

MODEL ANALYSIS OF TRAVELING IN THE INTEGRATED MODEL OF MADANI EDUCATION AREA IN THE CITY OF PALU

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Abstract: The city of Palu began to show as a city that is quite developed, this can be seen from the transportation problems. The many existing land use functions encourage the generation of attraction and generation, namely the large number of movements leading to and leaving the location which often causes traffic congestion, especially during rush hour. The large number of school buildings around the Madani Integrated Model Educational District of Palu certainly has a large influence on the number of travel attractions. This study aims to analyze the model of travel attraction in the Madani Integrated Model Educational Zone in Palu City and the imposition of road traffic around the Madani Integrated Model Educational Zone in Palu City. The results showed that several factors influence the attraction of travel in the Madani Education Zone in the city of Palu, which are independent variables, namely distance (x1), time (x2), way to and return (x3), mode selection variable (x4), variable parking space availability (x5) and traffic jam variables (x6). All independent variables have a good influence on travel attraction and between independent variables. The best model of attraction of travel movements in the Madani Education Area in Palu City is $Y = 12,112 + 1,601 x_2$, where Y is the vehicle travel pull and x2 is the Time Variable.

Keywords: Trip Generation and Regression Analysis

I. INTRODUCTION

Palu City is starting to show as a fairly developed city, this can be seen from the existence of transportation problems. This can be seen from the increase in population which directly affects traffic conditions, for example, the occurrence of congestion at several intersections and main roads in Palu City, especially during rush hours, both morning and evening. The trips and movements that are generated from an area in Palu City and its surroundings make a large contribution to the volume of traffic that burdens the road network, which is caused by the attraction of travel for both educational, business, and personal needs. The number of land use functions that exist encourages the emergence of traction and generation, namely the large number of movements to and from the location which often causes traffic jams, especially during rush hours. The number of school buildings around the Palu Madani Integrated Model Education Area certainly has a big influence on the number of travel attractions in the area, and in that area, it has not been studied about how the travel attraction model occurs. In this research, a case study will be taken on the Madani Integrated Model Education Area in Palu City. From the existing conditions, it is necessary to find a trip attraction model in the current condition caused by the number of school buildings in the education area. It is hoped that this travel attraction model can be used as a consideration in forecasting the number of trip attractions in the future and to determine policies in the field of transportation and urban planning development.

II. THEORY

Travel Attraction

Travel attraction is the number of travel movements that occur to a certain location per unit of time. In this case, it is the number of movements to the study location each day. The number of trips as the dependent variable is estimated to be influenced by the number of building occupants, floor area, vehicle ownership, and the intensity of activities, in this case, the number of courses (Munawar, 2000). As well as the factors of travel attraction that need to be considered, there are other factors, namely the trip generation. Trip generation is important in the transportation planning process because by knowing the trip generation, the number of trips per trip zone in the future can be estimated.

Transport and Land Use Interaction Model

Transportation planning without land-use control is futile because transportation planning is an attempt to anticipate the need for future movements and the planned activity factor is the basis of the analysis. The integration model is differentiated based on the land-use model, namely the land-use model which only analyzes the allocation of residential areas and the land-use model which analyzes both the allocation of residential and commercial (business) allocations. Each of these integration models is also differentiated into a land-use model that considers the price of land in the analysis and a model that does not consider the land price in the analysis. Each of these models is also differentiated based on the response mode.

Regression Analysis

The regression analysis method is used to generate a relationship between two or more variables in numerical form, and to see how two or more variables are related to each other, where it is known which variables are influenced by other variables and which variables affect them. For zone-based trips, the linear regression analysis method analyzes how the relationship between the independent variables is the socio-economic characteristics of the zone (land use) with the dependent variable in the form of the amount of traffic flow (trips) from the observed origin zone to the observed destination zone and also yields an estimate of the number of trips from origin to destination attributable to zonal socio-economic characteristics for zone-based travel and household socio-economic characteristics for home-based travel.

Data analysis was performed using the regression analysis method to get a travel attraction model with the help of the SPSS 26 program. The steps for data analysis are as follows:

1. To test the significance of the correlation, to determine the relationship between the variables under investigation, both between independent variables and dependent variables and between independent variables.
2. Creating an alternative model based on the results obtained from the significance test of the correlation coefficient.
3. Calculating the coefficient of the regression equation to get a travel attraction model in the study area.
4. Perform statistical tests on the alternative models being tested. Three statistical tests were performed, namely the R² value test, t-test, and F-test. In addition to the statistical test, a collinearity test was also carried out to detect multicollinearity problems in the model.
5. Determine the best model from several alternative models based on the results of statistical tests and the collinearity test.

Correlation Test

This statistical test must be carried out to fulfill the requirements of the mathematical model, where the independent variables cannot be correlated, while between dependent and independent variables there must be a strong correlation (both positive and negative). Correlation is the level of relationship between variables that determines the extent to which a linear or nonlinear equation can explain the existing variables.

Determination Index

The correlation index measures the degree of association between the variables x and y, if between x and y there is a regression relationship $y = f(x)$. The characteristic of the index of determination is that if the points of the scatter diagram are closer to the regression line, then the price of R² is getting closer to 1. If the points are farther from the regression line, the price of R² is getting closer to 0. In general, $0 \leq R^2 \leq 1$.

Linearity Test

This statistical test is carried out to ascertain whether the motion generated model can be approached with a linear regression-analysis model or a non-linear regression-analysis model. In this analysis, using a linear regression analysis method, so that all independent variables are assumed to have a linear relationship with the dependent variable.

Conformity Test

This statistical test must be done to determine the best movement generation, model. In general, this test is based on the closeness or suitability of the model results to the observation results. One of the easiest and most frequently used conformity tests is the regression-analysis model. The best model is a model that has a total residual quadratic between the model results and the minimum observed results.

Significance Test

In general, the significance test can be said as a hypothesis test on the regression coefficient individually, for each independent variable. A significance test is often referred to as a partial test.

Multicollinearity

Multicollinearity is an event that informs the relationship between the independent variables x_i , and the relationship that occurs is quite large so that it will cause an estimate of the significance of the regression coefficient obtained. Generally, multicollinearity can be seen from the very large correlation coefficient between the independent variables, for example between x_1 and x_2 , the value of r_{12} is close to 1.

III. METHODS AND ANALYSIS

A. Research Design

The method used in this research is quantitative descriptive, research that describes the conditions of a particular project by analyzing existing data. Data analysis uses analytical and descriptive methods. The object of this research is the students and teachers who experience the pull to the Madani Integrated Model Education Area in Palu City. In this case, what is analyzed is the factor that causes the attraction of the trip to the Madani Integrated Model Education Area in Palu City.

B. Research Locations

The object of this research is the students and teachers who experience the pull to the Madani Integrated Model Education Area in Palu City. In this case, what is analyzed is the factor that causes the attraction of the trip to the Madani Integrated Model Education Area in Palu City



Figure 1. Madani Integrated Model Education Area Research Location Map

C. Population, Samples and Sampling Techniques

The object of this research is the students and teachers who experience the pull to the Madani Integrated Model Education Area in Palu City. In this research, the factors that travel attraction in the Madani Integrated Model Education Area in Kota Palu to be examined are: Distance, Travel Time, Characteristics of Departure and Return Mode, Mode Selection, Availability of Parking Space, Congestion, Time to Arrive, Time to Go Home, Purpose of Travel, Mode Selection, Education Selection, Income and Accident.

TABLE I - Population Data and Number of Respondents

| | Kindergarten | Elementary | Junior High | High School | Total |
|----------|--------------|------------|-------------|-------------|-------|
| Teacher | 6 | 7 | 8 | 9 | 30 |
| Staff | 1 | 1 | 1 | 1 | 4 |
| Students | 0 | 174 | 191 | 215 | 580 |
| Total | 7 | 182 | 200 | 225 | 614 |

D. Data Collection Techniques

Data collection techniques in this research use the following methods:

1. Questionnaire

The questionnaire method is a method of collecting primary data conducted at the research location by giving questions to respondents in accordance with the criteria.

2. Interview

The interview method was conducted with the aim of obtaining information directly from respondents by conducting in-depth direct question and answer using interview guides.

IV. RESULTS AND DISCUSSION

Data collection

Respondents taken in this study were students, teachers, and staff who attend school and work in the Madani Integrated Model Education Area in Palu City. From this location, which is used as the object of research with a total of 614 respondents, all of whom have filled out the questionnaire. Furthermore, the questionnaires that have been answered in full by the respondents will be processed so that they can be analyzed the pull and load model in the Integrated Model Educational Area of Madani in Palu City.

Travel Attraction

The total trip attraction for each educational stratum cannot be analyzed by modeling it separately, because the amount of data in some strata is too small so that significant modeling is not obtained, therefore only the attraction model for the total trip (all educational strata) will be analyzed next. The total number of trips as the dependent variable is estimated to be influenced by the distance traveled, travel time, the way to and from it, the choice of mode, the availability of parking space, and congestion characteristics.

Correlation Analysis

Correlation testing using SPSS software produces a correlation coefficient between the dependent variable and the independent variable and the correlation coefficient between the independent variables. The resulting correlation coefficient illustrates a fairly strong relationship between variables, namely between 0.073-0.692. The smallest correlation value between the dependent variable and the independent variable is 0.073, which is the correlation between travel attractions and the level of congestion. A correlation with low scores (either positive or negative) indicates a low or weak relationship. One reason for the attraction of travel is not due to the availability of parking spaces, but there are other things that stimulate the trip. The biggest correlation coefficient between the dependent variable and the independent variable is the correlation between the distance traveled and the short time that is 0.742.

Analysis of Regression Equations

Determination of the model using the regression equation with the help of the SPSS program with the stepwise method. The stepwise method selects and excludes independent variables that have a strong significance value. This method produces an alternative model as follows:

1. $Y = 12,112 + 1,601 x_2$
2. $Y = 9,083 + 1.467x_2 + 1.199x_6$
3. $Y = 5,984 + 1,643x_2 + 0.891x_3 + 1,140x_6$
4. $Y = 4.404 + 0.954x_1 + 1.014x_2 + 1.060x_3 + 1.165x_6$
5. $Y = 2.842 + 1.010x_1 + 0.988x_2 + 1.113x_3 + 0.987x_5 + 1.025x_6$

The model used has one constant and several independent variables. This makes sense and is a good model alternative. Regression analysis produces several models. The independent variables that do not appear in these models are $x_4 - x_{13}$. This is because the variable ($x_4 - x_{13}$) does not have a strong influence on the attraction of the vehicle trip, it can be seen from the absence of the coefficient of ($x_4 - x_{13}$) in the model analysis.

Coefficient of Determination (R^2)

The SPSS output table Model Summary of the first linear regression equation produces a coefficient of determination of 0.551, which means that the independent variable, namely the time variable, explains the dependent variable in the form of vehicle travel attraction in the Education Area of 55.1%, while the rest is explained by other independent variables.

TABLE III - Coefficient of Determination

| No. | Model | R^2 |
|-----|--|-------|
| 1 | $Y = 12.112 + 1.601 x_2$ | 0.551 |
| 2 | $Y = 9.083 + 1.467x_2 + 1.199x_6$ | 0.726 |
| 3 | $Y = 5.984 + 1.643x_2 + 0.891x_3 + 1.140x_6$ | 0.827 |
| 4 | $Y = 4.404 + 0.954x_1 + 1.014x_2 + 1.060x_3 + 1.165x_6$ | 0.925 |
| 5 | $Y = 2.842 + 1.010x_1 + 0.988x_2 + 1.113x_3 + 0.987x_5 + 1.025x_6$ | 0.964 |

The percentage of 55.1% shows a big influence. The magnitude of the influence of the independent variables on changes in the value of the dependent variable, the resulting regression equation is good for estimating the value of the dependent variable.

Significance Test

The results of the SPSS calculation of the Coefficients table for each Education Area. The variable that has the highest significance value is the regression constant $Y = 12.112 + 1.601 x_2$, while the one with the lowest significance value is the equation $Y = 2.842 + 0.988x_2 + 1.025x_6 + 1.113x_3 + 1.010x_1 + 0.987x_5$.

Analysis of Variance (F-Test / Anova)

The following table shows the value of the analysis of the variance of the SPSS calculation results in the Analysis of Variance table for each Educational Area.

The equation $Y = 2.842 + 1.010x_1 + 0.988x_2 + 1.113x_3 + 0.987x_5 + 1.025x_6$ is the equation that has the highest F value, namely 3287.77. The equation that has the lowest F value is $Y = 50,775 + 1,797 X_1 + 0.019 X_3 - 0.053 X_5 + 0.010 X_6$ of 749,969.

TABLE IV- Anova Test Results

| Model | Analysis | Sum of Squares | df | Mean Square | F | Sig. |
|-------|------------|----------------|-----|-------------|----------|-------|
| 1 | Regression | 2702.831 | 1 | 2702.831 | 749.969 | 0.000 |
| | Residual | 2205.601 | 612 | 3.604 | | |
| | Total | 4908.432 | 613 | | | |
| 2 | Regression | 3564.181 | 2 | 1782.090 | 810.010 | 0.000 |
| | Residual | 1344.251 | 611 | 2.200 | | |
| | Total | 4908.432 | 613 | | | |
| 3 | Regression | 4061.521 | 3 | 1353.840 | 975.124 | 0.000 |
| | Residual | 846.910 | 610 | 1.388 | | |
| | Total | 4908.432 | 613 | | | |
| 4 | Regression | 4541.655 | 4 | 1135.414 | 1885.252 | 0.000 |
| | Residual | 366.777 | 609 | 0.602 | | |
| | Total | 4908.432 | 613 | | | |
| 5 | Regression | 4733.340 | 5 | 946.668 | 3287.277 | 0.000 |
| | Residual | 175.091 | 608 | 0.288 | | |
| | Total | 4908.432 | 613 | | | |

Linearity Test

The linearity test aims to test the linearity of the relationship between two variables. This test can be done by making a residual plot of the predicted prices. If the graph between the predicted prices and the residual prices does not form a pattern (parabolic, cubic, or other) then the assumption is fulfilled. This is indicated by the residuals that are randomly distributed and accumulated around the straight line through the zero points (0).

Homoscedasticity Test

One of the classical assumptions is homoscedasticity or non-heteroscedasticity, namely the assumption that the variance of each remainder is still the same for both small and large independent variables. One way to test for variance similarity is by looking at the residual spread pattern of the estimated Y value. If the residual spread is random (does not form a certain pattern), it is said that the residual variance is homogeneous.

Nonmulticollinearity Test

The non-multicollinearity test can detect multicollinearity by looking at the high R2 value and the strong correlation coefficient between independent variables. The basis for decision making in this multicollinearity test can be done by looking at the Tolerance and VIF values. Based on the results of the SPSS analysis, it is known that the Tolerance value for the distance variable (x_1), the time variable (x_2), the way to and return variable (x_3), the mode choice variable (x_4), the parking space availability variable (x_5) and the congestion variable (x_6) respectively -The sequence is 0.495, 0.508, 0.881, 0.966, 0.936 and 0.925 are greater than 0.10. Meanwhile, the VIF value for the distance variable (x_1), the time variable (x_2), the way to and return variable (x_3), the mode choice variable (x_4), the parking space availability variable (x_5) and the congestion variable (x_6) are respectively 2,022, 1,969, 1,134, 1,036, 1,069 and 1,081 < 10.0. Then it refers to the basis for decision making in the non-multicollinearity test.

Best Model Selection

Selection of the model through the conclusions that resulted from several criteria including Pass the highest regression constant test, Pass the linearity test for the relationship of two variables. There is homoscedasticity, which means that the assumptions are fulfilled. Has the smallest Tolerance Value on multicollinearity testing. Recapitulation of regression equation analysis and testing produces the best models, namely:

$$Y = 12,112 + 1,601 x_2$$

Information:

Y = The attraction of the vehicle trip

x_2 = Travel time

The model was obtained through SPSS 26 using the stepwise method. This model is the best model than other models because it is significant in the regression equation analysis testing stage and the fulfillment of assumptions at the model testing stage.

V. CONCLUSIONS

Some of the factors that influence the travel attraction in the Civil Education Area in Palu City are independent variables, namely the distance variable (x_1), the time variable (x_2), the way to and return variable (x_3), the mode choice variable (x_4), the place availability variable. parking (x_5) and congestion variable (x_6).

All independent variables have an influence both on the attraction of the trip and between the independent variables. The best model for the attraction of travel movements in the Civic Education Area in Palu City is $Y = 12,112 + 1,601x_2$, where Y is the attraction of the vehicle trip and x_2 is the Time Variable. The resulting model in the PaluMadani Integrated Model Education Area has several characteristics are contributing to Jl. Soekarno Hatta at 65%; the constant value of 12,112 is a large constant value while the multiplier for the independent variable is small. The magnitude of the constant and the small multiplier of the independent variables indicate that there are other independent variables that have a strong influence on the attraction of travel in the Educational Area in Palu City; the model has a positive sign which indicates that the greater the value of the independent variable (travel time), the greater the travel attraction and this model shows that the factor affecting the attraction of trips in the Educational Area in Palu City is the variable travel time.

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