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Behaviour Model of Motor Cycle User in Selecting Parking Location (Case study in Surabaya City of Indonesia)

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ABSTRACT

As a big city, Surabaya is not free from many problems in transportation. One of them is the parking problem. Parking problem which was happened was the number of vehicles on street parking was more than off street parking. This paper intended to investigate the behaviour model of motor cycle users in selecting demanded parking location. In depth analysis, the methodology consisted of analysis of descriptive and logit regression by using questionnaire. There were used 348 respondents in Surabaya City. According to the Land Transportation Department (Dinas Perhubungan Darat) in 2010, based on the available data, Surabaya had 1,568 parking points which were distributed in 31 districts. Results indicated that the most respondent was male (58.6%) and most of them was more than 40 years old (42.4%), the most education level was Senior High School (42.4%), the most occupation was public work (35.2%), the most income was between 1 to 2 millions rupiahs (26.7%), the most parking activity was in afternoon (50%), the most parking duration was less than 1 hour (44.8%), the parking frequency was less than one time (71%), and the parking location which was often selected was on street parking (38.1%). Recommendation of suggested action program included the decreasing on the available on street parking, the increasing on the income of on street parking, and on the contrary the decreasing on the income of off street parking

KEYWORDS: selection probability of parking location, motor cycle, logit multinomial model

INTRODUCTION

Nowadays, population growth in the world is continuously increasing as well as in Indonesia. Based on the data of Statistical Centre Department [1], population number of Indonesia until the end of 2010 was 234,181 millions people. Development of the population number was followed by the owner number of motor in big cities of Indonesia included Surabaya City. The number of motor cycle in Indonesia in 2000 was as 13,563,017 units and it has developed to continuously increase as 61,078,188 units in 2010. The using of motor cycle is continuously increasing due to the limitation of needed public vehicle.

One of the problems which was happened in Surabaya City nowadays was the limitation of parking space with the option was on street parking which was more than off street parking. Yusdi [2] said that although the demand of on street parking has been made, but it has not able to fulfil the available parling demand. The parking user also had different behaviour pattern each to other in selecting the wonder parking location [3]. This research used the approach by comparing the parking behaviour based on the selected location. To abtain the illustration about the demand of parking location was by using logit multinomial model. By using this approach, it was hoped to obtain mathematical model equation of parking location demand which was suitable with the wonder of parking user.

The aims of this research were to know the behavior model of motor cycle user in selecting demanded parking location and to make recommendation about the demanded parking location. This research was limited by the parking space was as motor cycle user and the parking space was managed by government of Surabaya City such as on street parking as well as off street parking.

MATERIALS AND METHODS

Population and sample

Population in this research included all user of motor cycle in the research region. The limitation of population could not quantitatively determinated, so the size of sample was determinated by using Snowball Sampling.

Flow chart of research

Steps of this research was set as in Figure 1 below.

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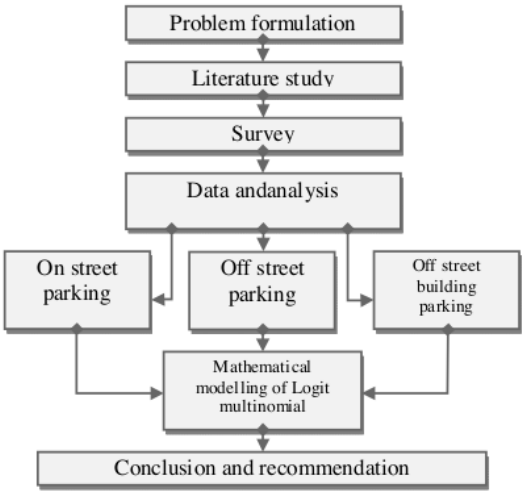

Figure 1 Flow chart of research

Variable of research

Variables of this research included response variable (y) and explained variable (x). Response variable is as the variable for knowing the probability influence of motor cycle user in selecting parking. Explained variable included characteristic of travelling, parking actor, and parking. The indicators that were used in this research consisted of:

1. Travelling characteristic such as economic destination (work or spending), and education
2. Parking actor characteristic such as income, vehicle owner, socio-economic (sex, age, and work)
3. Parking characteristic: duration of time, parking frequency, travelling time, and safety.

Value modelling of parking actor utility

There were some optional responses in logit multinomial regression. Logically, every individu only chose one alternative parking for travelling. The other alternative was only as the comparison and there would not be selected together. Based on the reason, every respondent only determined one option of 2 or 3 bargained choices. By using regression model of logit multinomial, utility function parametre was estimated by the method of maximum likelihod. This model would produce the occurrence probability for each choice of parking. Type of variable that was entered to each posiibility model of parking choice was designed indifferent to each other. The respondent was assumed to choose one parking based on the valid consideration for every alternative. Figure 2 presented the scheme on utility response of logit multinomial regression.

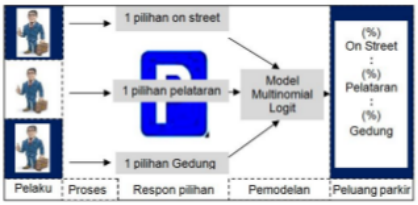

Figure 2 Scheme on utility response of logit multinomial regression

The advantage of this model only demands the respondent to select 1 selected parking. System of this selection is assumed logic and easy because the characteristic is suitable with the reality that every actor will only choose 1 optional parking from the process result of initial consideration. The other alternative will only be considerate again if there is policy change only in certainty.

METHOD OF DATA ANALYSIS

1. Descriptive analysis

On this analysis, description of data cakksification result was carried out based on the frequency or

percentage

2. Regressein analysis of logit multinomial

Logit regression is a model which is often used to know the relation between dicotomic output variable and factors group but with less modification. It can also be used when the output is as the polynomial one. It is chosen to use binary in dicotomy when descripting the number from the category of result which is often used in literature. For example, category of result variable: Y is coded of 0, 1, or 2. To call on logit regression for binary result variable is the logit: Y = 1 and Y = 0. In 3 categories, there are 2 function of logit model. First for Y = 1 and Y = 0 and the others for Y = 2 and Y = 0. Theoritically, it can use two pairs model of result comparison from logit model. The equation of logit regression [4] generally was as follow:

$$g_1 = \ln \frac{P(Y=1)}{P(Y=0)} = \beta_{10} + \beta_{11} x_1 + \cdots + \beta_{1p} x_p \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

and

$$g_2 = \ln \frac{P(Y=2)}{P(Y=0)} = \beta_{20} + \beta_{21} x_1 + \cdots + \beta_{2p} x_p \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

For the model of logit multinomial regression, if the response variable is divided into three categories which each of them are given the codes of 0, 1, and 3; and if the category of 0 is as the refrence category (β_0=0), so the conditional probability with the explained variable of P will produce the equation as follow:

$$P(Y = \mu_0) = \frac{1}{1+\exp(\beta_{10}+\beta_{11}x_1+\cdots+\beta_{1p}x_p)+\exp(\beta_{20}+\beta_{21}x_1+\cdots+\beta_{2p}x_p)} \quad \ldots\ldots (3)$$

$$P(Y = \mu_1) = \frac{\exp(\beta_{10}+\beta_{11}x_1+\cdots+\beta_{1p}x_p)}{1+\exp(\beta_{10}+\beta_{11}x_1+\cdots+\beta_{1p}x_p)+\exp(\beta_{20}+\beta_{21}x_1+\cdots+\beta_{2p}x_p)} \quad \ldots\ldots\ldots (4)$$

$$P(Y = \mu_2) = \frac{\exp(\beta_{20}+\beta_{21}x_1+\cdots+\beta_{2p}x_p)}{1+\exp(\beta_{10}+\beta_{11}x_1+\cdots+\beta_{1p}x_p)+\exp(\beta_{20}+\beta_{21}x_1+\cdots+\beta_{2p}x_p)} \quad \ldots\ldots\ldots (5$$

Design of tranportation

The base aim of transportation designer is to predict the quantity and demanded location of transportation (for example, to determine total of moving for public as well as private transport) on the next period or the next design year which will be used as investation policy of transportation design. In design of transportation system, there are some scales of long , middle, and short terms. Time duration of design can be very long (for example 25 years) which is usually used for long term design of development strategy. The strategy will be very influenced by design of land use and prediction of traffic route and it is usually categoried based on the moda and route [5]. Transportation can be meant as the effort to move anything or one location to other location by using certain utilization.

Parking

Parking is defined as the special location for vehicle to stop due to the safety. The other space can be used for parking such as on street as well as the parking location that has been professionally set such as garage parking as well as lot parking. Parking facility which is well organized is very needed especially in the region with very big vehicles and followed by limited area for parking. Based on the parking location, there is differentiated as on street parking and off street parking such as lot parking and garage parking.

Logit model

Ti carry out the logit model test, it is good to be also carried out multi-colonierity test. Multi-kolonierity test is intended to evaluate how far is found the correlation among the independent variables in regression. Good regression model ought to be not happened the correlation among the independent variables. If there correlation among the independent variables, so the variables are not orthogonal. Orthogonal variable is as the independent variable which the correlation among independent variables are zero. To evaluate the accuracy of logit model, there is carried out testing of goodness of fit by using log likehood test; Hosmer and Lemeshow's test [4].

Utikity function of parking location

In micro economic science, utility is as the abstract concept for explaining the enjoyness, usefull, or subjective satisfactory which are obtained when to consume something or service. Utility can also be defined as anything wjich is maximized by every individu. The utility concept can be used to express the pulling power of an alternative.

Utility is included of 2 components. The first component is as the component which can be measured based on the observation on the attributes of available alternative and usually is known as representative utility. Example of the component is education anf parking cost. However, the other component is as the component which represents the influence from optional characteristic or attribute which is not considerated or observed in utility function. This component is usually named as random utility. For example, the unsure of comfortability and safety are very difficult to be quantitatively measured. Random utility function gave an illustration that the values of

attribute have the different influence to the different individu or by the same individu in different time [6].

RESULTS AND DISCUSSION

Descriptive analysis

Result of analysis indicated that the most respondents was male (58.6%), the most age was more than 40 years old (42.4%), the most education level was senior high school (42.4%), the most work was public one (35.2%), the most income was between 1 to 2 millions (26.7%), the most parking activity was in the afternoon (50%), the most parking duration was less than 1 hour (44.8%), parking frequency was less than 1 time (71%), and parking location which was often selected was on street 38.1%).

Regression analysis of logit multinomial

Logit multinomial model of optional on street parking produced the best model of utility function of lot parking and garage for motor cycle user based on the sugnificant variable with significant level of 95% by using SPSS were as follow:

$$P_{(\text{lot parking})} = \frac{1}{1+e^{-3.882-1.154X1-2.385X2+1.393X3+0.449X4}+e^{-0.228+1.166X1-1.215X2+1.160X3+0.802X4}}$$

$$\text{with} P_{(\text{garage parking})} = \frac{e^{-3.882-1.154X1-2.385X2+1.393X3+0.449X4}}{1+e^{-3.882-1.154X1-2.385X2+1.393X3+0.449X4}+e^{-0.228+1.166X1-1.215X2+1.160X3+0.802X4}} \text{ and}$$

$$P_{(\text{Onstreet})} = \frac{e^{-0.228+1.166X1-1.215X2+1.160X3+0.802X4}}{1+e^{-3.882-1.154X1-2.385X2+1.393X3+0.449X4}+e^{-0.228+1.166X1-1.215X2+1.160X3+0.802X4}}$$

Based on the equations as above, it can be known that the probability of motor cycle user $P(X_i)$ to select parking location was influenced by X_1 = availability on street parking, X_2 = availability lot parking, X_3 = parking time in afternoon, and X_4 = income. Result of test indicated that all variables significantly gave partially or selft influence to the selecting on parking of motor cycle user due to the scenario as above. In addition, it was obtained the value of G^2 was 110.713 which indicated that all of the variables together had significantly influence to the probability of motor cycle user in selecting parking location.

Classification power of motor cycle user for selecting parking location on garage, on street, or lot indicated that 60.6% was on garage, 62.6% was on street, and 65.6% was on lot. Direct method model wholly had the classification power of 65.7%. Based on the result, it indicated that classification power of direct method had high classification power that indirect method. It indicated that the whole model prediction level was 65.7%. All of accurate and higher model prediction result in predicting the selecting of garage parking was 69.6% which the motor cycle user with higher income would have parking behaviour on garage when afternoon parking time variable was influenced the equation.. Figure 3 presented the probability prediction result of motor cycle user between on street and garage parking.

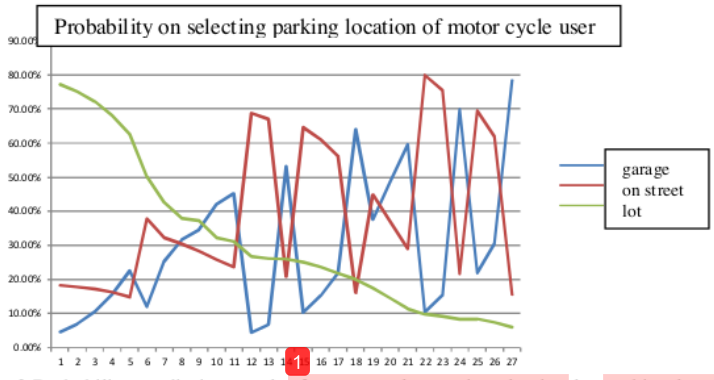

Figure 3 Probability prediction result of motor cycle user in selecting lot parking location to on street and garage

Figure 3 showed the illustration on the prediction result of probability model that was simulated to 27 samples od selected data which were set based on the probability and different ranking of significant variable. The figure in below showed that 27 combined samples ofvariable, there were 9 motor cycle users slected lot parking and the rest selected on street and garage parking. It indicated that the trend of selecting parking location was dominant on street and garage parking based on the 27 samples of the combined data.

Odd ratio of motor cycle user behavio with the availability of on street parking (X_1) was $e^{-1.154} = 0.315$. It meant that the occurrence probability of motor cycle user in selecting parking location on garage was 0.315

time. The value was less than one and it meant negative, it meant that the probability to carry out on garage parking would be decreasing. In addition, Odd ratio indicated that the availability on street parking was $e^{1.166}$= 3.209. It meant that the occurrence probability of motor cycle user in selecting on street parking was 3.209 times. This value was more than 1and it meant positive, so the probability to carry out on street parking would be more increasing. It was possible due to the available on street parking.

Odd ratio indicated that motor cycle user behaviour with on garage parking (X_2) was$e^{-2.185}$= 0.112. It indicated that the occurrence probability of motor cycle user in selecting on garage parking was 0.112 time. The value was less than one and it meant negative, so the probability to carry out on garage parking would be decreasing. In addition, the availability on lot parking (X_2) was $e^{-1.215}$= 0.297. It indicated that the occurrence probability of motor cycle user in selecting on lot parking was 0.297 time. The value was less than one and it meant negative, so the probability to carry out on lot parking would be decreasing. It was possible due to the available on lot parking.

Odd ration indicated that afternoon parking time was $e^{1.393}$= 4.027. The occurrence probability of motor cycle user in selecting on garage parking was 4.027 times. The value was more than 1 and it meant positive, so the probability to carry out on garage parking would be increasing. In addition, Odd ratio indicated that afternnon parking time (X_3) was$e^{1.160}$= 3.190. The occurrence probability in selecting on street parking was 3.190 times. The value was more than 1 and it meant positive, so the occurrence probability to carry out on street parking would be increasing. In Indicated that motor cycle user would select except lot parking in the afternoon.

Odd ratio indicated that motor cycle user due to the income (X_4) was$e^{0.449}$= 1.567. The occurrence probability of motor cycle user in selecting on garage parking was 1.567 times. The value was more than one and it meant positive, so the probability to carry out on garage parking would be increasing. In addition Odd ratio indicated the income (X_4) was$e^{0.002}$= 1.002. The occurrence probability of motor user in selecting on street parking was 1.002 times. The value more than 1 and it meant positive, so the probability to carry out on street parking would be increasing. It indicated that the income of motor cycle user would influence the behaviour to select parking location, but the influence was seen significant when there was optional alternative between on garage and lot parking.

CONCLUSION

Based on the result of research analysis, it could be concluded as follow:

1. Motor cycle users in selecting parking location will be changed from on lot to the other parking (on garage or on street) in the afternoon.
2. Motor cycle users will select on garage parking than on lot and on street parking when their income are higher.
3. The availability on street and an lot parking will help the motor cycle users to carry out the selection on the location, so if there was no parking location, motor cycle users will select on garage parking. This is supported by classification power on predicting of the best parking location option was on garage parking (69.6%)

SUGGESTION

1. There was needed the prohibition or parking limitation in business hours on street parking and the firm rule and sanksi
2. There was needed the consistant action to every building with economic activity for prepare self parking area which is suitable with demand of parking space in Surabaya City.
3. There was needed additional starred on garage parking by giving the insentive for businessmen which will develop without decreasing government policy of Surabaya City.
4. To change life style or attitude about the behaviour of on street parking to the on lot or garage parking by giving the interesting bargain such as some presents for the user except on street parking.

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