SELECTION MODELS OF JAYA UTAMA AND SUGENG RAHAYU BUS ROUTES USING THE INCREMENTAL ASSIGNMENT METHOD (CASE STUDY: PURABAYA TERMINAL – TERBOYO TERMINAL)

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Abstract

Pattern of interactions that occurred between Surabaya City and Semarang City is not only limited to economic factors but more than it takes place in all aspects of social life. People which are located outside of Semarang City area will try to choose the fastest route from several routes that connect between the zones of origin to Semarang City. This research is conducted based on the factors that influence the process of selecting travel routes from Surabaya City to Semarang City using the intercity-interprovincial bus transportations. This study using the incremental assignment method because it can be executed to determine the relationship between traffic flow and vehicle travel time, not depending on the assumptions of road users and the characteristics of the road network. The results of simple linear regression analysis, obtained a flow-cost relationship model on route A (Terminal Purabaya - Nganjuk - Ngawi - Solo - Ungaran - Terminal Terboyo) the form of the equation is \( Y_A = 48.937 + 0.022X \). While the flow-cost relationship model on route B (Terminal Purabaya - Gresik - Lamongan - Tuban - Rembang - Kudus - Terminal Terboyo) the form of the equation is \( Y_B = 36.822 + 0.034X \). The coefficient of determination \( (R^2) \) on route A is 0.6 and on route B the result is 0.4. The final result of loading the travel route with a uniform loading fraction of 5% obtained a Wardrop Equilibrium convergence value of 0.0065

Keywords: simple linear regression analysis, incremental assignment method, travel route selection.

INTRODUCTION

Availability and usage of transportations mode affect road user to the trip routes selection process. Trip routes selection process can be defined as a movement between two zones (which obtained from trip distribution stages) for determined mode (which obtained from modal choice stages) imposed to existing route which contained of exact road network links [1]. Public transportations modal choice such as bus still become a main options for ordinary people who nearly unwanted to using private vehicles with time efficiency and travel cost considerations. The emergence of movement between zones basically will never be separated from development plans. The regional development plan that is being or will be carried out is predicted to have a strong influence toward high activity of movement between zones. This influence, if not balanced with efforts to supporting fluency of transportations activity, can causing problems such as loss of travel time and many things that affecting the consideration of trip route selection [2]. Pattern of interactions that occurred between Surabaya City and Semarang City is not only limited to economic factors but more than it takes place in all aspects of social life. People which are located outside of Semarang City area will try to choose the fastest route from several routes that connect between the zones of origin to Semarang City. This research is conducted based on the factors that influence the process of selecting travel routes from Surabaya City to Semarang City using the intercity-interprovincial bus transportations.

This research use the incremental assignment method to complete task sequences of route selection. In this study, there were two routes that reviewed, namely route A (Terminal Purabaya - Nganjuk - Ngawi - Solo - Ungaran - Terminal Terboyo) with Sugeng Rahayu Bus Company and route B (Terminal Purabaya - Gresik - Lamongan - Tuban - Rembang - Kudus – Terboyo Terminal) with Jaya Utama Bus Company. Determining of object studies Sugeng Rahayu and Jaya Utama Bus Company according to the number of passengers whom feel comfortable with equipped service facilities from those bus are achievable tariff, wireless fidelity (Wi-Fi) on bus, rest room and others.
RESEARCH METHODS
First phase that must be done is to examining conditions of existing trip routes. This is a beginning of learning and investigations on trip route which is going to observe before primary data conducting to be achieved. Primary data which are necessary needed such as traffic volume, travel time and questionnaire that filled by respondents. Then, traffic volume data and travel cost are processed by using linear regression analysis equations in order to determine relationship between traffic flow and cost. The result of relationship between traffic flow and cost analysis can be brought as a reference for traffic load analysis by using the incremental assignment method. Procedure of traffic load analysis with using the incremental assignment method are listed below:

a. Making a table of traffic distributions from zone A to zone B which passing two routes with the incremental assignment method mechanism
b. Separating traffic flow into a several fractions with uniform parts on 25%
c. Imposed traffic flow to the routes with the less travel cost that executed in gradually until it reached final phase
d. Analyzing value of Wardrop Equilibrium indicator to determine convergence or not convergence of the loading results

Literature study is also done by reading and drawing conclusions from early studies and textbooks which are relevant to this research.

A. Route Selection Process
The objectives of route selection phase are to allocate every movements inter zone for various routes which most often used with road user that moving from origin to destination zone [3]. There are four points of route selection analysis:

a. Reason of road user to choose some route compares with the other routes
b. Model improvement that combining transportation system with road user reasons of choosing certain route
c. Several of road users have a different perceptions about “the best route” selection.
d. Traffic congestions and road segment physical characteristics limiting the amount of traffic flow.

B. Basic Concepts of Route Selection
Route selection is laid on a comparison of the operational characteristics of each alternative route for every available transportation modes. In addition, route selection can be based on certain factors that make a person feel safe or comfort-table [4]. The objectives of route selection process stage is to allocable every movement between zones to the various routes which most frequently used by road users that moving from the origin zone to the destination zone [5]. There are four points of route selection analysis, as mentioned below:

1. The reason of road users choosing a route compared to other routes.
2. Model development that combining transportation system with the reason of road users choosing specific routes.
3. Some road users have different perceptions about choosing the “best route”.
4. Traffic congestions and physical characteristics of road segment restrict the amount of traffic flow on the road.

C. Route functions based on road network structures
Route functions based on road network structures are [6]:

a. Trunk Route
This type of route has a high performance of service load and transportation mode time operation takes 24 hours. This route serving arterial road which main activities center available.

b. Principal Route
This type route has a same characteristics as trunk route with a specific distinguished on transportation mode time operation maximum only takes 22 hours.

c. Secondary Route
This type route has a low performance of service load than trunk and principal route. This route only serving corridor from residential area to second level of city

d. Branch Route
This type of route has a functions to connecting trunk route and principal route with another activities center area.

b. Local Route
This type of route is a connector between residential areas to a larger route. This route using collector and local type of road service because it has a low demands.

f. Feeder Route
This type of route has a big size of connecting point with another route. Usually intermodal facilities are available to serving passenger intermodal changes activities

g. Double Feeder Route
Basically this route has a same characteristics as feeder route, but this route can also serving two trunk route all at once.
D. Route Selection Model
Model is an instruments aid that can be used to simplifying a reality matters in engineering and described into measurable mathematical equations [7]. According with explained text, Tamin (2009) also declare about of model related:

1. Capacity Restraint Model
This model is take attention to traffic movement flow consideration, time travel, vehicle speed and travel cost. This model is also figuring upon changing travel time due to occurred traffic such as traffic congestion. In traffic conditions under road capacity, so travel time assumed relatively similar. Thus problem can be solved with considering Wardrop Equilibrium conditions. Capacity restraint model can be explained with a several method, one of those is incremental assignment method [8].

2. Incremental Assignment Method
Incremental assignment method is a method which restored in capacity restraint model. This method considering traffic congestion, travel time and travel cost on the best route selection assumptions. Basic principal of incremental assignment method usage is the way how to distribute total of Origin-Destination Matrix into a several parts by using proportional factor. Each parts of Origin-Destination Matrix assigned to road network incrementally. It means that every network which assigned, analyzed with using the cost produced from early traffic. The points of this method is every assignment and cost re-estimated according to mathematical relationship between traffic and travel time. That explained process repeated again until all Origin-Destination Matrix is assigned [9]. Things that must be paid an attention by using this method are:
   a. Accuracy of this method depend on proportional size of Origin-Destination Matrix which assigned
   b. If traffic flow have already assigned, so that traffic flow can’t be removed or re-assigned to another locations.

3. Wardrop Equilibrium
On Wardrop equilibrium principle explained that under equilibrium state, traffic arrange itself in congested networks in such a way that no individual trip maker can reduce his path cost by switching routes. Under equilibrium condition traffic should be arranged in congested networks in such a way that average (or total) travel is minimized. So it can be defined that if road user able to minimizing their travel cost, then route distribution system have achieve a state of equilibrium. Indicator of Wardrop equilibrium estimated after each repetition and total of traffic flow produced for every road segment. Produced value is a measure of total travel cost overhead compared with optimal travel cost. So it can be resumed that the smaller value as an estimation result, then the condition nearly appear to Wardrop equilibrium state [10]. Value or Wardrop equilibrium indicator can be estimated by using equations as following:
\[
\delta = \frac{\sum \sum T_{id}(C_{r} - C'_{id})}{\sum \sum T_{id} C_{id}} \tag{1}
\]

with:
- \(\delta\) = Wardrop equilibrium indicator
- \(C_{r}\) = travel cost from origin zone \(i\) to destination zone \(d\) which using route \(r\)
- \(C'_{id}\) = minimum travel cost from origin zone \(i\) to destination zone \(d\)
- \(T_{id}\) = total of movement from origin zone \(i\) to destination zone \(d\) on study area

4. Simple Linear Regression Analysis
Simple linear regression analysis is a statistical method which can be used to studying relationship between problem characteristics have been investigated. This analysis can modelling relationship between two independent variable (X) and dependent variable (Y). On this research traffic volume is an independent variable (X) in passenger car unit per hours (pcu/hrs) whereas travel time conducted as dependent variable in time unit (minute) [11]. Simple linear regression analysis calculated as equations following:
\[
Y = P + QX \tag{2}
\]

with:
- \(P\) = intercept or regression constant
- \(Q\) = regression coefficient
- \(X\) = independent variable
- \(Y\) = dependent variable

Value of \(P\) and \(Q\) obtained from equations as following:
\[
Q = \frac{N \sum (X_i)(Y_i) - \sum (X_i) \sum (Y_i)}{N \sum (X_i)^2 - (\sum (X_i))^2} \tag{3}
\]
\[
P = \bar{Y} - Q\bar{X} \tag{4}
\]

with:
- \(\bar{Y}\) = average value of \(Y_i\)
- \(\bar{X}\) = average value of \(X_i\)

5. Coefficient of Determination
Coefficient of determination (R²) is used to measuring model capability to explaining variation of independent variable or dependent variable. Coefficient of determination (R²) have value constraint which range between intervals 0 to 1 (0 ≤ R² ≤ 1). Coefficient of determination (R²) which have value close to 1 means that independent variables giving nearly all information that required to predicting dependent variables [12]. Coefficient of determination (R²) can be calculated with following equations:
6. Validity Test
Validity test is a statistical test which functioned to obtaining whether if some statistical instrument expressed valid or not. In this research validity test is used to examining propriety of the questionnaire answers which have filled by respondent. Validity test carried out by the way to comparing between \( r \)-count as the result of respondent analysis with \( r \)-table [13]. This paperwork also using \( r \)-table with error rate 5%. Validity test executed with SPSS Statistic analysis software aid to determining \( r \)-count. Validity test criteria which is used expressed as following:

(a) \( H_0 \) accepted if \( r \)-count > \( r \)-table which means that statistical instrument used is valid

(b) \( H_0 \) rejected if \( r \)-count ≤ \( r \)-table which means that statistical instrument used is not valid

To determine the value of \( r \)-table, so equations as following can be used:

\[
\text{df} = N - 2 \quad (6)
\]

with:

\[
\text{df} = \text{degrees of freedom} \\
N = \text{number used as sample}
\]

7. Reliability Test
Reliability test basically is known as an index number which showing how far of some statistic instruments can be trusted or reliable. So that reliability test can be used to obtaining consistency of statistic instruments when if measuring process repeatedly done. Some statistic instrument is declared reliable if giving a same results although it carried out in many times. As a sequence of statistical test, validity test is a first phase then reliability test locating a next phase. This allegedly happened because data which is measured must be valid so can be continued with reliability test. When data is measured on validity test not valid, then reliability test is not necessary done [14]. In this research, reliability test is executed with Cronbach’s Alpha method by using SPSS Statistic analysis software aid. The result of Cronbach’s Alpha method with SPSS Statistic will be compared with Cronbach’s Alpha Eisingerich and Rubera’s value is 0.7. If the result reach value over than 0.7 it means that respondent answers in this research is reliable.

8. Population and Sample
Population is generalization area that consists of object or subject which have specific quality and characteristics as defined by researcher for studying and then resuming for conclusions. Sample is a parts of amount and characteristics which have owned by populations. So it can defined that sample is a parts of populations which its characteristics will be observed and representable from a whole amount of population [15]. Estimation of sample amount commonly using Slovin Formula’s as following:

\[
n = \frac{N}{1 + N(e)^2}
\]

with:

\[
n = \text{number of respondent} \\
N = \text{number of population} \\
e = \text{percentage of accuracy on sample withdrawal}
\]

error tolerance

On Slovin Formula’s explained that \( e \) value which still can be tolerated is 10% to 20%. If \( e \) value is 10% then it used for a big amount of population, so if \( e \) value is 20% then it used for a small amount of population.

RESULTS AND DISCUSSION
According to the results of traffic volume survey that carried out on observing locations, the number of major movement from route A (Purabaya Terminal – Nganjuk – Ngawi – Solo – Ungaran – Terboyo Terminal) on Monday at 07.00 – 08.00 with amount 2000 pcu/hr. Whereas the other number of major movement from route B (Purabaya Terminal – Gresik – Lamongan – Tuban – Rembang – Kudus – Terboyo Terminal) on Monday at 07.00 – 08.00 with amount 2058 pcu/hr.

While the dependent variable (Y) is obtained from the results of the travel time survey which has calculated the average unit value of minutes. To obtain the results of the calculation of the traffic flow- travel cost relationship model on route A expressed as following:

\[
Q = \frac{N \sum (X_i Y_i) - \sum (X_i) \sum (Y_i)}{N \sum (X_i^2) - (\sum (X_i))^2} \\
Q = \frac{7(92864.60) - 10531.30(576)}{7(18645087.49) - (10531.30)^2}
\]
Q = 0.022

Traffic flow regression constant calculation due to travel cost (P):
\[ P = \bar{Y} - Q \bar{X} \]
\[ P = 82.29 - (0.022 \times 1504.47) \]
\[ P = 48.937 \]

The value of the independent variable and the dependent variable on route A (Purabaya Terminal – Nganjuk – Ngawi – Ungaran – Terboyo Terminal) is shown in table 2 below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Travel Time (minutes)</th>
<th>Traffic Volume (cur/hour)</th>
<th>Xi Yi</th>
<th>Xi 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>84.00</td>
<td>1999.50</td>
<td>167958.00</td>
<td>3998000.25</td>
</tr>
<tr>
<td>2</td>
<td>77.00</td>
<td>1794.00</td>
<td>138245.80</td>
<td>3223461.16</td>
</tr>
<tr>
<td>3</td>
<td>95.00</td>
<td>1910.00</td>
<td>182305.00</td>
<td>3682561.00</td>
</tr>
<tr>
<td>4</td>
<td>97.00</td>
<td>1628.20</td>
<td>157935.40</td>
<td>2651035.24</td>
</tr>
<tr>
<td>5</td>
<td>72.00</td>
<td>1642.20</td>
<td>118238.40</td>
<td>2696820.84</td>
</tr>
<tr>
<td>6</td>
<td>106.00</td>
<td>1547.00</td>
<td>163982.00</td>
<td>239520.00</td>
</tr>
<tr>
<td>7</td>
<td>45.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Σ</td>
<td>576.00</td>
<td>10531.30</td>
<td>928664.60</td>
<td>18645087.49</td>
</tr>
</tbody>
</table>

Source: results of analysis

From the calculation of the current relationship model - the cost of travel on route A (Terminal Purabaya - Nganjuk – Ngawi – Solo – Ungaran – Terboyo Terminal), the flow relationship model – the cost of the trip is \( Y_A = 48.937 + 0.022X \).

The value of the independent variable and the dependent variable on route B (Purabaya Terminal – Gresik – Lamongan – Tuban – Rembang – Kudus – Terboyo Terminal) is shown in table 3 below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Travel Time (minutes)</th>
<th>Traffic Volume (cur/hour)</th>
<th>Xi Yi</th>
<th>Xi 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>66.00</td>
<td>2058.30</td>
<td>135847.80</td>
<td>4236598.89</td>
</tr>
<tr>
<td>2</td>
<td>94.00</td>
<td>2016.80</td>
<td>189579.20</td>
<td>4067482.24</td>
</tr>
<tr>
<td>3</td>
<td>88.00</td>
<td>1655.80</td>
<td>145710.40</td>
<td>2741673.64</td>
</tr>
<tr>
<td>4</td>
<td>134.00</td>
<td>1576.40</td>
<td>212357.70</td>
<td>2485036.96</td>
</tr>
<tr>
<td>5</td>
<td>124.00</td>
<td>1490.50</td>
<td>184822.00</td>
<td>221590.25</td>
</tr>
<tr>
<td>6</td>
<td>76.00</td>
<td>1360.30</td>
<td>103382.80</td>
<td>1856416.09</td>
</tr>
<tr>
<td>7</td>
<td>20.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Σ</td>
<td>602.00</td>
<td>10158.10</td>
<td>970579.80</td>
<td>17602798.07</td>
</tr>
</tbody>
</table>

Source: results of analysis

Calculation of traffic flow-cost relationship model on route B expressed as following:

\[
Q = \frac{\sum(X_i \cdot Y_i) - \sum(X_i) \cdot \sum(Y_i)}{\sum(X_i^2) - (\sum(X_i))^2}
\]

\[
Q = \frac{(970579.80 \times 10158.10) - (10358.10 \times 10158.10)}{(7(16602798.87) - (10158.10)^2)}
\]
\[ Q = 0.034 \]

Traffic flow regression constant calculation due to travel cost (P):
\[ P = \bar{Y} - Q \bar{X} \]
\[ P = 86.00 - (0.034 \times 1451.16) \]
\[ P = 36,822 \]

From the calculation of the current relationship model - the cost of travel on route B (Purabaya Terminal – Gresik – Lamongan – Tuban – Rembang – Kudus – Terboyo Terminal), then the flow relationship model – the cost of the trip is \( Y_B = 36,822 + 0.034X \).

Coefficient of determination \( R^2 \) is used for measuring capability of a model on explaining independent variable variation. Coefficient of determination value placed on interval 0 to 1. If coefficient of determination value close to 0 can be defined that capability of a model to explaining independent variable is very definite. Otherwise if coefficient of determination value close to 1 can be defined that capability of independent variable to explaining dependent variable more adequate.

Coefficient of determination \( R^2 \) calculation results on route A with using SPSS Statistic analysis software aid is shown in table 4 as following:

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.747*</td>
<td>0.558</td>
<td>0.469</td>
</tr>
</tbody>
</table>

Source: results of analysis

Calculation of traffic flow-cost relationship model on route B with using SPSS Statistic analysis software aid is shown in table 5 as following:

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.616*</td>
<td>0.379</td>
<td>0.255</td>
</tr>
</tbody>
</table>

Source: results of analysis

From coefficient of determination analysis results showing that both of route (A and B) placed on interval 0.4 – 0.6, it means that capability of independent variable to explaining dependent variable is quite strong.

Value of r-count analysis using SPSS Statistics is shown in table 6.
Table 6. Value of r-count

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Employment Status (X1)</th>
<th>Monthly Income (X2)</th>
<th>Travel Purposes (X3)</th>
<th>Reaso n for Bus Selection (X4)</th>
<th>Xtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td>.504 **</td>
<td>.266**</td>
<td>.739*</td>
<td>.729*</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Earnings per Month (X2)</td>
<td>Pearson Correlation</td>
<td>.504*</td>
<td>.401**</td>
<td>.431**</td>
<td>.760*</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Travel Purposes (X3)</td>
<td>Pearson Correlation</td>
<td>.266 **</td>
<td>.401**</td>
<td>.443**</td>
<td>.725 **</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.008</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Reasons for Bus Selection (X4)</td>
<td>Pearson Correlation</td>
<td>.379*</td>
<td>.431**</td>
<td>.443**</td>
<td>.758**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Xtotal</td>
<td>Pearson Correlation</td>
<td>.729*</td>
<td>.760**</td>
<td>.725**</td>
<td>.758**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

Source: results of analysis

After obtaining r-count as an analysis result with using SPSS Statistic, then r-count value will be compared to r-table value with error rate 5%. Comparison result of r-count value with r-table value on validity test shown in table 7 as following:

Table 7. Validity Test

<table>
<thead>
<tr>
<th>Attribute</th>
<th>r Count</th>
<th>r Table (N - 2 = (100 - 2))</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>0.729</td>
<td>0.197</td>
<td>Valid</td>
</tr>
<tr>
<td>X2</td>
<td>0.760</td>
<td>0.197</td>
<td>Valid</td>
</tr>
<tr>
<td>X3</td>
<td>0.725</td>
<td>0.197</td>
<td>Valid</td>
</tr>
<tr>
<td>X4</td>
<td>0.758</td>
<td>0.197</td>
<td>Valid</td>
</tr>
</tbody>
</table>

Source: results of analysis

From validity test result obtained that r-count > r-table which means measuring instruments is valid. The result of Cronbach’s Alpha method with SPSS Statistic will be compared with Cronbach’s Alpha Eisingerich and Rubera’s value is 0.7. If the result reach value over than 0.7 it means that respondent answers in this research is reliable. The results of Cronbach’s Alpha value analysis using SPSS Statistic are shown in table 8 as following:

Table 8. Value of Cronbach's Alpha

<table>
<thead>
<tr>
<th>Reliability Statistics</th>
<th>Cronbach's Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.722</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: results of analysis

From analysis result which have shown in table can be noticed that Cronbach’s Alpha value is bigger than 0.7.

On this working paper 4 schemes is available to obtaining results from route A and B traffic flow assignment. Traffic flow assignment with incremental assignment method calculated as following:

a. Uniform fraction assignment 25% calculations shown in Table 9:

Table 9. Uniform fraction assignment 25% result

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Fraction (%)</th>
<th>Fraction (traffic flow)</th>
<th>Route A</th>
<th>Route B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Traffic flow</td>
<td>Cost</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>48,937</td>
<td>36,822</td>
</tr>
<tr>
<td>1</td>
<td>25%</td>
<td>1014,50</td>
<td>48,937</td>
<td>1014,50</td>
</tr>
<tr>
<td>2</td>
<td>25%</td>
<td>1014,50</td>
<td>71,256</td>
<td>1014,50</td>
</tr>
<tr>
<td>3</td>
<td>25%</td>
<td>1014,50</td>
<td>93,575</td>
<td>1014,50</td>
</tr>
<tr>
<td>4</td>
<td>25%</td>
<td>1014,50</td>
<td>93,575</td>
<td>1029,00</td>
</tr>
</tbody>
</table>

Total 100% | 4058,00 |

Source: results of analysis

From table 9, value of Wardrop balance convergence calculated as following:

\[ \delta = \frac{\sum \sum T_{id}(C_{id} - C_{ij})}{\sum \sum T_{id} C_{id}} \]

\[ \delta = \frac{2029(93, 575 - 93, 575) + 2029(105,808 - 93, 575)}{4058 \times 93, 575} \]

\[ \delta = 0.065 \]

b. Uniform fraction assignment 10% calculations shown in Table 10:

Table 10. Uniform fraction assignment 10% result

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Fraction (%)</th>
<th>Fraction (traffic flow)</th>
<th>Route A</th>
<th>Route B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Traffic flow</td>
<td>Cost</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>48,937</td>
<td>36,822</td>
</tr>
<tr>
<td>1</td>
<td>10%</td>
<td>405,80</td>
<td>48,937</td>
<td>405,80</td>
</tr>
</tbody>
</table>

6
From table 10, value of Wardrop balance convergence calculated as following:

\[ \delta = \frac{\sum \delta_f \sum t_{rd}(C_{id} - C_{od})}{\sum \delta_f \sum t_{rd} C_{id}} \]

\[ \delta = \frac{2029(93,575 - 93,575) + 2029(105,808 - 93,575)}{4058 \times 93,575} \]

\[ \delta = 0.065 \]

c. Non-uniform fraction assignment 40%, 30%, 20%, 10% calculations shown in table 11:

<table>
<thead>
<tr>
<th>Assignment of</th>
<th>Fraction (%)</th>
<th>Fraction (traffic flow)</th>
<th>Route A</th>
<th>Route B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Traffic flow</td>
<td>Cost</td>
<td>Traffic flow</td>
<td>Cost</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>48,937</td>
<td>36,822</td>
</tr>
<tr>
<td>1</td>
<td>40%</td>
<td>0</td>
<td>48,937</td>
<td>36,822</td>
</tr>
<tr>
<td>2</td>
<td>30%</td>
<td>1623,20</td>
<td>48,937</td>
<td>92,011</td>
</tr>
<tr>
<td>3</td>
<td>20%</td>
<td>1217,40</td>
<td>75,720</td>
<td>92,011</td>
</tr>
<tr>
<td>4</td>
<td>10%</td>
<td>811,60</td>
<td>1623,20</td>
<td>92,011</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>4058,00</td>
<td>4058,00</td>
<td>92,011</td>
</tr>
</tbody>
</table>

Source: results of analysis

From table 11, value of Wardrop balance convergence calculated as following:

\[ \delta = \frac{\sum \delta_f \sum t_{rd}(C_{id} - C_{od})}{\sum \delta_f \sum t_{rd} C_{id}} \]

\[ \delta = \frac{2029(93,575 - 93,575) + 2029(105,808 - 93,575)}{4058 \times 93,575} \]

\[ \delta = 0.065 \]

d. Non-uniform fraction assignment 10%, 20%, 30%, 40% calculations shown in table 12:

Table 12. Uniform fraction assignment 10%, 20%, 30%, 40% result

<table>
<thead>
<tr>
<th>Assignment of</th>
<th>Fraction (%)</th>
<th>Fraction (traffic flow)</th>
<th>Route A</th>
<th>Route B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Traffic flow</td>
<td>Cost</td>
<td>Traffic flow</td>
<td>Cost</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>48,937</td>
<td>36,822</td>
</tr>
<tr>
<td>1</td>
<td>10%</td>
<td>0</td>
<td>48,937</td>
<td>36,822</td>
</tr>
<tr>
<td>2</td>
<td>20%</td>
<td>811,60</td>
<td>66,792</td>
<td>50,619</td>
</tr>
<tr>
<td>3</td>
<td>30%</td>
<td>1217,40</td>
<td>66,792</td>
<td>50,619</td>
</tr>
<tr>
<td>4</td>
<td>40%</td>
<td>1623,20</td>
<td>102,50</td>
<td>92,011</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>4058,00</td>
<td>4058,00</td>
<td>92,011</td>
</tr>
</tbody>
</table>

Source: results of analysis

From table 12, value of Wardrop balance convergence calculated as following:

\[ \delta = \frac{\sum \delta_f \sum t_{rd}(C_{id} - C_{od})}{\sum \delta_f \sum t_{rd} C_{id}} \]

\[ \delta = \frac{2434,80(102,503 - 92,011) + 1623,20(92,011 - 92,011)}{4058 \times 92,011} \]

\[ \delta = 0.068 \]

CONCLUSION

1. Value Probability

Results of 100 questionnaires as a primary data that have been filled in by the respondent, it is known that the probability value of passengers who choosing route A (Terminal Purabaya – Nganjuk – Ngawi – Solo – Ungaran – Terminal Terboyo) is 0.38 and who choosing route B (Terminal Purabaya – Gresik – Lamongan – Tuban – Rembang – Kudus – Terboyo Terminal) as much as 0.62.

2. Relationship Model of Traffic flow – Cost

Relationship model of traffic flow–cost for route A (Purabaya Terminal – Nganjuk – Ngawi – Solo – Ungaran – Terminal Terboyo) is Y_A = 48,937 + 0.022X. While the traffic flow-cost relationship model for route B (Purabaya Terminal - Gresik - Lamongan - Tuban - Rembang - Kudus - Terboyo Terminal) is Y_B = 36,822 + 0.034X.

3. Coefficient of Determination

As a results noticed that route A has a coefficient of determination 0.4 and route B has a coefficient of determination 0.60. It defined that the ability of the independent variables in explaining the dependent variable is quite strong so that the travel time or travel costs contributing as determinant for passengers in traveling from Surabaya to Semarang City.

REFERENCES


