



Comparative Study of Transportation Mode Selection in Jakarta and Surabaya City

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Abstract: The diversity of transportation modes that already exist today results in competition in the choice of modes, so that there are modes that are very much favored and used by travelers to achieve a destination. This study aims to observe the behavior of travelers who use public transportation buses with rail transportation in the city of Jakarta and the city of Surabaya in order to know the factors that influence travelers in making mode choices, in order to obtain a mode selection model that can explain the probability of travelers in choose the mode of urban transportation. For the city of Jakarta, research was conducted on the Hotel Indonesia – Blok M corridor, while in the city of Surabaya the research was conducted on transportation from Sidoarjo to Surabaya. The research was conducted by distributing questionnaires and direct observations in the field, then processed by the binary logit method to obtain multiple regression equations that describe the relationship between variables. The results of the study indicate that people are more likely to choose the bus mode of transportation with consideration of cheaper costs and faster arrivals to their destination. The results of this study can be used by local governments and transportation providers to improve urban transportation services in the city of Jakarta and the city of Surabaya.

Keywords: Public Transportation, Mode of Transport, Modal Choice

INTRODUCTION

Transportation is an activity that cannot be separated in people's lives, because in the history of its development, humans have always moved from one place to another to meet the needs of life. Thus, humans need a tool or means to carry out these activities which are called modes of transportation. Based on the times, these modes have developed into three groups of modes, namely: land transport, sea transport and air transport, while the types of transportation services can be grouped into private transportation and public transportation. Public transportation facilities are one of the supporting activities for the community in an area or city, because anyone can use it, both from the lower class to the upper class all can use it, but sometimes not a few people at large think that city public transportation is only used by people from the middle class. lower middle class, especially for those who do not have a private vehicle. However, it is possible that some upper class people also use it to avoid traffic jams on the road. Seeing a situation like this, of course it can be understood that public transportation is very influential in the daily mobility of city people.

The diversity of modes that have existed at this time has its own advantages and disadvantages. Based on the strengths and weaknesses of each of the existing modes, as well as other factors such as service, comfort and security, these are the reasons why travelers choose to use these modes. One of the busiest corridors in Jakarta is Corridor 1 on the Hotel Indonesia (HI) route to Blok M, where along this corridor are commercial areas, offices, government, services and community economic centers. Corridor 1 of the Hotel Indonesia (HI) route to Blok M is now available in two modes of Transjakarta Bus and Mass Rapid Transit (MRT). After the operation of the Mass Rapid Transit (MRT), the average Transjakarta Bus passengers increased, especially on the Corridor route. The highest success achieved



by Transjakarta reached more than 700,000 passengers. The existence of these two modes is an attraction so that people have several alternative modes of transportation for travelers. With the existence of transportation modes that can accommodate passengers in large, integrated capacities, it can certainly help the mobility of residents in carrying out their daily routines. At least three Mass Rapid Transit (MRT) stations and Transjakarta bus stops have been integrated, namely at the Hotel Indonesia, Dukuh Atas, and Lebak Bulus. So that with this mode of transportation, it is expected that private vehicle users will start leaving their private vehicles to switch to public transportation.

In urban areas, urban transportation is very helpful for people's mobility for their daily activities. Various types of urban transportation that exist, both in the city of Jakarta and the city of Surabaya are the people's choice. Two alternative modes of public transportation, namely bus transportation and rail transportation that can be chosen by service users with mode selection variables, both cost variables, travel time, and transportation frequency.

METHOD

Transportation System

Transportation system is all forms of ties and linkages between passengers, goods, infrastructure and facilities that interact in the context of the movement of people or goods, which are included in an arrangement, either naturally or artificially/engineered. The purpose of the transportation system is to achieve the optimum process of transportation of passengers and goods in a certain space and time, taking into account the factors of safety, comfort and smoothness, as well as time and cost efficiency. Transportation systems are divided into macro transport systems and micro transport systems.

Transportation Mode Selection Model

The mode of transportation selection model aims to determine the proportion of people who will use each mode of transportation. This process is carried out with the intention of calculating the mode selection model by knowing the independent variables (attributes) that affect the mode selection. After the calculation, the model can be used to predict the choice of mode by using the value of the independent variable (attribute) for the future. Tamin (2000:242) explains that the binary logit model is a model that can describe the distribution of trips with mode selection. Rosyidi (2019: 286) states that the binary logit model is a travel distribution approach model that involves 2 modes of transportation. The binary logit model is modeled by the proportion of respondents choosing the mode and its variable factors. The binary logit model is divided into 2 types, namely the binary-difference logit model and the binary-ratio logit model. Tamin (2000:246) explains that the binary-difference logit model is intended if the variable factor does not vary, while the binary-ratio logit model is intended if the variable factor varies. Rosyidi (2019:291) describes the binary-difference logit modeling as follows:

$$P_1 = \frac{e^{-(\alpha_1 + \beta C_1)}}{e^{-(\alpha_1 + \beta C_1)} + e^{-(\alpha_2 + \beta C_2)}} \dots\dots\dots(1)$$

$$\log_e \left[\frac{1 - P_1}{P_1} \right] = -\alpha - \beta \Delta C \dots\dots\dots(2)$$

Where :

$$Y_i = \log_e \left[\frac{1 - P_1}{P_1} \right] \dots\dots\dots(3)$$

$$X_i = \Delta C_i \dots\dots\dots(4)$$

From the non-linear equation can be solved by multiple regression analysis as follows:

$$Y = A + B_1.X_1 + B_2.X_2 + \dots + B_Z.X_Z \dots\dots\dots(5)$$

Where :

- C = Combine cost of each mode
- P = Proportion of passengers choosing each mode (%)
- Y = Dependent variable
- A = Regression Constant
- B = Regression Coefficient
- X = Independent Variable

Logit biner equation will be :

$$P_1 = \frac{1}{1 + \alpha \left[\frac{C_1}{C_2} \right]^\beta} \dots\dots\dots(6)$$

$$\frac{1-P_1}{P_1} = \alpha \left[\frac{C_1}{C_2} \right]^\beta \dots\dots\dots(7)$$

$$\log \frac{1-P_1}{P_1} = \log \alpha + \log \beta \left[\frac{C_1}{C_2} \right] \dots\dots\dots(8)$$

$$Y_i = \log_e \left[\frac{1-P_1}{P_1} \right] \dots\dots\dots(9)$$

$$X_i = \log \left[\frac{C_1^i}{C_2^i} \right] \dots\dots\dots(10)$$

The non-linear equation can be solved by multiple regression analysis instead of simple linear regression.

$$Y = A + B_1.X_1 + B_2.X_2 + \dots + B_Z.X_Z \dots\dots\dots(11)$$

where,

- C = Combine cost of each mode
- P = Proportion of passengers choosing each mode (%)
- Y = Dependent Variable
- A = Regression Constant
- B = Regression coefficient
- X = Independent variable

RESULT

Survey Implementation

The type of research used is quantitative research which is calculated using regression calculations because it aims to see the relationship between the travel agent's choice of response variables (Y) to the variables of the difference in travel costs (X1), travel time (X2) and departure headway of each mode (X3). City of Jakarta are travelers on the Hotel Indonesia (HI) - Blok M route



using the Transjakarta bus and Mass Rapid Transit (MRT) modes, while for the City of Surabaya are travelers using trains and road transportation between Sidoarjo - Surabaya. For sampling in this study, taken as many as 100 respondents both for the city of Jakarta and the city of Surabaya randomly.

The survey results show that of the 100 respondents in Jakarta who stated that they had used one mode, as many as 54% and those who stated that they had used both modes, 46%. For those in the city of Surabaya, 58% stated that they had used one mode and 43% stated that they had used both modes. Based on the gender characteristics of respondents in Jakarta, 67% are male and 33% female, while in Surabaya, 65% are male and 35% female. Based on the age of respondents in Jakarta aged 16-20 years as much as 10%, age 21-28 years as much as 70%, age 31-40 years as much as 13%, age 41-50 years as much as 5% and age over 50 years as much as 2% , while the age of respondents in Surabaya aged 16-20 years as much as 5%, ages 21-28 years as many as 68%, ages 31-40 years as many as 20%, ages 41-50 years as much as 4% and ages over 50 years as many as 3%. Based on the purpose of passenger travel in Jakarta with the aim of business/work as much as 42%, education as much as 19%, tourism as much as 30%, family affairs 7% and others as much as 2%, while in Surabaya which aims at business/work as much as 54%, education as much as 22 % , tourism as much as 15%, family affairs 5% and others as much as 4%. Based on the income level of passengers in Jakarta who have an income of less than Rp. 3,000,000 as much as 55%, income Rp. 3,000,000 – Rp. 5,000,000 as much as 13%, income Rp. 5,000,000 – Rp. 8,000,000 as much as 27%, income more than Rp. 8,000,000 as much as 5%, while in Surabaya who have an income of less than Rp. 3,000,000 as much as 64%, income Rp. 3,000,000 - Rp. 5,000,000 as much as 25%, income Rp. 5,000,000 – Rp. 8,000,000 as much as 10%, income more than Rp. 8,000,000 as much as 1%.

Considerations for the selection of transportation modes by service users are related to speed or travel time, ease of access to travel safety and security, cost (fare), and convenience. The results of a survey of 100 respondents in the city of Jakarta and 100 respondents in the city of Surabaya. From the survey results it can be concluded that the largest percentage for the characteristics of bus mode users in the reason for choosing the mode is the consideration of ease of access (accessibility) in the city of Jakarta by 64% and in the city of Surabaya by 60%. For users of the train mode, the largest percentage in the city of Jakarta is the consideration of speed or travel time by 40% in the city of Surabaya, which is 44%.

Stated preference technique is an approach to respondents to find out their response to different situations. Each individual was asked about his opinion if they were faced with a given situation in 8 choices. Data was collected using a questionnaire containing socio-economic characteristics, travel characteristics and questionnaires compiled using stated preference techniques with attributes of cost difference, travel time difference and departure frequency difference between buses and trains for 100 respondents who traveled from Hotel Indonesia to Blok M in Jakarta City and from Purabaya Terminal to Porong Terminal in Surabaya City. In the questionnaire given, respondents are given a choice of a scale of 1-5, where a scale of 1 indicates a definite choice of bus, a scale of 2 indicates a possible choice of a bus, a scale of 3 indicates a balanced choice, a scale of 4 indicates a possible choice of train, and a scale of 5 indicates a definite choice of a train. Then the results of the interview are analyzed descriptively and binomial logit. From the results of the survey that has been carried out, it is obtained that data with a qualitative scale in the form of a choice scale is transformed into a probability scale form then the data is then converted into a symmetrical scale, which will later become a utility scale that corresponds to the probability scale.



Table 1. Symmetric Scale

Scale	Respond	Probability Scale (P)	Utility $\text{Ln}\left(\frac{0,9}{1-0,9}\right)$
1	Definitely choose the bus	0,9	2,1972
2	Maybe choose the bus	0,7	0,8473
3	Balanced	0,5	0,0000
4	Maybe choose the train	0,3	-0,8473
5	Definitely choose the train	0,1	-2,1972

The next step is to perform a regression analysis to obtain the utility model. The symmetric scale will be the dependent variable while the independent variable is the difference between each attribute. By using linear regression, constants and coefficients will be obtained for each model so that the utility model can be stated:

$$(U_B - U_T) = b_0 + b_1(\Delta X_1) + b_2(\Delta X_2) + \dots + b_n(\Delta X_n)$$

Where:

- P_B = probability of using bus
- P_T = probability of using train
- U_B = bus mode of utility function
- U_T = train of utility function
- b_0 = Constant
- b_1, b_2, \dots, b_n = Coefficient parameter model.
- $\Delta X_1, \Delta X_2, \dots, \Delta X_n$ = Independent variable

From the regression coefficients, the equation for the utility of travel costs is obtained as follows:

$$(U_{bus} - U_{train}) = 2.558 - 0.01904 \Delta X_1$$

From the regression coefficients, the equation for the utility of travel time is obtained as follows:

$$(U_{bus} - U_{train}) = 3,179 - 0,212 \Delta X_2$$

From the regression coefficients, the equation for the utility of transport headway is obtained as follows:

$$(U_{bus} - U_{train}) = -1,726 - 0,314 \Delta X_3$$

Reliability and Validity Test

Reliability test is a measurement that shows the extent to which the measurement is carried out without bias or error free. A questionnaire is said to be reliable if the Cronbach's Alpha value is > 0.60 . It can be concluded that the questionnaire is reliable because $0.966 > 0.60$.

Validity test is evidence that the instrument, technique, or process used to measure a statement actually measures the intended concept, this test aims to measure the validity of a statement item. A statement item is said to be valid if the corrected item total correlation (r_{count}) is greater than r_{table} . Based on the value of r_{table} , the value is 0.1666. All statements on the questionnaire used in the analysis to find the probability of mode selection are significant or pass the test using SPSS version 25, so no statements are changed or discarded.

Modal Choice

1. Jakarta City

For the same ticket price, the probability of choosing the bus Transjakarta is 0,513 or 51,3 % while the probability of choosing MRT Jakarta is 0,487 or 48,7 % so that passengers will choose the Bus



Trans Jakarta compare with the train. For the the difference travel time 5 minute with remain variable same, the probability of a bus Transjakarta is 0.611 or 61,1% while the probability of MRT is 0.389 or 38,9 %. So that in conditions of 5 minute difference travel time, passengers will chose the bus Transjakarta. For the same travel headway, the bus Transjakarta probability is 0.613 or 61,3 % while the train probability is 38,7 %. So on the condition of the user will prefer choose the Transjakarta.

2. Surabaya City

For the same ticket price, the difference in utility is 2,558. In this condition the probability of choosing the bus is 0.928 while the probability of choosing the train is 0.07 so that passengers will choose the bus over the train. For the same travel time, the difference in utility is 3,179. In this condition, the probability of a bus is 0.960 while the probability of a train is 0.040. So that in conditions of having the same travel time, passengers will chose the bus. For the same travel headway, the bus probability is 0.151 while the train probability is 0.750. So on the condition of the user will prefer choose the train.

CONCLUSIONS

Based on the results of the study, it can be concluded that for the selection of urban transportation modes, the attributes that need to be considered are transportation costs, travel time and headway. For the City of Jakarta people tend to use Transjakarta Buses compared to MRT, this is possible because the passenger's destination location is far from the station so it requires public transportation other. For the city of Surabaya with respect to these attributes, bus transportation is more favorite than train.

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