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The Airport Transportation Mode Choice Model Using A Logit Regression Method(A Case Study: Lombok International Airport)

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ABSTRACT:*This paper discusses passengers' behavior of airport transportation mode choice and develops airport transportation mode choice models to Mataram City fromLombok International Airportin Lombok, Indonesia. First, descriptive analyses are conducted to identify whether independent variables such as job type, trip of origin, education, transportation costs in a day, trip destination, quantity of goods carried, information of transportation, timeliness effect rate, low-cost effect rate, access level, and the reasons for choosing transportation are different among airport transportation mode. Second, Multinomial Logit (MNL) regression models are proposed for three types of airport transportation mode choice: Bus DAMRI, Taxi, and Travel. After analyzing, the model results indicate that the choice of airport transportation mode,Taxi is significantly affected by five factors ie job type, transportation costs in a day,information of transportation,access level, and the reasons for choosing transportation. Furthermore, the choice of airport transportation mode, Travel is also significantly affected by five factorsietransportation costs in a day, trip destination, information of transportation, access level, and the reasons for choosing transportation.*
KEYWORDS-*Airport Transportation Mode, Mode Choice, Multinomial Logit Regression*

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I. INTRODUCTION

Transportation is an important means in the development of a region. However, if transportation is not well regulated, it will cause some problems, such as accidents, congestion, etc. So that required the model of transportation planning. This paper uses one of the frequently used models of transportation planning, that is the mode choice.

Mode choice model aims to know the proportion of people who will use every mode. This process is performed with the intent to calibrate the mode choice model by knowing the independent variables (attributes) that influence the mode choice. After the calibration process, the model can be predicted for the mode choice by using the value of the independent variables (attribute) for the future [7].

The mode choice also has an important role for tourist destinations in Indonesia, one of which is if a trip to the Lombok Island. However, to get to the tourist destinations of course would require a transportation that facilitates the access of tourists to visit, the statement is in accordance with that proposed by [6] stating that, one of the factors of tourist attraction is the availability of ground transportation to the object of tourism, recently the transportation become one of the main choices for the society for traveling ie air transportation. This is due to the emergence of cheap flight costs and easily accessible, making it very affordable for the wider society.

This impact is also felt in Lombok International Airport (LIA) which causes the increase request for transportation from the airport to their desired destination, be it tourists or local people. The increasing number of tourists to the Lombok Island, so LIA provides several public transportation options such as Bus DAMRI, Airport Taxi and also special transportation such as Travel (travel agent). Therefore, an analysis is needed to determine the characteristics of passengers in choosing their travel mode.

There is a growing interest in matters relating to airport ground access planning [4]. People traveling by air usually choose the airport after considering several factors such as costs, flight frequency or flight schedule, departure time, access distance, and mode to get to the airport [2]. One of the analytical methods used to analyze the mode choice is using logit regression analysis. Logit regression consists of binary logit regression,

multinomial logit regression, and ordinal logits. Some research are widely used to resolving the choice of ground access modes ie Multinomial Logits (MNL), among which that has been investigated by [1], [3] also [5].

In 2015, Thrane examined the choice of long-distance transport modes and long-distance business travel of Norwegian domestic passengers using travel behavior survey data and using the MNL model and the results showed that long-distance travel and travel-related characteristics were the most important for determining factors from the choice of Norwegian tourist mode. Then in 2017, Agyemang seeks to investigate the modes of choice for long-distance travel to Ghana's largest metropolitan area of Accra, the destination to Accra central business area. Research of Gokasar and Gunay in 2017, analyzed the access of mode choice to Ataturk International Airport (IST) in Istanbul, Turkey using MNL method. Mode choices used are car, drop-off, public transportation, and taxi.

This study discusses the models and factors influencing the arrival of passengers from Lombok International Airport for choosing airport transportation modes, using multinomial logit (MNL) regression method. The choice of airport transportation modes consists of Bus DAMRI, Taxi and Travel destination to Mataram City.

II. METHOD

Questionnaire survey method used in this study, the number of respondents as much as 156, so the variables in this study are as follows:

Table 1. Type and description of variables used in the Multinomial Logit Model on mode choice

Variables		Description
1.	Job type (X_1)	1 if civil servant, 2 if army, 3 if private, 4 if student, 5 if entrepreneur, 6 if other
2.	Trip of origin (X_2)	1 if Lombok island, 2 if outside Lombok island
3.	Education (X_3)	1 if primary school/junior high school/equal, 2 if senior high school/equal, 3 if diploma/bachelor,4 if postgraduate
4.	Transportation Costs in a day(X_4)	1 if <50.000, 2 if 50.000-150.000, 3 if >150.000
5.	Trip destination (X_5)	1 if go home, 2 if vacation, 3 if business, 4 if family affairs,5 if college/school
6.	Quantity of goods carried(X_6)	1 if 1 goods, 2 if 2 goods, 3 if > 2 goods
7.	Information of Transportation(X_7)	1 if airport information center, 2 if information from colleagues/relatives, 3 if internet
8.	Timeliness effect rate (X_8)	1 if agree, 2 if disagree, 3 if doubtful
9.	Low-cost effect rate (X_9)	1 if agree, 2 if disagree, 3 if doubtful
10.	Access level(X_{10})	To the final destination; 1 if difficult, 2 if easy
11.	The reason of choosing transportation (X_{11})	1 if low-cost, 2 if good service, 3 if friend/family influence, 4 if timeliness, 5 if short travel time, 6 if other
Airport transportation mode variables		
12.	Bus DAMRI	Reference category
13.	Taxi	
14.	Travel (travel agent)	

This data were analyzed by multinomial logit regression method. Stages to analyze this method are descriptive analysis data, multicolinearity test, parameter estimation, simultaneously parameter test, partially parameter test, checking suitability of model formed, and interpretation of the multinomial logit regression model.

III. RESULT AND DISCUSSION

1.1 Multicolinearity Test

Table 2. VIF Values for each Predictor Variable

No.	Predictor Modifiers	VIF Values
1	Job type	1.068
2	Trip of origin	1.511
3	Education	1.052
4	Transportation Costs in a day	1.051
5	Trip destination	1.442
6	Quantity of goods carried	1.045
7	Information of Transportation	1.091
8	Timeliness effect rate	1.130
9	Low-cost effect rate	1.282
10	Access Level	1.078
11	The reason of choosing transportation	1.155

Based on Table 2. it can be seen that there is no VIF value more than 10, so it can be concluded that there is no multicolinearity for each predictor variable.

1.2 Parameter Estimation

The parameter estimator on multinomial logit regression uses Maximum Likelihood Estimation (MLE). The following is the full model formed parameter estimation of independent variables.

1. Logit 1 (Taxi):

$$g_1(x_i) = 4.202 - 4.241x_{1(1)} - 5.560x_{1(2)} + 7.194x_{1(3)} + 8.268x_{1(4)} + 0.684x_{1(5)} + 2.590x_{2(1)} - 7.897x_{3(1)} - 8.196x_{3(2)} - 7.185x_{3(3)} - 14.620x_{4(1)} - 3.015x_{4(2)} - 3.428x_{5(1)} - 7.356x_{5(2)} - 6.612x_{5(3)} - 2.761x_{5(4)} - 3.366x_{6(1)} + 2.384x_{6(2)} - 8.870x_{7(1)} - 10.650x_{7(2)} + 14.180x_{8(1)} + 23.341x_{8(2)} + 2.608x_{9(1)} + 4.780x_{9(2)} - 13.711x_{10(1)} - 1.109x_{11(1)} + 2.833x_{11(2)} + 11.017x_{11(3)} + 2.494x_{1(4)} + 8.847x_{11(5)}$$

2. Logit 2 (Travel):

$$g_2(x_i) = -19.731 + 5.184x_{1(1)} - 15.889x_{1(2)} + 12.670x_{1(3)} + 11.540x_{1(4)} + 7.372x_{1(5)} + 2.946x_{2(1)} - 3.623x_{3(1)} + 13.042x_{3(2)} + 13.798x_{3(3)} - 11.428x_{4(1)} - 3.469x_{4(2)} + 15.569x_{5(1)} + 14.448x_{5(2)} + 15.342x_{5(3)} + 17.846x_{5(4)} - 4.093x_{6(1)} - 0.281x_{6(2)} - 9.758x_{7(1)} - 8.907x_{7(2)} - 5.966x_{8(1)} + 9.177x_{8(2)} + 1.826x_{9(1)} + 1.934x_{9(2)} - 12.539x_{10(1)} - 2.990x_{11(1)} - 0.412x_{11(2)} + 9.843x_{11(3)} - 0.004x_{11(4)} + 3.472x_{11(5)}$$

3.3 Simultaneously Parameter Test

Parameter simultaneously test using G (Likelihood Ratio Test) statistic test, with hypothesis:
H_0: $\beta_0 = \beta_1 = \beta_2 = \cdots = \beta_k = 0$, the predictor variables do not affect to the response variable.
H_1: there is at least one $\beta_k \neq 0$, at least one predictor variable affect to the response variable.

Table 3.Results of Simultaneously Test

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	317.214			
Final	74.833	242.381	58	0.000

Based on Table 3. can be seen that the significant 0.000, meaning very small and less than the significance level of α(0.05), then H_0 rejected. Thus, it can be concluded that there is at least one predictor variable affect to the response variables.

3.4 Partially Parameter Test

Partial parameter test using Wald statistic test, with hypothesis:
H_0: $\beta_j = 0$, the predictor variables j has no affect the response variable.
H_1: there is at least one $\beta_j \neq 0$, then to get the best model used backward elimination method.

Table 4. Partially Parameter Test

Transportation Mode[a]	B	Std. Error	Wald	df	Sig.	*Exp(B)*
Intercept	12.777	4.437	8.293	1	.004	
[X1=1]	-3.760	2.413	2.428	1	.119	.023
[X1=2]	-6.665	2.832	5.539	1	.019	.001
[X1=3]	-.923	1.656	.311	1	.577	.397
[X1=4]	1.725	1.813	.906	1	.341	5.611
[X1=5]	-3.640	2.387	2.325	1	.127	.026
[X1=6]	0[b]	.	.	0	.	.
[X4=1]	-9.988	2.507	15.874	1	.000	4.597E-005
[X4=2]	-3.372	1.744	3.740	1	.053	.034
[X4=3]	0[b]	.	.	0	.	.
[X5=1]	-1.063	1.964	.293	1	.588	.345
[X5=2]	-4.061	3.017	1.812	1	.178	.017
[X5=3]	-3.028	2.441	1.539	1	.215	.048
[X5=4]	-1.142	2.283	.250	1	.617	.319
[X5=5]	0[b]	.	.	0	.	.
[X7=1]	-2.991	1.800	2.760	1	.097	.050
[X7=2]	-4.277	1.857	5.307	1	.021	.014
[X7=3]	0[b]	.	.	0	.	.
[X10=1]	-6.060	1.656	13.394	1	.000	.002
[X10=2]	0[b]	.	.	0	.	.
[X11=1]	-2.745	1.687	2.647	1	.104	.064
[X11=2]	1.055	1.659	.404	1	.525	2.872
[X11=3]	1.218	2.239	.296	1	.586	3.381
Taxi						
Transportation Mode[a]	**B**	**Std. Error**	**Wald**	**df**	**Sig.**	***Exp(B)***

	[X11=4]	.597	1.780	.113	1	.737	1.817
	[X11=5]	6.118	2.406	6.468	1	.011	453.948
	[X11=6]	0[b]	.	.	0	.	.
Travel	Intercept	-7.592	4.147	3.353	1	.067	
	[X1=1]	.605	2.639	.053	1	.819	1.832
	[X1=2]	-21.079	6682.992	.000	1	.997	7.009E-010
	[X1=3]	1.332	2.089	.407	1	.524	3.790
	[X1=4]	2.211	2.342	.891	1	.345	9.127
	[X1=5]	-.526	2.482	.045	1	.832	.591
	[X1=6]	0[b]	.	.	0	.	.
	[X4=1]	-8.262	2.538	10.595	1	.001	.000
	[X4=2]	-2.311	1.801	1.646	1	.200	.099
	[X4=3]	0[b]	.	.	0	.	.
	[X5=1]	15.649	1.351	134.224	1	.000	6256174.335
	[X5=2]	14.556	2.152	45.746	1	.000	2097914.241
	[X5=3]	13.859	1.456	90.555	1	.000	1044138.749
	[X5=4]	16.603	.000	.	1	.	16242458.754
	[X5=5]	0[b]	.	.	0	.	.
	[X7=1]	-3.799	1.939	3.838	1	.050	.022
	[X7=2]	-2.908	1.880	2.394	1	.122	.055
	[X7=3]	0[b]	.	.	0	.	.
	[X10=1]	-5.627	1.668	11.384	1	.001	.004
	[X10=2]	0[b]	.	.	0	.	.
	[X11=1]	-3.017	1.716	3.091	1	.079	.049
	[X11=2]	-.479	1.586	.091	1	.763	.619
	[X11=3]	1.713	2.129	.647	1	.421	5.545
	[X11=4]	-.997	1.795	.308	1	.579	.369
	[X11=5]	5.240	2.089	6.294	1	.012	188.714
	[X11=6]	0[b]	.	.	0	.	.

Based in Table 4, the predictor variables in both logits (Taxi and Travel) were significantly affect to the response variable because of the significance (p-value) <0.05, so H_0 rejected.

Multinomial logit regression model as follow:

1. Logit 1 (Taxi):

$$g_1(x_i) = 12.777 - 3.760x_{1(1)} - 6.665x_{1(2)} - 0.923x_{1(3)} + 1.725x_{1(4)} - 3.640x_{1(5)} - 9.988x_{4(1)} - 3.372x_{4(2)} - 1.063x_{5(1)} - 4.061x_{5(2)} - 3.028x_{5(3)} - 1.142x_{5(4)} - 2.991x_{7(1)} - 4.277x_{7(2)} - 6.060x_{10(1)} - 2.745x_{11(1)} + 1.055x_{11(2)} + 1.218x_{11(3)} + 0.597x_{11(4)} + 6.118x_{11(5)}$$

2. Logit 2 (Travel):

$$g_2(x_i) = -7.592 + 0.605x_{1(1)} - 21.079x_{1(2)} + 1.332x_{1(3)} + 2.211x_{1(4)} - 0.526x_{1(5)} - 8.262x_{4(1)} - 2.311x_{4(2)} + 15.649x_{5(1)} + 14.556x_{5(2)} + 13.859x_{5(3)} + 16.603x_{5(4)} - 3.799x_{7(1)} - 2.908x_{7(2)} - 5.627x_{10(1)} - 3.017x_{11(1)} - 0.479x_{11(2)} + 1.713x_{11(3)} - 0.997x_{11(4)} + 5.240x_{11(5)}$$

3.5 Suitability Model Test

Based on Table 5, testing using Pearson test. Show that the value of significance (p-value) is 0.961> α(0.05). It can be concluded that the multinomial logit regression model that is formed is appropriate. The results of the suitability model test are presented as follow:

Table 5.Suitability Model Test

	Chi-Square	df	Sig.
Pearson	180.784	216	0.961
Deviance	98.228	216	1.000

3.6 Model Interpretation

Interpretation of multinomial logit regression model is obtained based on the odds ratio value which is the level of influence tendency between the predictor variables to the response variable based on a reference category. Reference category in this study is the airport transportation mode Bus DAMRI. The odds ratio for each predictor variable can be seen in *Exp(B)* column.

Table 6.Parameters for each Logit

Logit	Variables	Categories	β_{jk}	Exp(B)
1 (Taxi)	Job Type(X_1)	Army	-6.665	0.001
	Transportation Costs in a day(X_4)	< 50000	-9.988	4.597E-005
	Information of Transportation(X_7)	Information from colleagues/relatives	-4.277	0.014
	Access Level(X_{10})	Difficult	-6.060	0.002
	The reason of choosing transportation(X_{11})	Short travel time	6.118	453.948
2 (Travel)	Transportation Costs in a day(X_4)	< 50000	-8.262	0.000
	Trip Destination (X_5)	Go home	15.649	6256174.335
		Vacation	14.556	2097914.241
		Business	13.856	1044138.749
	Information of Transportation (X_7)	Airport information center	-3.799	0.022
	Access Level(X_{10})	Difficult	-5.627	0.004
	The reason of choosing transportation (X_{11})	Short travel time	5.240	188.714

Based on Table 6. here is the odds ratio interpretation:

1. Passengers with the army type of job obtain information from colleagues/relatives choosing Taxi transportation mode, by spending less than Rp.50.000 in a day for short travel time, although the access level to the destination is not directly toward the destination.
2. Passengers who choose Travel transportation modes spend transportation costs less than Rp.50.000 in aday, getting information from the airport transportation center with the destinationto go home, vacation, business due to short travel time, although the access level to the destination is not directly toward the destination.

3.7 Accuracy of Classification Results

The results of classification accuracy aim to see the feasibility of a model by looking at how much observation is appropriately classified. Based on Table 7. the overall classification accuracy result is 86.5%. Indicates that the results of multinomial logit regression analysis formed can classify the observations appropriately by 86.5%.The results of classification accuracy of multinomial logit regression analysis are presented in Table 7.

Table 7. Accuracy of Classification Results

		Prediction			
		Y			Accuracy of Classification (%)
		Bus DAMRI	Taxi	*Travel*	
Y	Bus DAMRI	77	2	1	96.3%
	Taxi	1	39	7	83.0%
	Travel	4	6	19	65.5%
Overall Classification Accuracy		52.6%	30.1%	17.3%	86.5%

IV. CONCLUSION

Based on the results of the analysis and discussion that has been done, it can be concluded that:

1. Five of the eleven predictor variables in this study had a significant effect on the choice of passengers in choosing Taxi modes of airport transportation ie job type, transportation costsin a day, information of transportation, access level, and the reason for choosing transportation. While, the choice of passengers in choosing Travel modes of airport transportation, also obtained five predictor variables that have a significant effect, namely transportation costs in a day, trip destination, information of transportation, access level, and the reasons for choosing transportation. The results of the analysis were obtained from the primary data by distributing questionnaires to the arrival passengers of Lombok International Airport.
2. Multinomial logit regression model that formed is:

a. Logit 1 (Taxi):

$$g_1(x_i) = 12.777 - 3.760x_{1(1)} - 6.665x_{1(2)} - 0.923x_{1(3)} + 1.725x_{1(4)} - 3.640x_{1(5)} - 9.988x_{4(1)} - 3.372x_{4(2)} - 1.063x_{5(1)} - 4.061x_{5(2)} - 3.028x_{5(3)} - 1.142x_{5(4)} - 2.991x_{7(1)} - 4.277x_{7(2)} - 6.060x_{10(1)} - 2.745x_{11(1)} + 1.055x_{11(2)} + 1.218x_{11(3)} + 0.597x_{11(4)} + 6.118x_{11(5)}$$

b. Logit 2 (Travel):

$$g_2(x_i) = -7.592 + 0.605x_{1(1)} - 21.079x_{1(2)} + 1.332x_{1(3)} + 2.211x_{1(4)} - 0.526x_{1(5)} - 8.262x_{4(1)} - 2.311x_{4(2)} + 15.649x_{5(1)} + 14.556x_{5(2)} + 13.859x_{5(3)} + 16.603x_{5(4)} - 3.799x_{7(1)} - 2.908x_{7(2)} - 5.627x_{10(1)} - 3.017x_{11(1)} - 0.479x_{11(2)} + 1.713x_{11(3)} - 0.997x_{11(4)} + 5.240x_{11(5)}$$

REFERENCES

[1]. C. Thrane, 2015, Eximining Tourists' Long-Distance Transportation Mode Choices Using a Multinomial Logit Regression Model,*Tourism Management Perspectives*, 15 (2015) 115-121.

[2]. C. Sanghoo, Y. Soyoung,andL. Hyangsook, 2013, Exploring Characteristic of Airport Access Mode Choice: A Case Study of Korea. *Transportation Planning and Technology*, Vol.00, No.00, 1-17.

[3]. E. Agyemang, 2017, Mode Choice for Long Distance Trips: Evidence from the Greater Accra Metropolitan Area of Ghana. *Journal of Transport Geography*, 64 (2017) 150-157.

[4]. G. Akar, 2013, Ground Access to Airports, Case Study: Port Columbus International Airport,*Journal of Transport Management*, 3 (2013) 25-31.

[5]. I. Gokasar, and G. Gunay, 2017, Mode Choice Behavior Modeling of Ground Access to Airports: A case study in Istanbul Turkey,*Journal of Air Transport Mangement*. 59 (2017) 1-7.

[6]. M. Zebua,*Inspirasi Pengembangan Pariwisata Daerah*, (Yogyakarta: Deepublish, 2016).

[7]. O.Z.Tamin, 2000,*Perencanaan dan Pemodelan Transpostasi*. Edisi Kedua,(Bandung: Teknik Sipil Institut Teknologi, 2000).

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