833	2,04	0,472	0,530	1448,4

From the results of the direct elasticity analysis in the table above, it shows that the value of travel time and cost is the highest compared to the attributes of waiting

time and walking time. Thus, it can be concluded that the attributes that are sensitive to the choice of transportation mode are travel time and cost.

CONCLUSION

The results of this study show that the choice of transportation mode for students of the University of Bengkulu is greatly influenced by the cost and travel time factors. The model generated through binary logit analysis and stated preference shows that the majority of college students prefer to use private vehicles, unless public transportation offers cheaper costs or shorter travel time. These findings indicate that improving the quality of public transportation services, especially in terms of cost efficiency and punctuality, has the potential to increase students' interest in switching to more sustainable modes of transportation. In addition, the results of the elasticity analysis show that travel time and travel costs are the most sensitive factors in influencing student transportation mode decisions. Therefore, efforts to improve infrastructure, improve public transportation services, and transportation policies that support the use of public transportation need to be implemented to reduce dependence on private vehicles and create a more efficient and environmentally friendly transportation system.

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