

MASS TRANSPORTATION MODE INCOME ANALYSIS BUS RAPID TRANSIT TRANSJAKARTA

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ABSTRACT

Jakarta is the largest metropolitan city in Indonesia, with a current population of 10,609,681 people. The higher population in Jakarta is positively correlated with the higher demand for efficient and effective land transportation services. One of the land-transport provided by the Jakarta government is Bus Rapid Transit. The types of bus services available in Jakarta currently serve short-distance routes, with most users being middle-class workers. The problem faced by this bus service is that special lanes are often used by other road users, thus slowing down the vehicle. Bus Rapid Transit currently available is a local government service to improve the regional economy. This study uses a quantitative approach with correlation and multiple linear regression methods and analytical tools in the form of SPSS to measure the relationship between variables and ArcGIS Pro to analyze spatial data. The results obtained indicate that there are variables that affect the revenue of TransJakarta, where these variables have a simultaneous effect of 99.9% on the revenue of the TransJakarta Bus Rapid Transit. The revenue generated from this sector can be reused to improve facilities and services in the transportation sector and other related fields.

Keywords: bus rapid transit; revenue; transportation

INTRODUCTION

Jakarta is the capital city of the Republic of Indonesia. Jakarta is one of the cities with the largest population globally, which has grown and developed into a center for social, economic and political activities in Southeast Asia and the world. According to (BPS DKI Jakarta Province, n.d, 2022), the population of Jakarta is 10,609,681 people, with a density of more than 1000 people/ha, which means this city is very dense. In recent years, Jakarta has repaired and upgraded various infrastructures to support the activities of its residents. Some of the things that have been done include building a waterfront in the North Jakarta area, developing and modernizing transportation facilities and modes, as well as revitalizing and rehabilitating historic areas, tourism and public parks. Talking about Jakarta cannot be separated from people's lives. Like other metropolitan cities that are experiencing development, there are also problems that follow. The main problems facing Jakarta today are traffic jams, floods, infrastructure, pollution, slums, economic inequality, and political problems.

As the main activity center in Indonesia, Jakarta provides various facilities needed by its people. As an economic center, mobility in Jakarta is very high. One of the things that is of concern to the government is to provide good public transportation services. In addition to the construction of transportation facilities and infrastructure that the government is intensively carrying out, there are several obstacles that must be faced and solutions sought. The availability of proper public transportation is considered to be one of the answers to the demands of current needs to reduce transportation problems. Since 2004, the regional government, especially for the capital city of Jakarta through business entities, has launched

Bus-based public transportation (Bus Rapid Transit) with the name TransJakarta. This mode of transportation serves all administrative areas in almost all areas of the city (Jakarta Transportation Statistics, 2021).

Arif (2002) explained that land transportation in Jakarta is very dependent on the type of bus being operated. The buses available in Jakarta are short-distance vehicles used to transport middle-class workers. The problem faced by these buses is that the available dedicated lanes are sometimes seized by other road users, thereby slowing down their speed. These buses are generally low-maintenance vehicles, which are inconvenient, so many people tend to choose private vehicles as a means of movement. Of course, with a population of nearly 11 million and 21 million motorized vehicles, it is detrimental to Jakarta. This number is dominated by motorcycles, around 16 million units or 75%. It's hard to imagine the traffic jams this causes, especially during rush hour. This number will continue to grow in line with increasing urbanization in Jakarta. The high number of people and motor vehicles is not matched by the growth of transportation infrastructure. As is known, land in Jakarta is very minimal, making it impossible to build a new road network. Road construction in Jakarta is generally made with the concept of flyovers or elevated rails. Apart from BRT, the government is currently developing rail-based transportation, namely LRT, MRT, and ERT, which can serve the movement needs of residents of Jakarta and surrounding supporting cities. In the plan, rail-based transportation is also connected to BRT facilities.

Therefore, it is realized that public transportation facilities are needed that can serve all residents safely and comfortably. Aside from being a solution to transportation problems, the current BRT facility is also a local government service to improve the regional economy so that the revenue generated from this sector can be reused to improve facilities and services in the transportation sector and other related fields. In this regard, research is needed to analyze the effect of certain variables on BRT revenues in Jakarta.

METHODS

This study uses a quantitative research paradigm with correlation and multiple linear regression methods using the SPSS tool to measure the relationship between the dependent variable and the independent variable. Spatial data management is processed using ArcGIS Pro to see the distribution of research locations, geographical locations, and their descriptions.

The hypothesis put forward in this research is;

H1 : There is an effect of the number of passengers on income

H2: There is an effect of population on income

H3 : There is an effect of the number of buses on income

H4: There is an effect of the number of entrances/stops on income

H5: There is a simultaneous effect of variable X on income

RESULTS

Tabel 1
Descriptive Statistics

	Mean	Std. Deviation	N
Revenue	18706701106.42	10229080282.072	12
Passenger	5900604.42	3043973.097	12
Population	1585213.42	625497.465	12
Stops	21.50	7.610	12
Bus	65.33	27.497	12

This research was conducted to determine the effect of the variables number of passengers, number of residents, number of buses, and number of gates on TransJakarta revenues in one year.

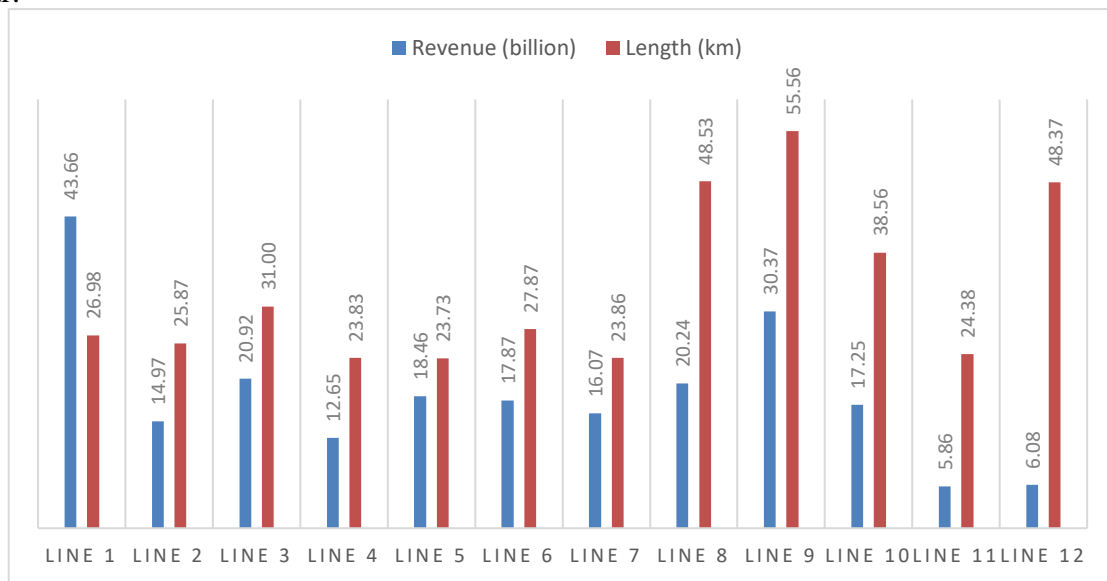


Figure 1. TransJakarta Revenue in 2021

The graph above shows that 12 TransJakarta bus lines operate in the Jakarta city area. The line with the highest income is Line 1 with the Blok M – Kota route. This line passes through the downtown area with a path length of 26.98 km. Then in second place on line 9, Pluit – Pinang Ranti, the longest route. This route serves the North Jakarta area which is the entrance to Jakarta via the Tanjung Priok International port, then crosses the downtown area and ends in a residential area in the East Jakarta area. While the lowest income is Route 11 for the Kampung Melayu – Pulo Gadung route, with a track length of 24.38 km. This route only crosses residential areas and mixed use land in the East Jakarta area.

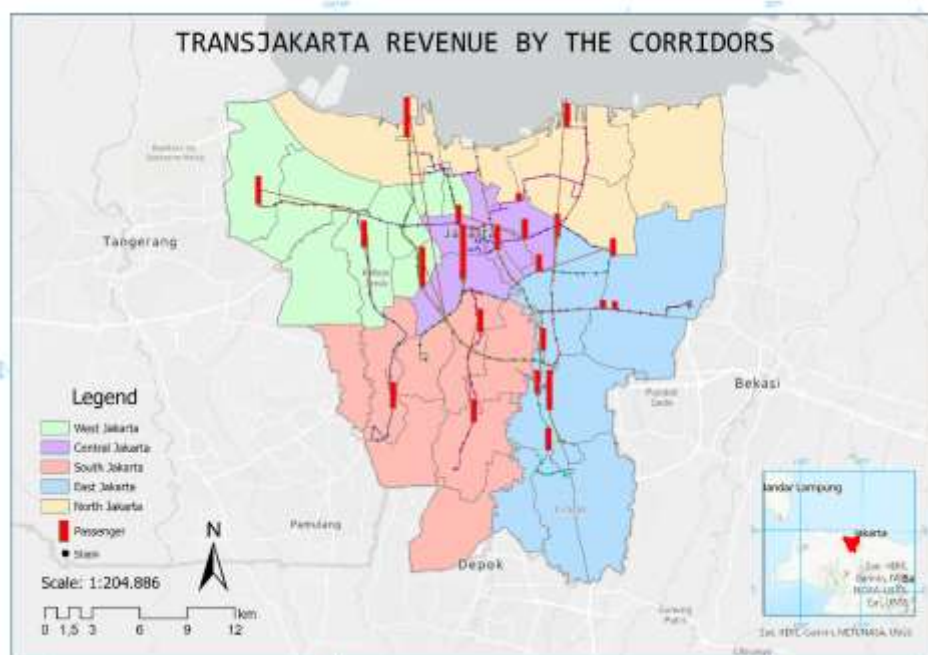


Figure 2. TransJakarta Revenue by Region

The image above shows the Special Capital Region of Jakarta (excluding the Thousand Islands). It can be seen that the most significant revenue is generated by routes that cross the North Jakarta area, then pass through Central Jakarta, and head to the southern part of Jakarta (South Jakarta and East Jakarta). These areas are indeed the main attraction in the city of Jakarta. Among them, there are port areas, industry, government centers, and trade and service centers.

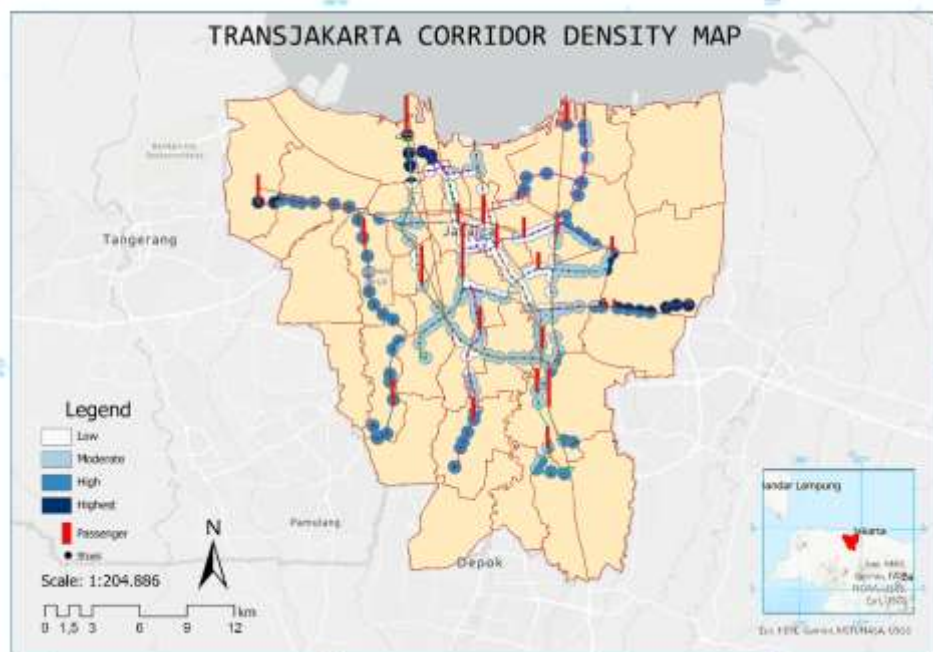


Figure 3. Density of the TransJakarta Corridor

The image above shows the density of the TransJakarta corridor. There are a total of 12 TransJakarta lines serving the Jakarta city area. Several bus stops are connected to other modes of transportation such as LRT, MRT, and ERT. The data is analyzed with a buffer. The size used to analyze the buffer zone of the TransJakarta corridor is 400 meters (Daniels & Mulley, 2013) explained in their research that the walking tolerance distance to access public transportation is a quarter mile or 400 meters, although in their findings (Neilson et al., n.d.) said that the number could be tripled, that is, one eight miles. It can be seen from the map above that the highest density is in the suburbs of Jakarta. These areas are densely populated residential areas, while the central areas are offices, government, as well as trade and service centers.

The data was then analyzed using multiple linear regression and correlation methods to see the relationship and its effect on the income variable of TransJakarta. Before analyzing the data obtained, a test must be carried out, namely the classical assumption test, to ensure that the regression equation functions correctly and is valid. Before carrying out multiple regression analysis and testing the hypothesis, it is necessary to carry out some classical assumption tests which aim to determine whether the regression model used is free from assumption deviations and meets the requirements to obtain good linearity. The following is a classic assumption test applied to the data.

**Classification Assumption Test
 Probability Plot Normality Test**

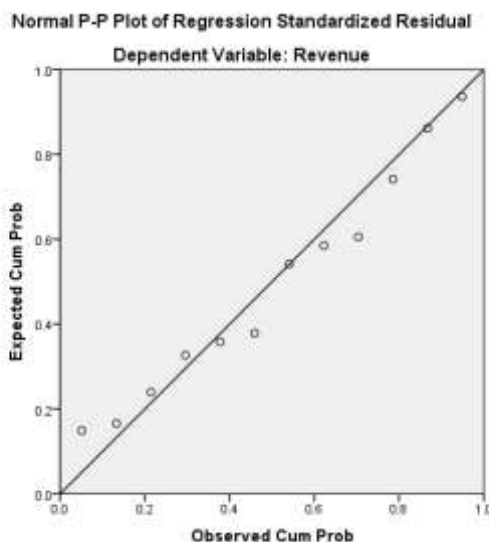


Figure 4. Normal P-P Plot

A normally distributed regression model if the plotted data that describes the actual data follows a diagonal line. Based on the picture in the plot above, it can be concluded that the data is normally distributed because it follows the diagonal line.

Multicollinearity Tolerance and VIF

There are no symptoms of multicollinearity if the tolerance value is > 0.100 and the VIF value is < 10.00.

Tabel 2
 Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.	Collinearity Statistics	
	B	Std. Error	Beta	t		Tolerance	VIF
1	(Constant)	-1707978399.070					
				-1.744	.125		
	Passenger	3268.722	.973	41.964	.000	.435	2.301
	Population	-215.588	-.013	-.462	.658	.287	3.487
	Stops	31709320.935	.024	.932	.382	.365	2.743
	Bus	12049662.509	.032	1.170	.280	.305	3.283

a. Dependent Variable: Revenue

In the output above it can be seen that the tolerance and VIF values fulfill the basis for decision making, so it can be concluded that there are no symptoms of multicollinearity.

Heteroscedasticity Scatterplot

Heteroscedasticity testing is done by making a scatterplot (distribution plot) between the residuals and the predicted values of the standardized dependent variable. The results of the heteroscedasticity test can be seen in the Scatterplot image, as shown below.

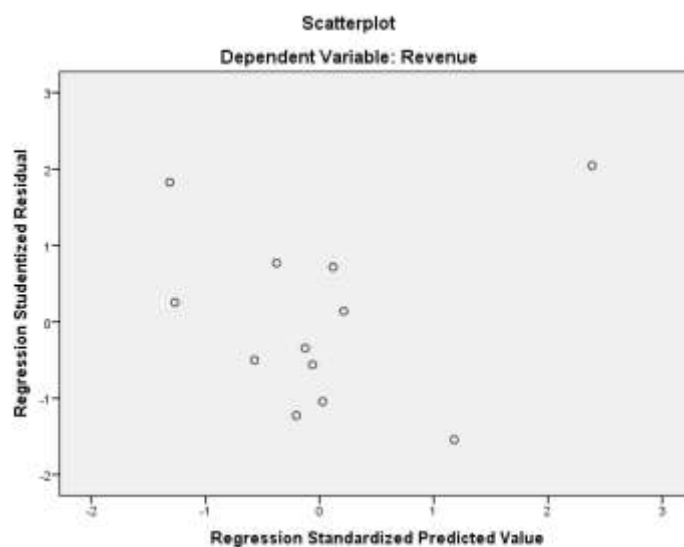


Figure 5. Scatter Plot

Heteroscedasticity does not occur if there is no clear pattern on the scatterplot and the points spread above and below zero on the Y axis. The output above shows that the pattern satisfies the basis for decision making, so it can be concluded that heteroscedasticity does not occur.

Autocorrelation

The Durbin-Watson value listed in the SPSS output is called the calculated DW. This figure will be compared with the acceptance or rejection criteria made with dL and dU values determined based on the number of independent variables in the regression model (k) and the number of samples (n). The dL and dU values can be seen in the DW table with a significance level (error) of 5% ($\alpha = 0.05$). There is no sign of autocorrelation if the Durbin Watson value is between 2 to (4-du).

Tabel 3
 Model Summary^b

Model	R	R Square	Adjusted Square	R Std. Error of the Estimate	Durbin-Watson
1	.999 ^a	.998	.997	518469345.188	1.277

a. Predictors: (Constant), Bus, Stops, Passenger, Population

b. Dependent Variable: Revenue

du value 2.5601 > Durbin-Watson value 1.277 < 1.4399. To confirm the symptoms of autocorrelation, a Run Test was performed.

Table 4.
 Runs Test

	Unstandardized Residual
Test Value ^a	-53142064.83808
Cases < Test Value	6
Cases >= Test Value	6
Total Cases	12

Number of Runs	5
Z	-.908
Asymp. Sig. (2-tailed)	.364

a. Median

The output above shows the Asymp value. The signature (2-tailed) is $0.364 > 0.05$ which means that there is no autocorrelation symptom so that the linear regression analysis can be continued.

Multiple Correlation Test

Correlation test is needed to test whether variable X simultaneously affects variable Y (income). The following is the result of calculating the correlation test using SPSS.

Table 6.
 Model Summary

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.998 ^a	1068.684	4	7	.000

a. Predictors: (Constant), Bus, Stops, Passenger, Population

b. Dependent Variable: Revenue

Pada *output* di atas diketahui bahwa nilai Sig. F_{change} $0,000 < 0,05$ sehingga dapat disimpulkan that the variable X is simultaneously related to the income variable (Y). Meanwhile, the R value of 1000 shows the perfect correlation that occurs in variable X to variable Y.

Multiple Linear Regression Analysis

The estimation of the regression equation model is as follows:

$$Y = 1707978399070 + 3268.722X_1 + (-215.588)X_2 + 31709320.935X_3 + 12049662.509X_4 + e$$

Partial t test

This partial t test is needed to measure the effect of each variable X on variable Y (income). Before being analyzed using SPSS, it is first necessary to calculate the t_{table} and f_{table} values as a basis for decision making.

The calculation of the t_{table} value is as follows:

$$\begin{aligned} t &= \frac{\alpha}{2} : n - k - 1 \\ &= (0.025 : 7) \\ &= 2.364 \end{aligned}$$

Perhitungan nilai F_{tabel} adalah sebagai berikut:

$$\begin{aligned} F &= k : n - k \\ &= 4 : 8 \\ &= 3.84 \end{aligned}$$

Hypothesis testing

1. H1 is accepted. The sig X1 value is $0.00 < 0.05$ and the tcount value is $41.964 > t_{table} 2.364$, which means that there is an effect of variable X1 on Y.
2. H2 is rejected. The sig X2 value is $0.658 > 0.05$, and the tcount value is $-0.462 < t_{table} 2.364$ which means that there is no effect of the X2 variable on Y.

3. H3 is rejected. X3 sig value $0.382 > 0.05$, and tcount value $0.932 < t_{table} 2.364$ which means that there is no effect of variable X3 on Y.
4. H4 is rejected. The sig value of X4 is $0.280 > 0.05$, and the tcount value is $1.170 < t_{table} 2.364$ which means that there is no effect of the variable X4 on Y.

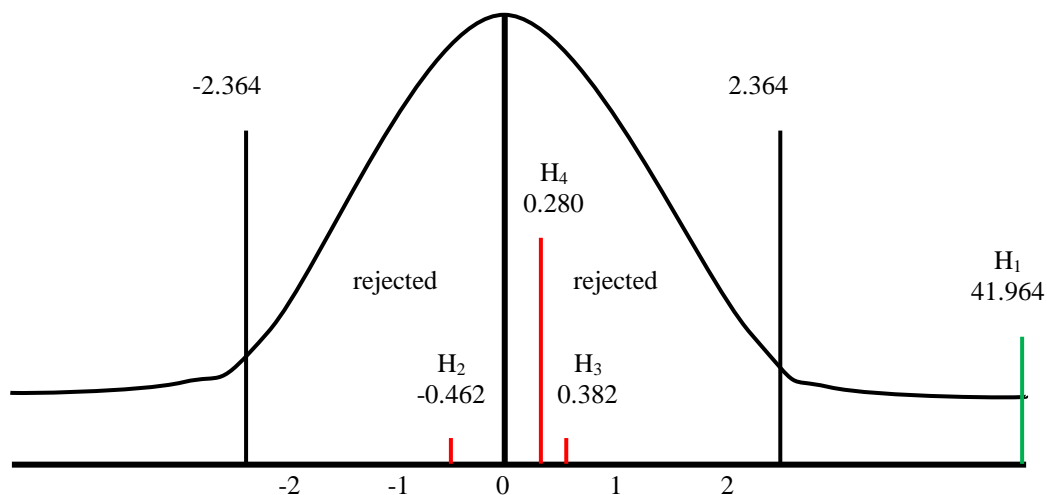


Figure 6. Regression Curve

F test

The following is the result of the SPSS analysis to see the Fcount value

Tabel 5.
ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	1149093244354617000000.000	4	287273311088654250000.000	1068.684	.000 ^b
Residual	1881673233298326270.000	7	268810461899760896.000		
Total	1150974917587915400000.000	11			

a. Dependent Variable: Revenue

b. Predictors: (Constant), Bus, Stops, Passenger, Population

Based on the results of the analysis in the ANOVA table above, it can be seen that the significance value of the influence of variables X1, X2, X3, and X4 simultaneously on variable Y is $0.00 < 0.05$, and the Fcount value is $1068.684 > F_{table} 3.84$ so that it can be concluded that H5 is accepted, which means that there is an effect of variable X simultaneously on Y.

Coefficient of Determination

The coefficient of determination explains the variation in the effect of the independent variables on the dependent variable. Or it can also be said as the proportion of the influence of all independent variables on the dependent variable. The coefficient of determination can be measured by the value of R-Square or Adjusted R-Square. R-Square is used when there is only one independent variable (commonly called Simple Linear Regression), while Adjusted R-Square is used when there is more than one independent variable. In calculating the value of the coefficient of determination, the author prefers to use R-Square instead Adjusted R-Square, even though there is more than one independent variable.

Based on the SPSS value output in the Model Summary table above, it is known that the R-Square value is 0.999. So it can be concluded that the effect of variable X simultaneously on Y is 99.9%.

DISCUSSION

There are four independent variables that are used in this study to determine the relationship with the income of land transportation based TransJakarta public transportation companies. Of the four variables, the number of passengers is the variable that has the strongest significant value and has a direct effect. Meanwhile, among the four independent variables used, only the population variable has a negative effect on TransJakarta revenue. Sudirman et.al., (2012) in his research showed that the variable number of passengers has a significant effect on total public transport revenue. The same thing was conveyed by Jura et al., (2016) who found the number of passengers is the main factor affecting public transport revenue along with the value of fuel. Several other variables presented in these studies have no relevance so they cannot be used to test the dependent variable in this study. The variable that is possible is the fare value variable as stated by Muawal, (2018) and Riswan (2018) who found the fare value has a significant effect on public transport revenue.

CONCLUSION

Based on the results of this study, it can be used as a basis for compiling and making decisions and determining policies in the field of transportation, especially mass transportation to increase local government revenues through TransJakarta for people's welfare. Related research is expected to be carried out to solve transportation problems in the future.

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