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Single and Multi-Mode Choice Commuting Models in Surabaya and Sidoarjo Region

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Abstract : ***Large urban areas require a reliable multi-modal transport system to serve the needs of urban commuters. Urban public transport is currently still considered minimal by users of Multi mode (public transport). This has an impact on the dominance of single private modes, especially Single mode (motorcycles) that impact on city congestion, a mode that today can still be relied upon by urban commuters, to meet expectations in terms of quality of service, cost, time, experience and accessible only commuter trains. It takes effort to divert the end-user of the motorcycle to the final destination to switch to motorcycle over commuter train to get to the final destination. The study focuses on improving the comprehension of influencing factors, opportunities and models on the choice of single mode modes of multi mode switching, using the Binary Logistic Regression method with Stated Preference survey. The results Single mode user community in Surabaya and Sidoarjo willing to use the multi mode in case of improvement of service quality, affordable travel costs, travel time is adequate, and acces is enjoyable.***

Keyword : ***Motorcycle, Commuter rail, Binary Logistic Regression, Stated Preference.***

I. INTRODUCTION

Gerbangkertosusila area makes the city of Surabaya as the center of movement., then the area around Surabaya makes Surabaya as the destination. So the mobilization moves from the City of Gresik, Bangkalan, Mojokerto, Sidoarjo and Lamongan to Surabaya. The mobilization involves the role of the transport sector as a liaison tool, the well-known land transportation mode is a two-wheeled motorcycle. The selection of motorcycles because is considered to have advantages in terms of mobility, accessibility, and economical. Cheap and easy process of purchasing motorcycle make motorcycle demand continue to increase. Unbalanced growth ratio of motorcycles and roads, according to Susantono (2014) cause congestion and also pollution.

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The high number of motorcycles on the road greatly affect the fluctuation of the speed of traffic flow (Kusdinar, 2010) which impact on the congestion that produces negative impacts are not small.

From economic reviews, congestion can hamper production processes and distribution of goods that lead to the slowing down of the economy(Gardner & Abraham, 2010).

Seeing the superiority of the commuter train, the commuter train became one of the alternatives chosen as the liaison of Sidoarjo Surabaya. Although the existence of commuter Sidoarjo Surabaya has been several years, but the availability of this route can not be utilized optimally as the entry point of Surabaya. It is a big question that commuters can not yet play a role in reducing congestion in urban transport systems (Barua et al., 2013; Gunawan et al., 2013).

Efficient urban transport is identical to the multi-modal mode of transportation so that its role is enormous in urban development. However, in developing countries, the availability of muti moda means a large cost that is not owned by developing countries, the role of multi modal means is replaced by single mode which causes various negative impacts such as congestion, high transportation cost, pollution, and other psychological impact. So the transport users combine multi-modal in this case the train and single mode in this case the motorcycle to improve the quality of long-distance driving to the destination. Zhang et al. (2008) highest preference of new transit system among travel modes

Factors to be considered by the passengers from the start of the parking lot to the owner of the commuter ride vehicle are related to the parking tariff, parking convenience, parking security, the distance of parking, the total time and distance required from the parking area to the commuter train. The second stage is after the passengers are on the commuter train to the end station. The factors considered are commuter services, commuter tariff, commuter security. Then the stage is the ease of accessing the final destination need to consider the time and distance from the stop station to the end of the passenger location besides that also The existence of other transitional modes that allow passengers to reach their final destination. Taking into account all stages of travel in the concept of choice of modes is expected to generate a model of transportation modes that can answer the problem of city blocking from congestion. Based on several aspects considered above, then the model of direct transfer of motorcycle or motorcycle modes using the Surabaya - Sidoarjo commuter train developed in this study involves several latent variables of service quality, cost, travel time, experience, accessability.

Del'Olio et.al (2011) Stated that the quality of service used in this study is related to tangible aspects or physical evidence, assurance, responsiveness, empathy and reliability. Costs incurred passengers include all components of the cost incurred is the parking tariff, commuter tariffs issued passengers when using a direct motorcycle and use a motorcycle switch commuter train Surabaya - Sidoarjo.

The travel time in this study consists of all the time spent when using direct motorcycles to use the Surabaya - Sidoarjo commuter train until access to the final destination. Experience in research The experience of motorcycle users when using the commuter train surabaya - sidoarjo and accessibility include the availability of supporting facilities to facilitate the user to this commuter train station. These five latent variables will affect the decision of motorcycle users to switch to commuter trains or use motorcycles directly to the final destination.

So far, research solutions that integrate over this mode of transportation have not been widely implemented. Efforts that have been done only limited to research from the parking lot to the commuter. It is hoped that the integration will better answer the model of motorcycle owner's decision to transfer the modes of private vehicles using public transportation (Durgaji et.al, 2013)

This research will be conducted on motorcycle users who transfer the modes to commuter trains and motorcycle users who do not transfer the modes to commuter trains. With these two research subjects are expected to be explored more deeply about the factors that make users switch to the train and the factors that make the user does not use the train.

II. MATERIAL AND METHOD

A. Mode Theory of Mode in Determining the Role of Commuter Trains

Kadiyali (1991) states that there are two groups, namely the selection pre-spread mode of movement and the selection of post-spreading mode movement, Dickey and Diewald (1983) tend to put two types, namely the rise of movement and the spread of movement Capital-split models) and between modal-split trip interchange and Khisty (1990) suggest that combinations with the 'Direct Generation' model and between the range of movement and route selection (' Trip interchange 'model), while Black (1981) classifies the selection of modes of transport in a transportation planning position in one of four places, namely (a) a combination of the movement generation, (b) between the trip generation and the triple-end model), (C) the combination of the gravitational model, and (d) between the trip's interchange and tripping model (Filip et.al, 2012).

Andrew et al (2012) stated that the field transport general election model is reviewed in the form of probability choice. This approach is often used in the analysis of choice is the probit model and logit model. because many studies dealing with attitudes, behaviors, characteristics, and decisions that are essentially measurable only in the form of discrete data , Nominal, ordinal, or in short the data is not continuous. Zegars and Srinivasan (2007) travel times and distances according to high, middle, and low income terciles, It is however not appropriate to use a classic (linear linear) regression model that requires only continuous dependent variables. The probit model was developed by Chester Ittner Bliss in 1934 and Joseph Berkson in 1944 introduced a new model which was the opposite of logistics.

B. The Logit Model Approach

Logit model is a non-linear probability model that formulates an equation with a categorical dependent variable (Hoetker, 2007) . Cramer (2013) stated the most basic categories used are binary values such as the numbers 0 and 1 that state the existence of a category. The logit model regression equation is derived from the decrease of the probability equation of the categories to be estimated (Dilum & Takayuki 2010).

C. Stated Preference Technique for Choice Mode Plan

The technique stated preference has its own characteristic, that is the use of experimental design to construct alternative or hypothetical scenarios with hypothetical situation attributes (Hensher, 1994) which are then presented to respondents. Rose et.al (2013) and Kroes and Sheldom (1988) stated that Technique stated preference is a method of choice that uses Individual statement of respondents about their choice in a set of options to estimate utility function . This hypothetical scenario is further used as a forecasting tool (Leitham et al., 2000) applied in the option set as a way of estimating utility functions in discrete choice models(Bliemer et al 2009&2014)

Logistic regression is part of the regression analysis used when the dependent variable (response) is a dichotomous variable. Dichotomous variables typically consist of only two values that represent the occurrence or absence of an event typically assigned the numbers 0 and 1. In this study will see how the selection of modes by commuters in using motorcycles and commuter trains Surabaya - Sidoarjo in relation to service quality variables , travel expenses, travel time, experience and accessibility to the final travel destination.

The basic logit model is as follows:

$$Pi = E(Yi = 1|Xi) = \beta 0 + \beta 1X1i + \beta 2X2i + \beta 3X3i + \beta 4X4i + \beta 5X5i$$

Where X is the independent variable and Y = 0 if the committer uses a direct motorcycle and Y = 1 if using a motorbike instead of the Surabaya - Sidoarjo commuter train. The model can be interpreted as Yi's conditional expectation of Xi, E (Yi | Xi) as the conditional probability that the event will occur against Xi, ie Pr (Yi = 1 | Xi). Thus, the function of the respondent's probability equation using a motorcycle is:

$$Pi = \frac{1}{1 + -(\ 0 + 2 + 2\ 2 + 3\ 3 + 4\ 4 + 5\ 5)}$$

So that the logit model in the analysis analysis of Motorcycle Modes and motorcycles over the commuter trains Surabaya - Sidoarjo For The Journey Toward Final Destination are the following:

$$Li = \ln\left(\frac{\quad}{\quad}\right) = \beta 0 + \beta 1Q + \beta 2C + \beta 3T + \beta 4E + \beta 5A + ui$$

1 –

Where,

Li = Usage Mode of Transportation, Dependent variable is to use motorcycle or Motorcycle over commuter train Surabaya - Sidoarjo.
( ) = Odds Ratio from the use of motorcycle or
1 – Motorcycle instead of commuter train Surabaya - Sidoarjo.
$\beta 0$ = constants
$\beta 1,2,3,4,5$ = estimated coefficient
Q = Quality of Service, which indicates the level of service perceived by the user.
C = Cost, which indicates the amount of expenditure of respondents in travel to final destination for se-month.
T = Travel Time, ie the length of the journey from home to the final destination by using a motorcycle or using a motorcycle switch to the commuter train Surabaya - Sidoarjo.
E = Experience, which shows the experience of motorcycle and motorcycle users over the Surabaya - Sidoarjo commuter train.
A = Accessibility, which shows the access level of motorcycle and motorcycle users over the Surabaya - Sidoarjo commuter train until the final destination.
ui = error rate (maximum error rate of 5%)

D. Instrument

Instrument questions on respondents to choose or not to choose to use Motorcycle switch using train covers as follows:

Table – I: Indicator Motorcycle Direct and Motorcycle switch using train

Variable	Dimensions	Indicator	Kode
Quality of service	Tangible	1. Parking space at the station is quite wide	Tang1
		2. The lounge area at the station is convenient	Tang2
		3. The chairs in the waiting room are clean and well maintained	Tang3
		4. Seats on clean clean commuter trains	Tang4
		5. The room on the commuter train is cleanly manicured	Tang5
		6. Handrails on commuter trains are well maintained	Tang6
		7. The air temperature on the commuter train is cool	Tang7
		8. The windows on the commuter trains are clean and undamaged	Tang8
	Responsiveness	9. Parking officers respond quickly to community difficulties	Res1
		10. Train technicians respond quickly to customer complaints and problems	Res2
		11. Speed officers at the station in providing the information required passengers	Res3
		12. Speed of personnel at the station in response to emergency conditions in the train as well as at the station	Res4
	Reliability	9. Experienced coaching officer	Rel1
		10. The parking attendant knows how to park the vehicle safely	Rel2
		11. Officers at the station know the train schedule well	Rel3
		12. Officers at the station know the train route clearly	Rel4
	Assurance	13. The parking attendant arranged the parking well	Ass1
		14. The parking attendant and the clerk at the station are polite	Ass2
		15. The parking attendant returned items left behind	Ass3
		16. Trains arrive on time	Ass4
		17. Timetable on-time parking	Ass5
		18. The concierge is honest with the parking fee	Ass6
	Emphaty	19. The parking attendant pays attention to the difficult community	Emp1
		20. The machinist gives priority to passengers of children, pregnant women, parents or special needs	Emp2
		21. Officers at the station pay attention to the passengers of children, pregnant women,	Emp3
		the elderly or with special needs	Emp4
		22. There are paths for people with special needs	
Cost		23. The cost of parking of vehicles at the station is relatively cheap	Tar1
		24. The cost of travel by commuter train is relatively cheap	Tar2
		25. The cost of travel after using commuter trains to the final destination is relatively cheap	Tar3

Variable	Dimensions	Indicator	Kode
Time		26. Access to nearby vehicle parking is relatively fast	Wk1
		27. The time it takes to park a vehicle near the station is relatively fast	Wk2
		28. The waiting time for commuter trains in the waiting room is relatively fast	Wk3
		29. Travel time by commuter train is relatively fast	Wk4
		30. Travel time from the end of the commuter train station to the final destination (workplace, or other) is relatively fast	Wk5
Accessibility		31. Using a commuter train is a fun experience	Ex1
		32. Using commuter trains makes it easy to reach destinations	Ex2
		33. Using commuter trains is faster than using your own vehicle	Ex3
		34. Using commuter trains reduces traffic congestion	Ex4
		35. Using a commuter train can meet many other passengers	Ex5
Experience		36. Pedestrian provided after using commuter trains is within easy reach of pedestrians	Aks1
		37. The angkot facilities in Surabaya are easily accessible from the station to	
		38. The city bus facilities in Surabaya are easily accessible from the station to the final	Aks2
		destination	Aks3
		39. Taxi facilities in Surabaya are easily accessible from the station to the final destination	Aks4
Decision Transfer Mode		40. Decided to park Motorcycles near the station and take the Surabaya - Sidoarjo commuter train	1
		41. Deciding to use Motorbike is the final destination	0

III. RESULT AND DISCUSSION

Identity of respondents of motorcycle mode selection directly - motorcycle over commuter train Surabaya – Sidoarjo. The data shows that 52% of respondents are Surabaya surabaya sidoarjo are female and 48% of men with average productive age between 25 - 41 years are 92% only about 8% of respondents are aged more than 41 years. The work of respondents is dominated by students and private employees by 52% followed by students 20%, 7% civil servants and 11% entrepreneurs, consultants and others by 4%. Data of respondents who become customers of Surabaya - Sidoarjo commuter train station are 18% and unsubscribed 82%. From the data also shows that 86% of respondents have used commuter trains Surabaya - Sidoarjo.

Based on monthly expenditure cost data for transportation 90% of respondents stated their monthly expenses of between 300-500 thousand rupiah per month, and 6% between 500-1 million rupiah per month, only 4% of respondents stated spending over 1 million rupiah.

The daily data of the respondent's daily journey toward the final destination indicates that 88% of respondents are driven for more than 1 hour and only about 12% drive less than 1 hour. And the distance from home to the final destination shows that 77% of respondents travel more than 10 km per day, only about 23% of respondents who drive less than 10 km.

Data of perpetrators of mode selection in this study include ownership of motorcycles, motorcycle movement to work, commuting train experience, distance of railway station home. Based on data of motorcycle movement to the workplace in Surabaya and Sidoarjo city only 15% of respondents who leave for work place do not use motorcycle and 68% of respondents claimed ever ride commuter train Surabaya - Sidoarjo, distance between home and commuter train station Surabaya - Sidoarjo stated that 91 % Of respondents stated that the furthest house distance is 5 Km from Surabaya - Sidoarjo commuter train station.

The purpose of the movement of the respondents is divided into 6 major destinations, almost 70% travel from sidoarjo to Surabaya with the intention of walking and working, and 19% for school, 7% for other purposes, 4% shopping, and 2% going home.

Table – II: Percentage Prediction Motorcycle Direct and Motorcycle switch using train

Selecting Direct Motorcycle Mode	Prediction		Persentase
	Selecting Direct Motorcycle Mode	Choosing a motorcycle mode by commuter train Surabaya - Sidoarjo	
Selecting Direct Motorcycle Mode	59	154	27,7
Choosing a motorcycle mode by commuter train Surabaya - Sidoarjo	44	344	88,7
Overall Percentage			67,1

Based on Table 2 it is known that of 103 people who chose direct motorcycle mode, as many as 59 people (27.7%) were correctly classified by the logistic regression model choosing the mode of the direct motorcycle. Of 388 people who chose Surabaya motorcycles - Sidoarjo, as many as 344 people (88.7%)

were correctly classified by the logistic regression model choosing the Surabaya-Sidoarjo commuter trains. Overall, it is known that the classification accuracy of the logistic regression model in this study is 67.1%. It can be said that logistic regression model in this study has a good accuracy in predicting respondents in the mode selection.

Table – III: logistic regression model

Variables	Coefficient	Wald	Sig.	Exp (B)
Constants	-2,981			
Service Quality	0,537	16,771	0,011	1,710
Cost	0,617	5,529	0,000	1,853
Time	0,433	0,022	0,019	1,542
Experience	-0,024	7,714	0,883	0,976
Accessibility	-0,461	19,238	0,005	0,631

Based on the estimation result in Table 3 we get the logistic regression model as follows:

Ln_{1-} = - 2,981 + 0,537 Service Quality + 0,617 Cost + 0,433 Time– 0,024 Experience– 0,461 Accessibility

$\overline{1-}$ = EXP (- 2,981 + 0,537 Service Quality + 0,617 Time + 0,433 Time– 0,024 Experince– 0,461

a) Accessibility

To test the significance of logistic regression coefficient each independent variable used waldtest. If waldtest produces a significance value <0.05 (α = 5%), then the independent variable has a significant effect on the dependent variable. Here are the results of testing the significance of each logistic regression coefficient:

b) Quality of Service

Logistic regression coefficient value of service quality variable is 0,537 with exponential value equal to 1,710. This can be interpreted if the quality of service has increased, the chances of people to switch from motorcycles to commuter trains Surabaya - Sidoarjo will be bigger that is 1.710 times the opportunity to move to the commuter train Surabaya - Sidoarjo. The effect of service quality on Surabaya - Sidoarjo commuter train mode is significant with significance value of waldtest 0,011 <0,05.

c) Cost

The value of the logistic cost regression coefficient variable is 0.617 with an exponential value of 1.853. This can be interpreted if the cost has increased, then the chances of people to switch from motorcycles to commuter trains Surabaya - Sidoarjo will be bigger that is 1.853 times the opportunity to move to the commuter train Surabaya - Sidoarjo. The effect of cost on Surabaya - Sidoarjo commuter train mode selection is significant with a significance value of waldtest of 0.000 <0.05.

d) Time

The value of logistic regression coefficient of time variable is 0,433 with exponential value equal to 1,542. This can be interpreted if the travel time commuter train Surabaya - Sidoarjo the shorter, then the chances of people to switch from motorcycles to commuter trains Surabaya - Sidoarjo will increase the 1,542 times the opportunity to move to the commuter train Surabaya - Sidoarjo. The effect of time on the selection of Surabaya - Sidoarjo commuter train modes is significant with the significance value of waldtest of 0.019 <0.05.

e) Experience

The value of the logistic regression coefficient of experiential variables is -0.024 with an exponential value of 0.976. This can be interpreted if the experience of commuting trains Surabaya - Sidoarjo more frequent, then the chances of people to switch from motorcycles to commuter trains Surabaya - Sidoarjo will be lower that is 0.976 times the opportunity to move to the commuter train Surabaya - Sidoarjo. The effect of experience on Surabaya - Sidoarjo commuter train mode selection is not significant with the significance value of waldtest of 0.883> 0.05.

f) Accessibility

The value of logistic regression coefficient of accessibility variable is -0.446 with exponential value of 0.631. This can be interpreted if accsesbility has increased, then the chance of people to switch from motorcycles to commuter train Surabaya - Sidoarjo will be lower that is 0.631 times the opportunity to move to commuter train Surabaya - Sidoarjo. The effect of accessibility to the selection of Surabaya - Sidoarjo commuter train modes is significant with the significance value of waldtest by 0.005 <0.05.

IV. CONCLUSIONS

1. The result of the research shows that there are five variables that influence motorcycle users to change the modes of Surabaya - Sidoarjo commuter train mode, ie service quality, cost, time, experience and access.
2. Based on the predicted classification matrix, 88.7% of Surabaya-Sidoarjo motorcycle user respondents are willing to take over the Surabaya - Sidoarjo commuter train mode.
3. Provided logistic regression model of choice of direct motorcycle mode and motorcycle over commuter train Surabaya - Sidoarjo are as follows:
4. Ln_{1-} = - 2,981 + 0,537 Service Quality + 0,617 Cost + 0,433 Time– 0,024 Experience– 0,461 Accessibility

$\overline{1-}$ = EXP (- 2,981 + 0,537 Service Quality + 0,617 Cost + 0,433 Time– 0,024 Experince–0,461 Accessibility.

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