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Mode choice analysis between online ride-hailing and paratransit in Banjarmasin city

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Abstract
Nowadays, application-based transportation is in great demand by the public. Public transport users began to switch to private-hire transportation. This is influenced by the increasingly sophisticated communication tools, making it's easier for people to mobilise. Another reason for the large number of private-hire transportation use is due to the disappointment that arises on the insufficient of public transportation facilities. This raises the competition between both transporation modes-providing people with a choice in choosing the most appropriate one to use in supporting their activities.
The aim of this research is to get a model that can explain the probability of Banjarmasin people's preference in choosing between online ride-hailing and paratransit in banjarmasin city. In addition to this, the research also aims to find out about the factors or attributes that affect their preference, analyze the influence of travel costs and other attributes reviewed from different travel distance. This research was analyzed using multinomial logite method in Limdep Nlogit 4.0 software. Further analysis is done by multinomial logic analysis to obtain utility and probability on the transportation preference. After obtaining the best utility model,the data on cost sensitivity, travel time and convenience in choosing between both type of transporation, were obtained.
Based on the result, the researcher found that the greater the cost and the travel time are, the greater the probability for the private-hire transportation to be choosen will be. Another aspect that makes people tend to choose private-hire transporation rather than public one is the convenience. The result shows that even if public transporation tries to improve its convenience from what it has now, it won't cause any significant change on the number. In conclusion, private-hire transportation has the highest probability value compared to others. Based on the sensitivity of convenience, then it can be concluded that if the convenience of public transport is improved from its existing conditions, the probability may increase but the raise in the probability value isn't going to be significant. Therefore, the largest probability value of the three modes belongs to online taxibike.

Keywords: Mode choice, public transportation, private-hire transportation, multinomial logistic regression

Introduction
The behavior of people in Indonesia, especially in the city of Banjarmasin, has changed. They prefer app-based transportation. This is because people want ease to travel. For the past few years, a massive change on the transportation mode preference has been occured in Banjarmasin. People tend to choose online-application based transportation over the traditional public transportation, as it offers them more benefits: quick and easy to understand and use, and it doesn't go against the values in the society.
Furthermore, the disappointment that Banjarmasin people have experienced towards the traditional public transportation is also contributed in causing the change. As the option to use private-hire transportation instead available (and it allows people to choose one that fits them better), both sides compete to attract people. Hence, the researcher did this research to find out the probability on people's transportation preference between the private-hire transportation and public transportation.

Literature Review
Stated Preference Technique
The requirements to get the best formula are (Radam, Mulyono, & Setiadji, 2015) [11]:
1. The P-value is close to 0 (< 0.05) to illustrate that the attribute under review is valid for use.
2. The algebraic sign of attributes, especially travel time and travel cost, is (-) to illustrate the reality that if the travel time is longer, the probability of choice is smaller, as well as

tariffs, the greater the fare value of a mode, the smaller the probability of choice.

3. The RSQUARE value should be > 0.21 to describe the utility equation that has a strong relationship between the independent and dependent variables.

The guideline for interpreting the correlation coefficient can be seen in Table 1.

Table 1: The guideline for interpreting the correlation coefficient (Radam *et al*, 2015) [11].

Pseudo Value r_2	Value r_2	Coefficient Interval r	Relationship Level
< 0,014	< 0,04	0,00 - 0,199	Very Low
0,014	0,04	0,20 - 0,399	Low
0,050	0,16	0,40 - 0,699	Medium
0,210	0,49	0,70 - 0,899	Strong
0,403	0,81	0,90 - 1,000	Very Strong

Multinomial Logistic Regression

Basically, the aggregate behavior of individuals in choosing transportation modes is entirely the result of each individual's decision. Travel agents are faced with various alternatives in the form of alternative travel destinations, modes of transportation and travel routes. The hypotheses that support the selection model regarding the situation of choice, are usually expressed by measures of attractiveness or utility.

The general form of the utility of a product is a linear model, which is a combination of various attributes, as shown in Equation (II.2) below. (Rahman, November 2009)

$$U_i = a_0 + a_1x_1 + a_2x_2 + a_3x_3 \ldots\ldots\ldots\ldots + a_nx_n$$

Where:

U_i = product utility i

$x_1 \ldots x_n$ = product attribute i

$a_1 \ldots a_n$ = model coefficient

a_0 = constant

Usually, the logit function for 3 (three) alternative modes is called the multinomial logit function which is shown in equation (2.4) below.

$$P_1 = \frac{\exp^{U_1}}{\exp^{U_1} + \exp^{U_2} + \exp^{U_3}}$$

Where:

P_1 = Mode Choice Probability 1

U_1 = Alternative utility using Mode 1

U_2 = Alternative utility using Mode 2

U_3 = Alternative utility using Mode 3

Research Methodology

Research Variables

In this research, the research attributes are divided into 3 (three), namely:

1. **Fare Attribute:** This attribute is obtained from a fare survey for each mode application and for public transportation using a flat rate. Then, made 2 (two) different types of levels in each alternative.
2. **Travel Time Attribute:** These attributes are obtained from direct surveys in the field. Travel time is the time required to travel plus the waiting time. Then, made 2 (two) different types of levels in each alternative.
3. **Convenience Attribute:** In each alternative, the convenience attribute has the same 2 levels, namely "Convenienceable" and "Unconvenienceable". In determining convenience and disconvenience, a research pre-survey was conducted with a total of 25 (twenty five) respondents. The results of the pre-survey can be described in Table 2.

Designing the Hypothetical Conditions

In this study, arranged in a hierarchical form, for the limb is called "modes preference". Meanwhile, the branch section is divided into 3 (three) alternatives: “online taxis (Grab)” and “online taxibike/motorcycle taxis (Gojek)” and *angkot* (city transportation). The first two belongs to private-hire transportation while the latter one belongs is a public transportation. The tree structure of the multinomial logit model used in this study can be seen in Figure III.4 Multinomial Logit Model for the Alternative Types of Transport.

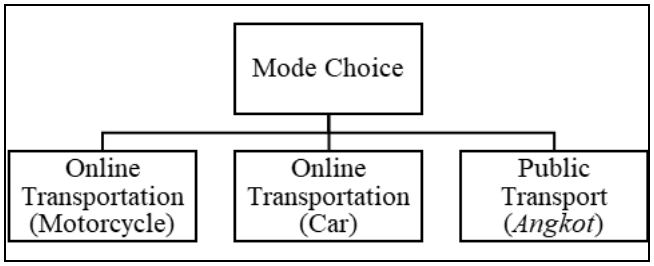


Fig 1: Multinomial Logit Model for the Alternative Types of Transport

Designing the Questionnaire

The steps for designing a questionnaire with the SPSS are as follows

1. Preparing the data that will be calculated using the SPSS application.
2. Opening the SPSS (Statistical Product and Service Solutions) application.
3. Clicking Data in the menu on the upper left corner, then click Orthogonal Design and select Generate.
4. The Generate Orthogonal Design window will appear. In this window, fill in the Factor Name and Factor Label sections with conditions then click Add and click Define Values.
5. The next step will appear in the Generate Design: Define Values window. In this window, fill in the Auto Fill column with the number 3 because there are 3 options, namely City Transportation, Online Taxis and Online taxibike and then click Fill.
6. Then in the label section, fill in Weekday, then fill in the bottom with Weekend and click Continue.
7. Then repeat steps 3 and 4 by entering the time and cost factors.
8. Next in the Data File section for the Dataset Name column, fill in Ortho and click Ok.
9. Then the results of the SPSS calculation will come out.

10. From the data, it can be seen that there are several kinds of data combinations, then we will sort the data. The ones that are classified as extreme data will be eliminated.
11. Arranging the data.
12. Completed.

Research Methodology

In this research, the questionnaire survey was done using the stated preference method. The application used to design the questionnaire is SPSS. Therefore, we get variations in travel costs, travel time and convenience. The questionnaire survey was conducted on 334 respondents. After obtaining the results of the questionnaire, the analysis was carried out using the multinomial logit method using the NLogit LIMDEP software.

Then, an analysis of the results of the questionnaire was carried out with the following conditions:

1. The P-value is close to 0 (< 0.05). Means that the data is valid for use.
2. The value of RSQUARE is 0.21. Means that the utility equation between the variables has a strong relationship.
3. Value of the special attribute: The cost of the trip is (-). It means the data is realistic. The greater the value of the cost of the trip, the smaller the probability value will be.
4. The value of the special attribute: Travel Time is (-). It means the data is realistic. The longer the travel time, the smaller the probability value is.
5. The value of the special attribute: Convenience is (-). It means the data is realistic. The more inconvinence of the transportation is, the smaller the probability value will be.

Result and Discussion

Footnotes should be typed in singled-line spacing at the bottom of the page and column where it is cited. Footnotes should be rare.

In this research, trial and error was carried out to get the best equation results. In order to obtain the results, the LIMDEP NLOGIT program was used. The result is as follows:

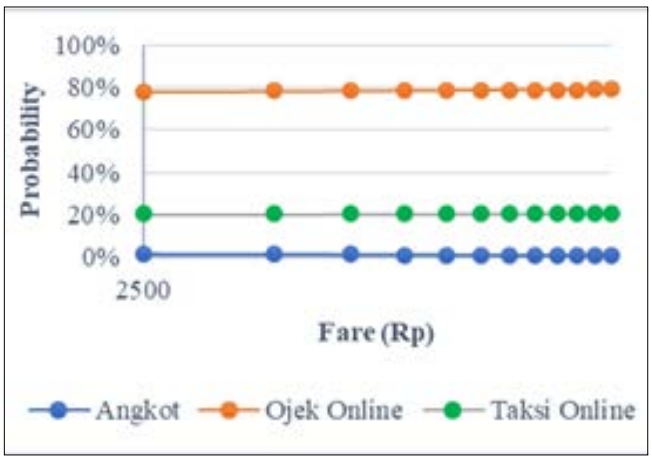
Attribute	Output Program		
	Rsquare ≥0,21	Realistic Attribute	*P-Value* < 0,05
	OK	OK	OK
Cost	R-S*q*=0,21964	Cost, Time,	0.00
Time	R-S*q(Adj)*=0,21940	Conv (-)	0.00
Conv			0.00
Mcost	Disc:	Ket:	0.00
AbltyR4	The variables has a strong relationship.	Algebra symbols: cost, time, conv (-) Met the requirement	0.00

Discussion

a) Sensitivity of Trasnportation Mode Preference based on Cost

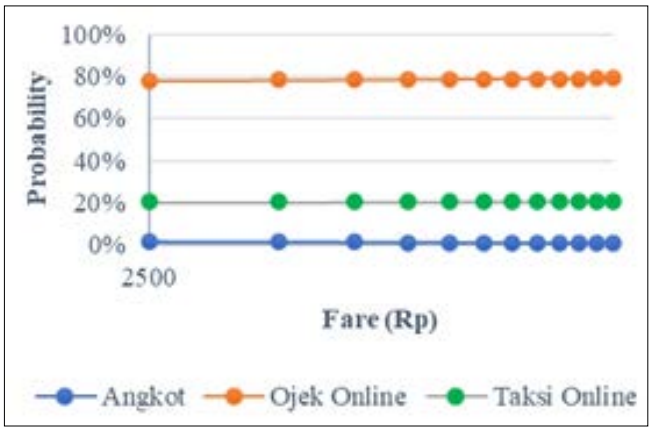
1) Improved *Angkot* Convenience

The utility value and the probability of the effect of travel costs on the selection of the three types of transportation modes can be seen in the following graph:



2) The Convenience of *angkot* Existing Condition

The utility value and the probability of the effect of travel costs on the selection of the three types of transportation modes can be seen in the following graph:



The graphs above can be interpreted as follows

1. The selection model *angkot* (public transportation) has the tendency to go towards the negative slope, which means the greater the travel cost is, the lower the probability value of it being chosen will be. On the other hand, the selection model for Online taxibike and Online Taxis shows a trend towards the positive slope, which means that the greater the cost of the trip is, the greater the probability of this transporation mode being chosen will be
2. For the situation where the fare changes, the respondents still chose Online taxibike and Online Taxis rather than *angkot*. Based on the probability value, Online taxibike is more desirable than the *Angkot* and Online Taxi modes.
3. If the convenience of *angkot* is improved from the

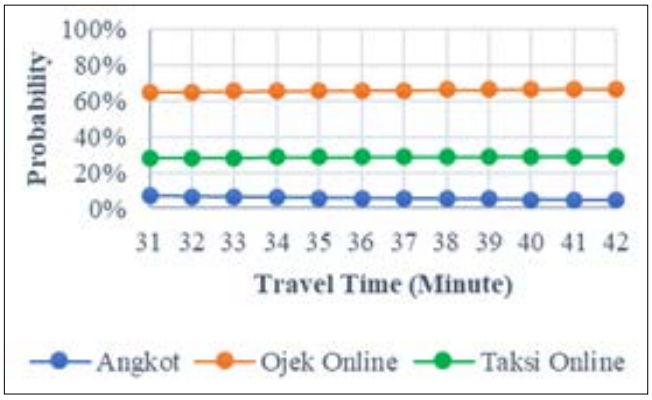
existing conditions, the probability of people choosing it will also increase. However, the increase in the probability value is not very significant. The difference in the probability value is only 5.29%. The probability of people choosing private-hire transportation is still higher. This proves that Online taxibike and Online Taxi modes are more desirable than *angkot*.

4. Based on the results of the sensitivity analysis, it is found that the travel costs and convenience do not affect the probability of people choosing *angkot* over the other two options.

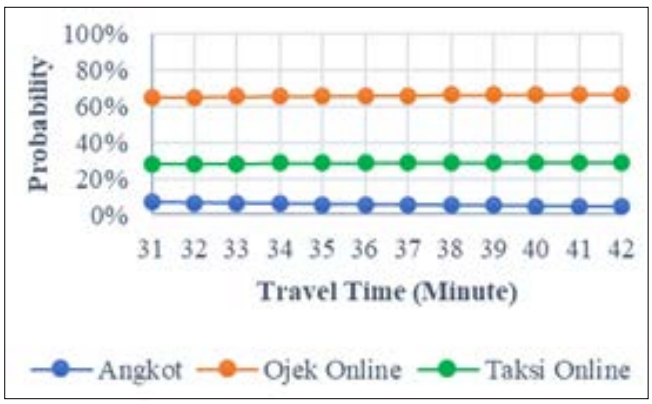
b) Sensitivy on Travel Time

1) Improving *angkot*'s convenience

The utility value and the probability of the travel time on *angkot* in influencing people's preference can be seen in Table IV.27.



2) The convenience of *angkot*'s existing condition The utility value and the probability of the travel time on *angkot* in influencing people's preference can be seen on the following table.



The graphs above can be interpreted as follows

1. The selection model for *angkot* shows a negative trend, which shows that the longer the travel time is, the lower the probability value will be. On the other hand, the selection model for Online taxibike and Online Taxi modes goes to the positive slope direction, which means that the longer the travel time is, the greater the probability will be.
2. On the scenario where the private-hire transportation requires more travel time, the respondents still chose Online taxibike and Online Taxis. Based on the probability value, Online taxibike is more desirable than the *Angkot* and Online Taxi.
3. If the convenience of *angkot* is increased from the existing conditions, the probability of choosing *angkot* will also increase. However, the increase in the probability value is not very significant. The difference in the probability value is only 4.69%. The probability for the Online taxibike and an Online Taxi is still higher. This proves that Online taxibike and Online Taxi modes are more desirable than *angkot*.
4. Based on the results of the sensitivity analysis, the researcher found tthat the travel time and convenience factors cannot make the probability of for *angkot* higher than the other two.

Conclusion and Suggestion

Conclusion

This research is conducted to find out to the preffered transportation mode of Banjarmasin people, between private-hire transportation (online motorcycle taxis and online taxis) and public transportation (*angkot*). Based on the analysis, it can be concluded that:

1. The attributes that significantly affect the selection of private-hire transportation (online motorcycle taxis and online taxis) and public transportation (*angkot*), are: travel costs, travel time, convenience, 2-wheel ownership, and monthly costs spent for the transportation.
2. According to the sensitivity analysis of the attributes that affect the preference, with the assumption that the behavior of all modes is the same, the following results are obtained:

a. Based on the sensitivity of travel costs, it can be seen that the greater the cost of city transportation travel is, the greater the probability of choosing online motorcycle taxis and online taxis will be. On the other hand, the greater the cost of urban transportation is, the smaller the probability of choosing *angkot* will be.

b. Based on the sensitivity of travel time, it can be concluded that the longer the travel time for *angkot* is, the greater the probability of choosing online motorcycle taxis and online taxis. On the other hand, the longer the travel time for *angkot*, the smaller the probability of choosing city transportation.

Suggestions

1. Further research on this topict that compares similar modes, for instance motorbikes with motorbikes, and cars with cars, needs to be conducted.
2. Further research on the selection between Public Transportation and Private-hire Transportation with another variables needs to be done, in order to determine the factors that can make Public Transport compete better with another mode.
3. It is recommended to add a group of respondents who do not have a private vehicle (captive rider) for data collection.
4. Policy makers can increase the convenience of city transportation. This can be done by providing better facilities like what private-hire transportation offers, such as application-based services and door-to-door services.
5. Policy makers can set or determine the minimum fare per km of online transportation which is higher than the current condition. This is necessary to suppress the

public's choice of mode for online taxis. Thus, the choice of mode for online taxis and city transportation can compete.

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