

Home Based Trip Generation Model S Analysis in Medan, Binjai, Deli Serdang and Karo (Mebidangro) Urban Area, Indonesia

Agustinus Panjaitan^{1*}, Abdul Rahim Matondang², Marlon Sihombing³, Agus Purwoko⁴

¹Regional Planning Program, University of North Sumatra, Medan, Indonesia

²Department of Industrial Engineering University of North Sumatra, Medan, Indonesia

³Faculty of Social and Political Science University of North Sumatra, Medan, Indonesia

⁴Faculty of Forestry University of North Sumatra, Medan, Indonesia

Corresponding author: agustinuspanjaitan@gmail.com

Abstract

The purpose of this research is to develop a home based trip generation model and analyze the variables that influence the trip generation model of people. This study focuses on trip generation of home-based people in the Medan-Binjai-Deli Serdang (Mebidang) area, so that the sample to be used is households that make home-based trips in the region. The mathematical model that generated regression with the dependent variable the number of home-based trips affected by several independent variables that influence it. The resulting model was then validated by the VIF and Anova tests and the Heteroscedasticity test. From the results of this study, it is expected that a trip generation model of home-based trip generation in the Mebidang urban area will be generated, so that it can be known what factors influence the trip generation of the area.

Keywords :

Trip Genertion, Regression Analysis.

1. Introduction

Urban areas are one of the land uses that play an important role in attracting the movement of people and goods. This relates to the definition of transportation which is a derived request, namely to fulfill human activities from one region to another. Mebidang Urban Area, is one of the National Strategic Areas (KSN) in North Sumatra province where the city of Medan as the core city and regency of Deli Serdang and Binjai as its hinterland. The results of the 2015 BPS survey showed that the total commuter movement in the Mebidang area was 315,425 people, then based on data from PT. Telkomsel in 2019 total commuter movement in the region reached 587,739 people, an increase of 86.33% in the last 5 years, or an average increase of 17.24% per year. For this reason, it is necessary to know the trip generation model of people based on the region and the factors that influence it.

The basic purpose of a trip generation is to produce a relationship model that links land use parameters with the number of movements going to a zone or the number of movements leaving a zone. Stages of trip generation can be used in predicting the number of movements to be carried out by a person in each origin zone by using detailed data on the level of trip generation, socioeconomic attributes and land use.

2. Literature Review

Movement patterns are formed from the behavior of people or goods from the initial place to the destination. The decision to make a move with a specific goal is based on several considerations, such as time, distance, efficiency, cost, security, and comfort (Khisty and Lall, 2003: 9). There are four patterns of movement in urban areas which become the basic pattern of movement (Miro, 1997: 165), namely:

1. External-External Movement Pattern
This pattern of movement has a place of origin and destination outside the study area and only passes through the study area.
2. External-Internal Movement Pattern
The origin node is outside the study area, and the destination node is in the study area.
3. Internal-Internal Movement Pattern
The starting point node is in the study area and the destination point is in the study area.
4. Internal-External Movement Pattern

The starting point node is in the study area and the destination point is outside the study area.

Travel base is a place where the trip location begins / starts and where the trip location ends. Travel bases are divided into 2 types, namely: home-based travel and non-home based travel. This type of trip is a trip where one or both zones (origin and destination) are home. While non-home based travel is a journey that has both origin or destination, not related at all to home. This kind of trip, usually also referred to as *zone-based trip* (*zone based trip*) because the place of origin and destination is a zone that has nothing to do with the house. (Tamim, OZ, 2000)

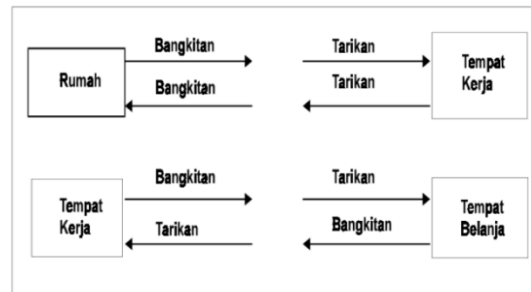


Figure 1 . Travel Awakening and Pulling (Tamim OZ, 2000)

According to Tamim, OZ (2000), in the modeling of trip generation the following factors need to be considered in several studies that have been carried out, namely: income, vehicle ownership, household structure, household size, land value, density of residential areas and accessibility. The first four factors (income, vehicle ownership, structure, and household size) have been used in several trip generation studies, while land values and residential area densities are only often used for zone studies.

Trip generation is a trip that leaves a zone or a trip to a zone (Miro, 2005: 65). For trip generation modeling, there are two analytical methods that can be used, namely cross classification analysis or category analysis and regression analysis. Cross-classification analysis or category analysis is based on the relationship between the occurrence of movement and household attributes (Tamin OZ, 2000: 143). The method of cross-classification analysis is carried out by allocating households into each category so that each category contains several households that have exactly the same level of characteristics. Then determine the average level of trips per household in each category and after that determine the number of trips in each category by multiplying the average number of trips per household in the respective category by the estimated number of households and totaling them for all categories so an estimate of the number of trips produced by the residential zone studied in the planned year can be obtained.

However, the problem in using this method lies in how to determine the household category and how to predict the number of households in the future for each household category. Apart from that there is no statistical test that can support the analysis of this category, so the benchmark is the magnitude of the deviation between the estimated results with the observations. Therefore for modeling trip generation. Another approach in analyzing trip generation is the regression analysis method. Regression analysis has been used in transportation studies widely. In each study zone a number of trips from the *trip ends* (dependent variable) are observed with certain characteristics that can be measured to produce a trip generation model. These characteristics for example X_1, X_2, X_3, X_4, X_5 , etc., are independent variables which are land use factors and socioeconomic attributes . In developing the regression equation it is assumed that: 1. All independent variables do not correlate with each other. 2. All independent variables are normally distributed; if the distribution is not normal (skew) logarithmic transformation is performed. 3. The independent variable is continuous. One example of a regression equation produced by the Leicester transport study in Anusanto, D (2013) is as follows:

$Y = 0.0649X_1 - 0.0034 X_2 + 0.0066 X_3 + 0.9489X_4$, where: Y = total trips per household; X_1 = family size; X_2 = residence density; X_3 = total family income; X_4 = car / household.

Trip generation is the modeling stage that estimates the amount of movement that comes from a zone or land use, and the amount of movement that is attracted to a land use or zone. Traffic movement is a function of land use that results in traffic movement. The rise and pull of traffic depends on two aspects of land use according to (Tamin, 2000: 41), namely:

1. Types of land use . Types of land use is a different land uses such as residential, commercial, education has a characteristic rise of the different traffic on the amount of traffic, type of traffic, traffic at different times.
2. The amount of activity and intensity of land use . Trip generation not only vary due to the type of land use, but also by the level of activity. The higher the level of land use, the higher the movement of the resulting traffic

flow. Meanwhile Martin in Warpani (1990: 111), states that traffic generation is influenced by several factors including:

- a. The purpose of the trip, is a social characteristic of a trip, for example there are those who work, school, and so on.
- b. Family income, income is another characteristic that has to do with one's journey. This change is continuous even though there are several income groups. Family income is closely related to vehicle ownership.
- c. Vehicle ownership, which is related to individual trips (per unit of house) in the choice of modes and characteristics of the population
- d. Land use at the place of origin is a physical characteristic that can be measured. Studying land use is a good way to study traffic as the activities so far are measurable, constant, and predictable
- e. Distance from the center of activity, which is related to population density and mode selection.
- f. A long journey, is a natural characteristic that can be used as a parameter in determining land use
- g. Travel mode, is the other side of the purpose of the trip that can be used to group different types of trips. Each mode has a specificity in urban transportation and has several advantages besides a number of shortcomings.
- h. The use of vehicles, can be stated by the number of people driving.
- i. Land use at the destination, in essence is not much different from the land use at the place of origin.

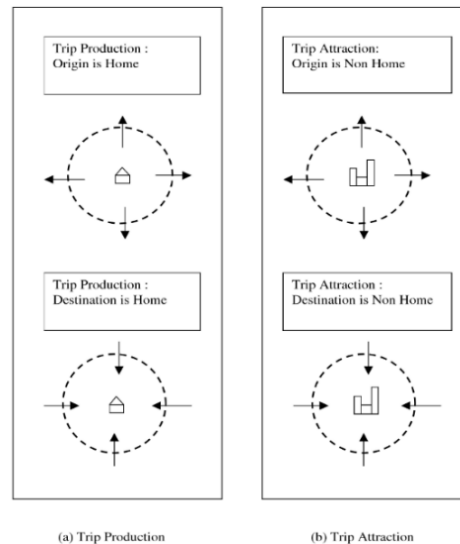


Figure 2. Relationship Between Origin of Travel Destinations and Awakening and Pulling Movements (Nam Seok Kim , 2005).

3. Methodology

3.1. Research sites

The location of this research is the urban area of Medan-Binjai-Deli Serdang (Mebidang) of North Sumatra Province.

3.2. Data collection technique

Primary Data , namely data obtained through direct observation in the field. This data was obtained through a household interview survey (home interview survey).

The independent variables that affect the number of home-based trips (Y), obtained from primary household interview survey data consist of:

1. Number of family members
2. Number of 2-wheeled vehicle ownership
3. Total ownership of 4-wheeled vehicles
4. The total amount of family income per month
5. Distance to the destination work

6. Travel time to work destination
7. Public transport fares
8. Private vehicle operating costs

Secondary data is data obtained from the relevant agency or resource person.

3.3. Data analysis technique

The analytical method used in this research is multiple linear analysis. Multiple linear regression analysis is a concept developed in cases that have many explanatory variables and parameters. The general form of multiple linear regression analysis methods (Tamin, 2000: 119) are:

$$Y = a + b_1X_1 + b_2X_2 + \dots + b_nX_n \dots \dots \dots (1)$$

Where:

Y = response variable

X = explanatory variable

a = regression constant

b₁, b₂ = regression coefficient

In the method of multiple linear regression analysis, several things need to be considered as follows:

1. Multicollinearity
Multicollinearity is an event that informs the relationship between the explanatory variables and relationships that occur quite large. Generally multicollinearity can be known from the value of a very large correlation coefficient between these explanatory variables.
2. Number of parameters "b"
The number of parameters "b" required is an unknown model that has an influence on the model.
To determine the equation for the trip generation model to be used, the following steps are taken :
 1. Determine the value of correlation between fellow variables. The correlation coefficient determines the relationship between each variable, both between the explanatory variable and the response variable. This coefficient is used to select explanatory variables that can be used to explain response variables. These variables are explanatory variables that have a strong or significant correlation with the response variable. Furthermore, if the correlation between the two explanatory variables is strong, then only one of them can be used in the regression equation model, which has a strong correlation with the response variable. Meanwhile, if the correlation is weak, the two variables can be used simultaneously in the regression equation model.
 2. Determine the value of the regression coefficient and regression constants (regression analysis).
 3. To test T (T - test) Calculation of the T-test with a level of significance of 95% was done to test the significance of the coefficients and constants of regression. Every variable that has a statistically insignificant regression coefficient must be removed from the model (Ofyar Z. Tamin, 2000).
 4. Model Testing After getting the multiple linear regression equation model, it is necessary to test the regression model to find out whether the linear regression equation model obtained includes BLUE (Best Unexpected Estimator) or not. The statistical tests carried out include:
 - a. F - test (linearity)
Calculation of the F-test with a level of significance of 95% was done to test the significance of regression model, which means that if there is a linear relationship between variables explanatory and variable response of the equation regression.
 - b. Non autocorrelation (no cases of autocorrelation)
In a regression analysis it is possible to have a relationship between the explanatory variables themselves or correlate themselves. To detect the presence or absence of autocorrelation then tested Durbin Watson (DW) provided as follows : 1) 1.65 <DW <2.35, no autocorrelation. 2) 1.21 < DW <1.65 or 2.35 <DW <2.97, cannot be concluded (inconclusive). 3) DW <1.21 or DW > 2.79, autocorrelation (Makridakis in Sualiman, 2002).
 - c. Non multicollinearity (there is no very strong or even perfect relationship between explanatory variables).
Heteroscedasticity (variance similarity) The test conducted is by the Glejser test with a significance level of 5% to test whether in the regression model there is an inequality of variance from the residuals of one observation to another. If the variant from one observation residuals to another observation remains, then it is called homoscedastic and if different is called heteroscedastic. A good regression model is a homoscedastic one.

d. Chi-Square Test

Chi-Square testing is done by comparing the calculated χ^2 value with χ^2 table using 95% significance level. If $\chi^2_{\text{arithmetic}} > \chi^2_{\text{table}}$, then the difference between observation value and actual value is significant, and if $\chi^2_{\text{arithmetic}} < \chi^2_{\text{table}}$, then the difference between observation value and actual value is not significant.

4. Result and Discussion

In the analysis and discussion, which will be analyzed and discussed include:

1. Characteristic analysis of house-based movement in the Mebidang urban area
Correlation analysis between home based trip generation variables
2. Test the multicollinearity multiple regression assumption, to find out whether or not the multicollinearity problem of the independent variables in the home-based trip generation regression model.
3. F test (Anova), After passing the multicollinearity test, the F test is continued, which is to find out whether the variance is the same or not. The significant F used must be <0.05 , if significant > 0.05 then the modeling cannot be accepted because the two data are the same
4. Heteroscedasticity Test.
Santoso (2000) explains that the heteroscedasticity test aims to test whether in a regression model, there is an inequality of variance from the residuals from one observation to another.

References

- Arianos, I. (2001). Model trip generation of Sidoarum, Muhammadiyah Yogyakarta. Final Project, University
- Black, J. (1981). Urban transport planning: Theory and practice, Baltimore: John Hopkins University Press.
- Fakih (2001). Travel Trip Model, Mino Martani, Final Project, Yogyakarta Muhammadiyah University.
- Firdaus O (2011), Modeling of Pangkal Pinang City Travel Trips Using JICA Strada Ver.3, 2011.
- Miro F (1997), Transportation Planning. Jakarta: Erlangga. 1997.
- Ortuzar, J. de D. & Willumsen, LG (1990). Modeling Transport, Chicester: John Willey.
- Salter, RJ (1976). Highway traffic analysis and design, London and Basingstoke: The Macmillan Press.
- Santoso, S. (2000). SPSS Parametric Statistics Exercise Book, Jakarta: Elekmedia Komputindo.
- Sualiman, Wahid (2002). Shortcuts master SPSS 10. Yogyakarta: Andi. 2002.
- Sulistiani, Tamin OZ (2000), Transportation Planning and Modeling. Bandung: Second Edition. Bandung Institute of Technology, 2000.
- Tamin, OZ (2000). Transportation Planning and Modeling (Edition and 2), Bandung: Bandung Institute of Technology Press.
- Warpani, S, (1990). Planning the Transportation System, Bandung, Bandung Institute of Technology Press. Bandung.