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Logistic Regression Application in Determining Mode Selection Factors of Musi Emas Feeder Transport, Palembang City

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ABSTRACT

Mode of transportation is absolutely a basic human need, especially in urban areas which tend to have high mobility. One type of mode that an important role in the urban transportation system is public transportation. oday, public transportation continues to make updates, one of which is public transportation in Palembang City marked by the start of operation of the Musi Emas feeder city transport in July 2022 with 7 routes. This study aims to identify the factors that influence and become the parameters of the traveling community in choosing mode of Musi Emas feeder city transportation Palembang City on the route corridor 1 Talang Kelapa – Punti Kayu, and corridor 2 Asrama Haji – Sematang Borang. The research approach used was quantitative with primary data sources from a revealed preference survey of 208 respondents who had used the Musi Emas feeder transport, and 192 respondents who had never used it. Analysis of the results of the survey data was modeled by logistic regression in order to look for factors that have an influence on choosing the mode of transportation of the Musi Emas feeder. The results of the analysis show that the independent variable data has a significant effect on variable dependent and the results of logistic regression analysis showed variable gender, age, and travel costs are influential variables in determining the choice of travelers to use the Musi Emas feeder city transportation mode.

Key word: mode of transportation; public transport; Musi Emas feeder; revealed preference; logistic regression

INTRODUCTION

Transportation is a movement that makes it easier for humans to carry out their daily activities from one place to another (Tamim, 2008). The development of transportation systems has been a major topic for the past decade (Arreeras et al., 2020), and the scope of transportation problems has expanded in both developed and developing countries (Miro, 2012). Apart from facilitating human activities, transportation also acts as the lifeblood of the nation and state (Dodi & Nahdalina, 2019; Handayeni et al., 2016), because transportation have a significant role in various aspects such as social, economic and political (Puan et al., 2019).

In carrying out activities, it takes a mode of transportation as a means of movement. This mode of transportation is absolutely a basic human need that helps in terms of mobility by land, sea or air (Borkowski et al., 2021; Przybylowski et al., 2021; Tardivo et al., 2021). Public transportation is one of the modes of transportation needed, especially in big cities. This is because urban public transport is a part of the urban transportation system which has an important role in supporting community mobility (Buamona et al., 2017), and public transport is also the pulse of urban transportation mobility, both in developed and developing countries (Prayudyanto, 2021). In addition, public transportation is also an effective means of transportation in reducing congestion (Binovan et al., 2022).

The emergence of increased economic and development activities in a region has an impact on increasing the need for travel (Fahrizal & Dwiatmoko, 2023). The increase in travel needs has also occurred in Palembang City, which is one of the big cities in Indonesia and has a fairly high growth rate and serves as the capital city of South Sumatra Province. Transportation conditions in Palembang City are starting to face several problems, such as traffic jams and the lack of public transport services (Widiyanti, 2019). Therefore reliable management of public transport services is

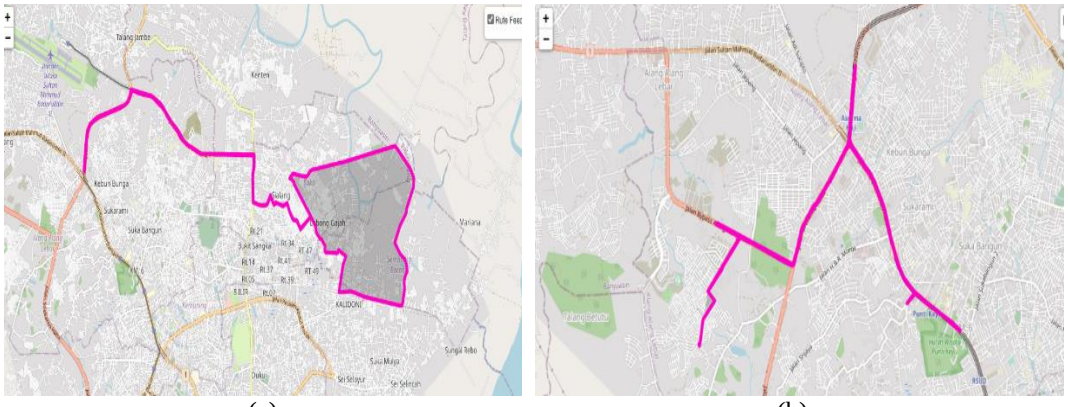
needed as an effort to overcome these problems (Oktariansyah et al., 2017), because if transport management is still not optimal it is assumed that it will become a new problem in the transportation sector (Devi et al., 2021). In line with the development of time, public transportation in the city of Palembang continues to make updates, including the availability of the Musi Emas feeder city transportation with 7 routes including the Asrama Haji – Sematang Borang, Punti Kayu – Talang Kelapa, Asrama Haji – Talang Betutu, Polresta – Opi Complex, DJKA – Pasar Plaju, RSUD – Sukawinatan, and Kamboja – Bukit Siguntang with the implementation of buy the service which is currently free to use due to subsidies from the Government. Basically, the implementation of a well-planned buy the service can be developed and is capable of reducing government subsidies and improving public transport services (Prayudyanto, 2021).

Modeling the choice of transportation mode is one of the most studied areas in travel behavior research and is an important step in the process of forecasting demand for travel (Wang & Ross, 2018). Transport modeling is also used to evaluate changes in behavior and to determine the impact of infrastructure improvements (Al-Salih & Esztergár-Kiss, 2021). Many factors can influence election mode of travel, including ratesservice the mode of travel and the socio-demographic characteristics of the traveler (Wang & Ross, 2018). Although the theoretical foundations of these models are different, they generally assume that individuals have a choice in setting their preferred alternative (Al-Salih & Esztergár-Kiss, 2021). Therefore, this choice is very important in activity-trip modeling (Bhat & Koppelman, 1999; Bowman & Ben-Akiva, 2001), where the main problem is identification of the most relevant modeling parameters (Binder et al., 2019). Therefore, this study aims to identify the factors that influence and become a parameter for travelers in choosing Musi Emas feeder city transportation modes Palembang City as a means of transportation.

RESEARCH METHODS

Research place

This research is located in the Palembang City with the object of Musi Emas feeder city transportation. The transport routes under review are corridor 1 of Talang Kelapa – Punti Kayu, and corridor 2 of Asrama Haji – Sematang Borang. Each route length is 20.1 km in corridor 1 and 40.27 km in corridor 2. Both corridor routes are integrated with Palembang City Light Rail Transit stations, namely Punti Kayu Station and Asrama Haji. An overview of the research location is shown in Figure 1.



(a) (b)

Figure 1. (a) Route of Musi Emas Feeder, Asrama Haji – Sematang Borang Corridor (b) Route of Musi Emas Feeder ,Talang Kelapa – Punti Kayu Corriodor

Methods of collecting data

The data used in this study were obtained from distributing questionnaires with a revealed preference approach, so the data used were primary. Questionnaires were distributed to 208 respondents who had used the Musi Emas feeder transport, and 192 respondents had never used it. The variables used are shown in table 1.

Table 1. Research variable

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Predictor	Information	Category	Code	Scale
Y	The experience of respondents using the Musi Emas feeder	Never	0	Nominal
		Once	1	
X1	Gender	Male	1	Nominal
		Female	2	
X2	Age	< 15 years	1	Ordinal
		15 – 19 years	2	
		20 – 24 years	3	
		25 – 29 years	4	
		30 – 34 years	5	
		35 – 39 years	6	
		40 – 44 years	7	
		45 – 49 years	8	
		50 – 54 years	9	
		55 – 59 years	10	
		60 – 64 years	11	
		65 – 69 years	12	
		>70 years	13	
X3	Income	>2.500.000	1	Ordinal
		2.500.000 – 3.300.00	2	
		3.300.000 – 4.500.000	3	
		4.500.000 – 5.500.000	4	
		5.500.000 – 6.500.000	5	
		6.500.000 – 10.000.000	6	
		10.000.000 – 15.000.000	7	
		15.000.000 – 20.0000	8	
		>20.000.000	9	
X4	Work	State Officer	1	Ordinal
		Private Officer	2	
		Trader	3	
		Teacher	4	
		Driver / Transportation Service	5	
		Laborer	6	
		Security	7	
		Student	8	
		Housewife	9	
		Retired	10	
		Unemployment	11	
X5	Travel intent	Return to Home	1	Ordinal
		Work	2	
		School / College	3	
		Shopping	4	
		Social	5	
X6	Trip frequency	1 day	1	Ordinal
		2 days	2	
		3 days	3	
		4 days	4	
		5 days	5	
		6 days	6	
		Every day	7	
X7	Travel expense (IDR)	1 – 10.000	1	Ordinal

Predictor	Information	Category	Code	Scale
		10.000 – 20.000	2	
		20.000 – 30.000	3	
		30.000 – 40.000	4	
		40.000 – 50.000	5	
		50.000 – 60.000	6	
		60.000 – 70.000	7	
		>70.000	8	

Data Analysis

Research data obtained through revealed preference approach, then analyzed by logistic regression. Logistic regression is a part of the regression analysis that is used when the dependent (response) variable is a dichotomous variable. The dichotomous variable usually consists of only two values, which represent the occurrence or absence of an event which is usually given the number 0 or 1 (Widiarta & Wardana, 2011). The regression analysis in this study consisted of four test models, namely (1) assessing the entire model, (2) testing the feasibility of the regression model, (3) the coefficient of determination, and (4) the classification matrix. The model testing uses Statistical Package for Social Science (SPSS) Version 25.0.

RESULT AND DISCUSSION

Assessing the Overall Model (Overall Model Fit)

In assessing the entire model, it is shown by the Log Likelihood Value (-2LL value), that is by comparing the -2LL value at the beginning (block number = 0) with the -2LL value at the end (block number = 1). The test is carried out by looking at the difference between the -2log values probability initial (block number = 0) with a final log likelihood value of -2 (block number = 1).

The hypothesis for assessing overall model fit is:
H_0 : The hypothesized model is fit with the data
H_1 : The hypothesized modelNo data fit

In table 2, the results of the regression analysis show that the initial -2Log likelihood value (block number = 0) before being included in the independent variable is 553,707. After the seven independent variables were entered, the final -2Log likelihood value (block number = 1) decreased to 527,352. The difference between the initial -2Log likelihood and the final -2Log likelihood shows a decrease of 26,355. It can be concluded that the initial -2Log likelihood value (block number = 0) is greater than the final -2Log likelihood value (block number = 1), resulting in a decrease. This indicates that the hypothesized model is in accordance (fit) with the data, so that the addition of independent variables to the model shows that the regression model is getting better or in other words H_0 accepted.

Table 2. Overall Model Fit Test Results

Overall Model Fit Testing	Nilai
-2Log Initial likelihood (block number = 0)	553.707
-2Log Final likelihood (block number = 1)	527.352

Testing the Feasibility of the Regression Model (Goodness of Fit Test)

Testing the feasibility of the regression model was assessed using Hosmer and Lemeshow's Goodness of Fit Test as measured by the chi square value. If the Hosmer and Lemeshow tests show a probability value (P-value) ≤ 0.05 (significant value) it means that there is a significant difference between the model and the observed value so that the model cannot be used to predict the observed value. If the Hosmer and Lemeshow tests show a probability value (P-value) ≥ 0.05 (significant value) it means that there is no significant difference between the model and the data or it can be

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said that the model can be used to predict the observed value. The Hosmer and Lemeshow test values in this study are shown in table 3.

Table 3. Hosmer and Lemeshow Test Results

Chi – Square	Df	Significant
11.651	8	0.167

Based on table 3, the results of the regression analysis show that the results of the Hosmer and Lemeshow Goodness of Fit Test obtained a chi-square value of 11,651 with a significance level of 0.167. The test results show that the probability value (P-value) ≥ 0.05 (significant value) is 0.167 ≥ 0.05, then H0 accepted. Thus, this value indicates that there is no significant difference between the model and the data so that the regression model in this study is feasible and able to predict the observed value.

Coefficient of Determination (Nagelkerke's R Square)

The variability of the independent variables in explaining the dependent variable is measured using the coefficient of determination which can be seen from the Nagelkerke R Square value. The Nagelkerke R Square test results are shown in table 4.

Table 4. Nagelkerke R Square Test Results

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
527.352	0.064	0.085

Based on table 4, the results of the regression analysis show that the coefficient of determination as seen from the Nagelkerke R Square value is 0.85. This value indicates that the ability of the independent variable to explain the dependent variable, namely the respondent's experience of riding the Musi Emas feeder, is only 8.5%. While the rest is explained by other variables outside of this research model, which is equal to 91.5%.

Classification Matrix

The classification matrix shows the predictive power of the logistic regression model to predict the influencing factors selecting respondents using the Musi Emas feeder city transportation. The results of the classification matrix are shown in table 5.

Table 5. Classification Matrix

Observed	Predicted Pengalaman Responden		Percentage Correct
	Never	Once	
Never	111	80	58.1
Once	74	135	64.6
Overall percentage			61.5

Based on the results shown in table 5, the regression analysis shows that the factors influencing respondents to use the Musi Emas feeder city transportation are 61.5%. From this table, the probability that a respondent has ever ridden on the Musi Emas feeder is 64.6% of the total sample of 400 respondents. While the respondents who had never climbed the Musi Emas feeder were 58.1% of the total sample of 400 respondents.

Logistic Regression Models

The results of logistic regression analysis of the influence of gender (X1), age (X2), income (X3), occupation (X4), travel intention (X5), trip frequency (X6), and travel costs (X7) on respondents' experience of using public transport Musi Emas feeder cities are shown in table 6.

Table 6. Logistic Regression Models

Variable	B	S. E	Wald	Df	Sig.
Gender	0.813	0.220	13.659	1	0.003
Age	0.116	0.047	6.082	1	0.014
Income	0.013	0.111	0.014	1	0.906
Work	0.032	0.032	1.028	1	0.311
Travel Purpose	0.008	0.053	0.009	1	0.925
Trip Frequency	0.074	0.117	1.928	1	0.165
Cost	0.239	0.735	4.195	1	0.041
Constant	-1.853		6.359	1	0.012

Based on table 6 the logistic regression equation is as follows:

$$Y= \frac{e^{0,813\ X1+0,116\ X2+0,013\ X3+0,032\ X4+0,008\ X5+0,074\ X6+0,239\ X7-1,853}}{1+ e^{0,813\ X1+0,116\ X2+0,013\ X3+0,032\ X4+0,008\ X5+0,074\ X6+0,239\ X7-1,853}}$$

$g(X) = -1,853 + g(X) = -1.853 + 0,813\ X1 + 0,116\ X2 + 0,013\ X3 + 0,032\ X4 + 0,008\ X5 + 0,074\ X6 + 0,239\ X7 + 1,853$

The logistic regression equation above, can be analyzed the effect of independent variables on the dependent variable, including:

(1) The constant value (α) is -1.853, meaning that if the independent variable has a fixed value (constant), then the value of the community's experience using the Musi Emas feeder is -1.853.
(2) The gender variable has a positive coefficient value of 0.813, meaning that if each respondent's gender assumes the value of the other variables is constant, it will increase the experience value of the community using the Musi Emas feeder by 0.813.
(3) The age variable has a positive coefficient value of 0.116, meaning that if each respondent's age increases with the assumption that the values of other variables are constant, then the value of the community's experience of using the Musi Emas feeder will increase by 0.116.
(4) The income variable has a positive coefficient value of 0.013, meaning that if each respondent's income increases assuming the value of other variables is constant, it will increase the value of the community's experience of using the Musi Emas feeder by 0.013.
(5) The work variable has a positive coefficient value of 0.032, meaning that if each respondent's income increases assuming the value of other variables is constant, it will increase the experience value of the community using the Musi Emas feeder by 0.032.
(6) The travel intention variable has a positive coefficient value of 0.008, meaning that if each respondent's travel intention increases assuming the value of other variables is constant, it will increase the experience value of the community using the Musi Emas feeder by 0.008.
(7) The trip frequency variable has a positive coefficient value of 0.074, meaning that if each increase in the frequency of the respondent's trips assumes the value of other variables is constant, it will increase the experience value of the community using the Musi Emas feeder by 0.074.
(8) The travel cost variable has a positive coefficient value of 0.239, meaning that if each respondent increases travel costs assuming the value of other variables is constant, it will increase the experience value of the community using the Musi Emas feeder by 0.239.

Wald Hypothesis Test

In determining the decision to accept or reject the hypothesis is to compare the t count and the significant level α = 0.05 with the following criteria:

(1) If the value of $t_{count} < t_{table}$ and p-value > 0.05, then the hypothesis (H_0) accepted. This shows that the independent variables individually (partially) do not affect the dependent variable.
(2) f the value of $t_{count} > t_{table}$ and p-value < 0.05, then the hypothesis (H0) rejected. This shows that the independent variables individually (partially) affect the dependent variable.

Based on table 6, the results of hypothesis testing can be obtained using logistic regression analysis, as follows:

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(1) The first hypothesis (H_1) is that gender has a positive effect on the experience of respondents using the Musi Emas feeder. The results of the wald test (t) show that the value of t_{count} bigger than t_{table} (13.659 > 1.966034) and the probability value is smaller than the significance level (0.003 <0.05). Based on the test results, it can be concluded that H_1 is rejected and it is stated that gender has an effect on people's experience of using the Musi Emas feeder.
(2) The second hypothesis (H_2) is that age has a positive effect on the experience of respondents using the Musi Emas feeder. The results of the wald test (t) show that the value of t_{count} bigger than t_{table} (6.082 > 1.966034) and the probability value is greater than the significance level (0.014 <0.05). Based on the test results, it can be concluded that H_2 is rejected and it is stated that age influences people's experience of using the Musi Emas feeder.
(3) The third hypothesis (H_3) is that income has a positive effect on the experience of respondents using the Musi Emas feeder. The results of the wald test (t) show that the value of t_{count} bigger than t_{table} (0.014 < 1.966034) and the probability value is smaller than the significance level (0.906 > 0.05). Based on the test results, it can be concluded that H_3 is accepted and it is stated that income has no effect on people's experience of using the Musi Emas feeder.
(4) The fourth hypothesis (H_4) is that work has a positive effect on the experience of respondents using the Musi Emas feeder. The results of the wald test (t) show that the value of t_{count} bigger than t_{table} (1.028 < 1.966034) and the probability value is smaller than the significance level (0.311 > 0.05). Based on the test results, it can be concluded that H_4 is accepted and it is stated that work does not affect people's experience of using the Musi Emas feeder.
(5) The fifth hypothesis (H_5) is that travel intentions have a positive effect on respondents' experience of using the Musi Emas feeder. The results of the wald test (t) show that the value of t_{count} bigger than t_{table} (0.009 < 1.966034) and the probability value is smaller than the significance level (0.925 > 0.05). Based on the test results, it can be concluded that H_5 is accepted and it is stated that the purpose of the trip does not affect the experience of the community using the Musi Emas feeder.
(6) The sixth hypothesis (H_6) is that the frequency of trips has a positive effect on the experience of respondents using the Musi Emas feeder. The results of the wald test (t) show that the value of t_{count} bigger than t_{table} (1.928 < 1.966034) and the probability value is smaller than the significance level (0.165 > 0.05). Based on the test results, it can be concluded that H_6 is accepted and it is stated that the frequency of trips has no effect on people's experience of using the Musi Emas feeder.
(7) The seventh hypothesis (H_7) is that travel costs have a positive effect on the experience of respondents using the Musi Emas feeder. The results of the wald test (t) show that the value of t_{count} bigger than t_{table} (4.195 > 1.966034) and the probability value is smaller than the significance level (0.012 <0.05). Based on the test results, it can be concluded that H_7 is rejected and it is stated that travel costs affect people's experience of using the Musi Emas feeder.

Omnibus Tests of Model Coefficients

In this study the number of variables is 8, so the value of DF = 8 – 1 = 7 with an error rate taken is 0.05. Then analyzed using the Chi-Square table with the formula DF = K – 1(8 – 1=7) to get the result L table = 14.06714, the results of the same calculation also use Microsoft Excel with the formula = CHIINV (0.05.7) to get the result 14.06714. Therefore the value of L0 – L1 = 26.355 ≥ 14.06714, which means that the values of the variables X1, X2, X3, X4, X5, X6, and X7 simultaneously affect the experience of the community using the Musi Emas feeder as a means of transportation.

CONCLUSION

The Reveal Preference survey has been conducted on the respondents in order to identify the factors that determine the community/actorsjourney chose to use the Musi Emas feeder with travel routes in corridor 1 Talang Kelapa – Punti Kayu, and corridor 2 Hajj Dormitory – Sematang Borang. Each route length is 20.1 km corridor 1 and 40.27 km corridor 2. Of the 400 respondents who passed the Musi Emas feeder route, 208 respondents had used the Musi Emas feeder and 192 respondents had never used it. The results of testing the analyzed data show that the data variable independent significant effect on variable dependent and the results of logistic regression analysis showed

variable gender, age, and travel costs are influential variables in determining people's choices of using the Musi Emas feeder city transportation mode. In this study, eight variables were examined and analyzed by applying an error level of 0.05. The results of calculations using the Chi-Square table show the value of L table = 14.06714. The same calculation value is also shown in the CHIINV formula (0.05,7) in Microsoft Excel. The value of L0 – L1 = 26.355 ≥ 14.06714, shows there are significant differences between the variables studied.

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