

Analysis of the Selection of City and Railroad Bus Transport Modes

Route to Tebing Tinggi City - Medan City

Dewi Lestari Siregar*, Prof.Dr.lic.rer.reg.Sirojuzilam, SE, Dr.Ir.Riadil Akhir Lubis, M.Si

Department of Rural Development Planning
University of Sumatera Utara, Medan, North Sumatera, Indonesia



Abstract - Transportation is needed to ensure the implementation of population mobility and goods. The large number of workers, social relations such as education and trade has caused population mobility between the cities of Tebing Tinggi and Medan to increase. This study aims to analyze the factors that influence the community in choosing a mode of transportation to travel the Tebing Tinggi-Medan route between buses and trains. The research sample was 150 passengers. The analytical method used is binary logistic regression. The results showed that the variables that influence the choice of city and railroad bus transportation modes in the city of Tebing Tinggi - Kota Medan are gender variables (X2), income (X3), transport availability (X4), comfort and suitability (X5), costs transport (X6) and travel time (X8). The community of Tebing Tinggi City prefers buses as a mode of transportation to get to Medan City because based on the availability of transportation, buses are more in demand because passengers do not have to wait for the time available, can be obtained according to the departure time desired by passengers.

Keywords - Mode of Transportation, Bus, Railway, Binary Logistic Regression

I. INTRODUCTION

Indonesia is an archipelagic country where the development of the transportation sector is designed for three purposes, namely: supporting economic movement, national stability and also reducing development inequality between regions by expanding the reach of the distribution of goods and services throughout the archipelago. (Indonesian Central Bureau of Statistics, 2016).

Domestic transportation needs continue to increase, as the population grows every year. This can be seen through the increasing number of motorized vehicles from year to year as shown below.

Table 1.1 The Development of the Number of Motor Vehicles Specified by Type, Year 2012-2016 (units) in Indonesia

Transportation Type	2012	2013	2014	2015	2016	Growth per Year
Car	10.432.259	11.484.514	12.599.038	13.480.973	14.580.666	8,73
The bus	2.273.821	2.286.309	2.398.846	2.420.917	2.486.898	2,26
Freight cars	5.286.061	5.615.494	6.235.136	6.611.028	7.063.433	7,52
Motorcycle	76.381.183	84.732.652	92.976.240	98.881.267	105.150.082	8,32
Amount	94.373.324	104.118.969	114.209.260	121.394.185	129.281.079	8,19

Source: Police of the Republic of Indonesia

In addition to motorized vehicles, land transportation also provides railroad transportation. Increase in passenger train production this is in line

with the number of train passengers being transported. This can be seen in the following table.

Table 1.2 Passenger Railway Production in Java and Sumatra in 2012-2016 (Million Km-Passenger)

Region	2012	2013	2014	2015	2016	Growth Per Year
Java	16.315	16.218	19.601	21.463	20.837	6,31
Sumatera	839	708	795	833	799	-1,21
Amount	17.154	16.926	20.396	22.296	21.636	5,97

Source: PT (Persero) Kereta Api Indonesia and PT Kereta Commuter Indonesia

Table 1.3 Number of Train Transport Passengers in Java and Sumatra, 2012-2016 (Million people)

Region	2012	2013	2014	2015	2016	Growth Per Year
Java	197,8	212,0	272,6	320,6	345,8	14,99
Sumatera	4,4	4,0	4,9	5,3	6,0	8,06
Amount	202,2	216,0	277,5	325,9	351,8	14,85

Source : PT (Persero) Kereta Api Indonesia and PT Kereta Commuter Indonesia

Tebing Tinggi City is one of the city administrations of 33 Regencies / Cities in North Sumatra. It is located about 80 km from Medan City (the capital city of North Sumatra Province) and is located in the main crossing of Sumatra that connects the Eastern Cross and Central Sumatra Cross through a diagonal crossing on the Jalan Tebing Tinggi, Pematangsiantar, Parapat, Balige and Siborong-borong segments.

To get to Medan City, the people of Tebing Tinggi City are faced with a variety of transportation modes. The types of transportation available in Tebing Tinggi City include trains and buses. Where before choosing the mode of transportation, of course there are various factors that influence the community in choosing transportation modes.

This encourages the desire to examine what factors cause people to choose buses or choose

trains.

The purpose of this study is to analyze the factors that influence the community in choosing transportation modes to travel the Tebing Tinggi - Medan route between buses and trains and analyze the probability of choosing a mode of transportation to travel the Tebing Tinggi - Medan route between buses and trains.

By using the binary logit regression model method, to analyze how much the probability of the occurrence of the response variable by its predictor variable. The response variable in binary regression consists of 2 types of variables, namely 0 and 1. The binary logit regression model is as follows:

$$\frac{p}{1-p} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_8 X_8$$

Where:

$\frac{p}{1-p}$: *Odd Ratio* (comparison of opportunities),
where:

p state the probability of occurrence of events

$1-p$ state the probability of not occurring an event

β_0 : constants

Y = Type of transportation mode

1 = respondents took the train

0 = respondents took the bus

X_1 = Age

1 = More than 20 years

0 = Up to 20 years

X_2 = Gender

1 = Female

0 = Male

X_3 = Income (Rp/month)

X_4 = Availability of transportation modes

1 = Main Consideration

0 = Not Primary

X_5 = Comfortable and suitable

1 = Main Consideration

0 = Not Primary

X_6 = Transportation Costs

X_7 = Length of trip

0 = less than 2 hours

1 = more than 2 hours

X_8 = Travel Time

1 = Main Consideration

0 = Not Primary

II. RESULTS AND DISCUSSION

Factors Affecting the Selection of the Mode of Transportation.

Descriptive explanation of the factors that influence this research as follows:

a. Age

Based on the results of research in the field, respondents aged between the age of 20 years were 58 people, while respondents aged over 20 years were 92 people. So that it can be concluded that passengers in the transportation mode of Tebing Tinggi City to Medan City are domiciled by more than 20 years of age.

According to Butcher, et al. (1996) the socio-economic characteristics of travelers in cities, one of which is influenced by age. The age of a person can influence in determining the choice of city transportation use.

c. Income

Income will affect the choice of transportation modes, that often found with increasing income, then the type of transportation chosen by passengers, will be increasingly picky or choose a better direction from all aspects. This is in accordance with the results of research in the field, respondents with income above Rp.6,000,000 prefer to ride the train because the quality has been tested according to passengers in Tebing Tinggi City. The mode of transportation of the type of train in the City of Tebing Tinggi is considered to have proven its quality because it is compared to the mode of transportation of bus types in Tebing Tinggi City. From the main aspects, namely convenience, railroad facilities are better, both in terms of stops or stations and services in the mode of transportation itself.

Revenue is the amount of income received by community members for a certain period of time as remuneration. Income can also be derived from the receipt of salaries and the business involved (Reksoprayitno, 2004).

d. Availability of Transportation

In addition to the socio-economic variables, there are also several travel attributes that influence the choice of transportation modes, one of which is the availability of transportation. The difference between trains and buses in the aspect of availability of transportation is that buses are more commonly found than by train. Because to get a train, passengers must depend on the time of departure, while to ride the bus, passengers do not need to wait for the time available, can be obtained according to the desired departure time by the passenger.

Based on the results of research in the field, respondents prefer the availability of transportation not as a primary consideration. Because, generally passengers are never in a state of urgency not to get a bus or train. This is due to the smooth availability of transportation both buses and trains in Tebing Tinggi City, except in certain circumstances or days, such as national holidays and weekends.

e. Comfortable and Suitable

Based on the results of research in the field, more respondents make comfortable and suitable factors a major consideration. This is because the trip to the city of Medan is quite time consuming so that comfort and suitability are needed in the chosen mode of transportation. The more comfortable passengers in the chosen transportation mode, the more suitable passengers will be for the transportation mode.

According to Soizick and Bastien (2008) states that there are two levels of comfort, namely the static level where the passenger sits quietly and the physical characteristics of the chair interact with a person's sitting (strength and pressure on the body and knee joint) in causing pain and causing passengers to adjust sitting position. Then the dynamic level where the subject moves in his seat to do some activities.

f. Transportation Costs

Based on the results of research in the field, the average cost incurred by passengers to board a bus is Rp. 20,000 - Rp. 30,000 while transportation costs incurred by passengers to board the train are Rp. 22,000 - Rp. 90,000. The amount of variation in costs incurred by passengers to board a train is greater than riding a bus, so respondents such as the passengers of Tebing Tinggi City prefer buses as a mode of transportation to get to Medan City.

To explain the mode of choice behavior, in addition to the socio-economic variables there are also some attributes that affect travel (Kanafani, 1983). One of the attributes of the trip is the cost of travel. Travel costs are the amount of money or fees that must be paid by passengers when boarding the selected transportation mode, from Tebing Tinggi City to Medan City.

g. Travel Duration

Based on the results of research in the field, respondents who spent up to 2 hours of travel were 55 people and respondents who spent more than 2 hours were 95 people. This means more passengers board the

bus. But not always trains arrive on time, as well as buses that don't always last more than 2 hours. This depends on the situation and conditions, such as road congestion, accidents or transportation modes.

The duration of travel is one of the factors that influence passengers in choosing the mode of transportation. Travel time is the time passengers spend to get to their destination.

The difference in the length of travel between the bus and the train is that the train must have arrived at the place according to the time set, while the bus, the passenger has not yet arrived at the destination according to the time delivered.

h. Travel Time

Based on the results of research in the field, respondents who made the travel time factor not as a primary consideration as many as 84 people and

respondents who made the travel time factor become the main consideration as many as 66 people. This means that passengers do not race at the time of travel, because transportation modes tend to be easy to find and transportation mode travel time is routine or that arrival only at that time. Travel time is the arrival of transportation modes namely buses and trains going up the transportation mode from Tebing Tinggi City to Medan City.

Results of Logistic Regression Analysis

Based on the interview results, respondents who chose to ride the train were 71 respondents and those who chose to board the bus were 79 respondents. The results of processing using logistic regression analysis can be seen in Table 1.

Table 4.1. Results of Logistic Regression Analysis

Variable	B	S.E.	Sig.	Exp(B)
Age	0,304	1,697	0,858	1,356
Gender	2,920	1,334	0,029	18,536
Income	0,000	0,000	0,012	1,000
Availability of Transportation	-3,870	1,687	0,022	0,021
comfortable and suitable	-5,236	1,860	0,004	0,005
Transportation costs	0,000	0,000	0,012	1,000
length of journey	48,038	3277,948	0,988	72851,000
Travel Time	-7,230	2,268	0,001	0,001
Constant	18,094	6,618	0,006	72139,687
G=178,740 (sig = 0,000)				
Log likelihood= -0,107				

Source: Primary Data processed in 2018

From the results of the logistic regression analysis the logistic regression equation was obtained as follows:

$$\ln \frac{p}{1-p} = 18,094 + 0,304 X_1 + 2,920 X_2 + 0,000 X_3 - 3,870 X_4 - 5,236 X_5 + 0,000 X_6 + 48,038 X_7 - 7,230 X_8$$

At a real level of five percent ($\alpha = 5\%$), it is

known that the variables that influence the selection of City Transportation and Railway Bus Mode Transportation in Tebing Tinggi City - Medan City are sex variables (X_2), income (X_3), transport availability (X_4), convenient and suitable (X_5), transport costs (X_6) and travel time (X_8). This can be seen from the value of sig $< \alpha = 5\%$, which indicates that the variable affects the choice of transportation mode.

The coefficient value indicates the relationship between the independent variable (X) and the dependent variable (Y). The coefficient that has a positive value indicates that if the independent variable (X) increases, the dependent variable (Y) will also increase, which means the opportunity to choose the mode of transportation increases.

Odds Ratio Value (Probability)

The way to interpret the magnitude of the odd ratio for a k predictor variable is the value of Antiln of (β_i) or $\exp(\beta_i)$ for $i = 1, \dots, k$. If logistic regression results have been obtained in table 4.1, then the odd ratio value can be seen in the $\exp(\beta_i)$ value in the table. So that the odds ratio and the probability for each predictor variable are obtained as follows:

Sex variable, sig value = 0.029 is smaller than $\alpha = 5\%$, then sex variable significantly influences the choice of transportation mode. The odds ratio for sex variables is 18,536, meaning that passengers with female sex have the opportunity to ride the train is 18,536 times compared to passengers with male sex. This is because the passengers who ride the most modes of transportation in this study are women.

This is in line with the research of Reviline Sijabat and Anita Ratnasari R (2013) that one of the socio-economic factors that have a significant influence on modal choice is gender. The results of the study state that users of transportation modes are dominated by women, preferring to use public transportation because they can avoid fatigue. Because the purposes of the transportation mode other than for passenger transport media to get to the destination, it can also be a place for resting passengers when traveling, especially for women who are generally easier to feel tired.

The income variable, the sig value = 0.012 is smaller than the value of $\alpha = 5\%$, then the income variable has a significant effect on the choice of transportation mode. The odds ratio for the income variable is one, meaning that at each passenger income level, the opportunity to choose the mode of rail and bus transportation is the same.

In the research of Dayaning Wahyu Primasari, et al. (2013), the character variable of transportation users is income, both family income and personal income. The income variable influences the choice of transportation mode, where the higher income will affect the desire to buy a private vehicle as a means of transportation. The results of the study, respondents with income levels of less than 1 million chose to ride public transportation.

The variable availability of transport, the sig value = 0.002 is smaller than the value of $\alpha = 5\%$, then the variable availability of transportation has a significant effect on the choice of transportation mode. The odds ratio for the transport availability variable is 0.021, meaning that the opportunity for passengers to choose the train based on transportation availability factors which shows that the availability of rail transport is the main consideration of the bus is 0.021 times compared to the bus. This is because most passengers are not in a state of urgency not to get a train. Availability of the train fleet is smooth, except in certain circumstances or days, such as national holidays and weekends.

This is in line with the research of Oktaviani and Andre Yudi Saputra (2015), stating that in a transportation activity there are components that influence it. These components can be in the form of facilities and infrastructure. Means are tools which are tangible modes. The facilities used by the object or traveler must have standards, both in terms of quality and quantity. As for one of the standards of the facility is guaranteed availability.

Comfortable and suitable variables, sig = 0.004 value is smaller than $\alpha = 5\%$, then comfortable and suitable variables significantly influence the choice of transportation mode. The odds ratio for convenient and suitable variables is 0.005, meaning that the opportunity for passengers to choose a train based on convenient and suitable factors which shows that the comfort and fit factor when choosing a train is more a main consideration than a bus is 0.005 times compared to a bus. The trip to the city of Medan is quite time consuming so that comfort and suitability are needed in the chosen mode of

transportation. The more comfortable passengers in the chosen transportation mode, the more suitable passengers will be for the transportation mode. From the comfortable and suitable factors, the train is the right choice for passengers to travel to their destination.

This is in line with Andi Wijaya's research, Gusri Yaldi, Ph.D Ir. Hamdi Nur, MTP (2015) states that the choice of transportation modes in urban areas is not a random process, but is influenced by several factors, one of which is convenience. From the results of the study, it was obtained the reason respondents chose to use transportation modes, one of which was safe and comfortable.

Transportation cost variable, sig value = 0.012 is smaller than $\alpha = 5\%$, then transportation cost variables have a significant effect on the choice of transportation mode. The odds ratio for the variable transportation costs is one, meaning that at each level of transportation costs, the opportunity to choose the mode of rail and bus transportation is the same.

The study of Ludfi Djakfar, Amelia Kusuma and Akhmad Sya'ban (2010) states that the level of satisfaction offered by each mode of transportation can change. This is caused by changes in characteristics such as changes in the cost of travel of a mode due to an increase in the price of fuel oil which will affect a person's decision. However, the results obtained that the variable cost of travel certainly does not affect the choice of mode. The absence of respondents who have characteristics as mentioned causes variables to be of no effect.

Meanwhile, in the research of Rizyak Wale Simanjuntak and Medi S Surbakti (2012), the modes of transportation were charged in the form of costs in their travels. Each mode has different characteristics, one of them in terms of costs (costs). Modes that have lower costs do not mean having more interested users of transportation modes.

Travel time variable, sig = 0.001 is smaller than $\alpha = 5\%$, then travel time variables significantly influence the choice of transportation mode. The odds ratio for travel time variables is 0.001, meaning

that the opportunity for passengers to choose a train based on travel time factors shows that the travel time factor when choosing a train is more of a main consideration than a bus is 0.001 times compared to a bus. For train type transportation modes, travel times or departure times have been set or on time, while for bus type transportation modes, the departure time is based on the departure time of the passenger itself, so passengers can choose the time at any time, because on the bus, there is no official departure schedule and there are many fleets available.

This is in line with the research of Futri Fajarni Oktavia and Indra Jaya Pandia (2013) stating that travel time is one of the factors that influence the choice of transportation modes.

Variables that do not significantly influence the choice of transportation modes are the variables of age and duration of travel. This is because the sig value > α value. The older a person is, the passenger will be responsive to information, so that he will add knowledge that will determine the attitude towards the choice of transportation modes, for example the amount of growth that will be used to determine what mode of transportation to choose. Age differences will influence the choice of transportation mode. The duration of the trip does not become an influence in choosing a mode of transportation because these two modes of transportation tend not to have different travel times to get to their destination.

Likelihood Log Value

The G test value is 178,740 greater than $\chi^2_{2\alpha}$, sig with the value sig = 0,000 smaller than the value ($\alpha = 5\%$). This means rejecting H_0 or accept H_1 which indicates that there is at least one variable that influences the choice of transportation modes for city and rail transport buses in the route of Tebing Tinggi City - Medan City. The variables that influence the choice of transportation modes are six variables, namely gender, income, transportation availability, comfort and suitability, transportation costs and travel time. The other two variables (age and duration of travel) that were not significant meant

that they did not influence the choice of transportation modes for city and rail transport buses. Route of Tebing Tinggi City - Medan City.

III. CONCLUSION

The conclusion of this study is that the variables that influence the choice of city and rail transport bus modes of route Tebing Tinggi City - Medan City are gender variables (X2), income (X3), transport availability (X4), comfortable and suitable (X5), transport costs (X6) and travel time (X8). The community of Tebing Tinggi City prefers buses as a mode of transportation to get to Medan City because based on the availability of transportation, buses are more in demand because passengers do not have to wait for the time available, can be obtained according to the departure time desired by passengers.

REFERENCES

- [1] Andi Wijaya, Gusri Yaldi, Ph.D Ir. Hamdi Nur, MTP. 2015. *Analisis Faktor-Faktor Dalam Pemilihan Moda Transportasi Udara dan Darat Rute Muaro Bungo – Jakarta*. Department Urban and Regional Planning, Faculty of Civil Engineering and Planning, University of Bung Hatta, Padang.
- [2] Badan Pusat Statistik Kota Tebing Tinggi, 2016. *Tebing Tinggi dalam Angka Tahun 2016*. Medan : Badan Pusat Statistik
- [3] Butcher, J.N., & Han, K. 1996. *Methods of Establishing Cross-Cultural Equivalence*. International Adaptations of The MMPI-2. University of Minnesota Press. Minneapolis.
- [4] Dayaning Wahyu Primasari, dkk. 2013. *Pemilihan Moda Transportasi ke Kampus oleh Mahasiswa Universitas Brawijaya*. Jurusan Teknik Sipil, Fakultas Teknik, Universitas Brawijaya. Malang.
- [5] Futri Fajarni Oktavia dan Indra Jaya Pandia. 2013. *Analisa Pemilihan Moda Transportasi Untuk Perjalanan Kerja (Studi Kasus : Kelurahan Mabar, Medan Deli)*. Jurusan Teknik Sipil. Universitas Sumatera Utara. Medan.
- [6] Kanafani, Adib. 1983. *Transportation Demand Analysis*, Mc Graw-Hill Book Co Inc, USA.
- [7] Ludfi Djakfar, dkk. 2010. *Studi Karakteristik Dan Model Pemilihan Moda Angkutan Mahasiswa Menuju Kampus (Sepeda Motor Atau Angkutan Umum) Di Kota Malang*. Fakultas Teknik. Universitas Brawijaya. Malang.
- [8] Oktaviani dan Andre Yudi Saputra. 2015. *Alternatif Pemilihan Moda Transportasi Umum (Studi Kasus: Bus dan Kereta Api Trayek Kota Padang – Kota Pariaman)*. Jurusan Teknik Sipil, Fakultas Teknik, Universitas Negeri Padang. Padang.
- [9] Rizyak Wale Simanjuntak dan Medi S. Surbakti. 2012. *Analisa Pemilihan Moda Transportasi Medan – Rantau Prapat dengan Menggunakan Metode Stated Preference*. Jurusan Teknik Sipil. Universitas Sumatera Utara. Medan.
- [10] Reksoprayitno, 2004. *Sistem Ekonomi dan Demokrasi Ekonomi*. Bina Grafika. Jakarta.
- [11] Reviline Sijabat dan Anita Ratnasari R. 2013. *Model Pemilihan Moda Pergerakan Komuter Di Kecamatan Sayung*. Jurusan Perencanaan Wilayah dan Kota. Fakultas Teknik. Universitas Diponegoro. Semarang.
- [12] Soizick, B., and Bastien J. M. C. 2008. *The Contribution of Ergonomics to the Design of Product: an Application to Airplane Passenger Seats*. France.