Research Article

# Traffic Generation in Surapati Gasibu Bandung City

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**Abstract.**
Based on the data from the Bandung City Central Statistics Agency in 2020, population growth has been increased by 0.49%. The use of private vehicles, certainly affects the growth of traffic movements, especially at the Surapati Gasibu Intersection, Bandung City. To find out the traffic flow that passes through Surapati Street, a study was carried out using a movement generation model. The generation model uses the multiple regression analysis methods with the generated variable being the number of vehicles (Y) and the variables that influence it are the population (X1), the number of domestic tourists (X2), and the value of gross regional domestic income (X3) in Bandung. The data was obtained through the publication of the Bandung City BPS from 2012 to 2021 (10 years). Using the data analyst feature in Microsoft Excel, the regression equation is found to be Y = -7,003,565.898 + 3.213 X1 + 0.142 X2 and the growth value of traffic movement is at 2.39% per year. It means in 30 years the average traffic will grow by 20% and need a renewal intersection.

**Keywords:** traffic, generation, Surapati Gasibu, Bandung

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## 1. INTRODUCTION

According to data from the Central Statistics Agency for the City of Bandung in 2020 population growth increased by 0.49%. In addition to the population, the number of domestic tourists also increased by 0.98%. With the increasing tourists and population of the city of Bandung, it must be balanced with the development of transportation infrastructure, especially roads [1]. To find out the projected growth of a segment, multiple regression can be used [2]. This regression involves various variables that are considered to have an effect on traffic growth at the intersection.

Many researchers have conducted traffic generation modelling using regression models. Traffic model forecasts can use multiple regression analysis methods [3]. This method can provide high accuracy because it involves several variables. Similar to

the research before, the estimation of traffic movement can be measured by multiple regression methods [4].

The purpose of this study was to determine the model of traffic flow generation through the Surapati intersection, Bandung City. It is hoped that the writing of this article can be useful for planning solutions to congestion at the Gasibu intersection in the future.

Traffic growth is the number of vehicles using the road from year to year which is influenced by regional developments, increasing community welfare, and increasing the ability to buy vehicles [5]. In designing an intersection or road for the short, medium, and long term, current traffic data needs to be projected into a traffic hour plan. This projection is a mathematical calculation that can provide the volume of planning hours. The formula was formulated with the equation:

$$PHV = \frac{(1+i)^n \ x \ AADT \ x \ K}{F}$$

## 2. RESEARCH METHOD

The method of writing is a scientific method of data collection with a specific purpose and use [6]. In this paper, the method of obtaining writing that will be used is descriptive quantitative. Writing is done by analyzing the data from the field and related agencies and then regressed using Data Analyst in Microsoft Excel.

The research location is on Surapati Street, Citarum, Bandung City. The area studied specifically at the intersection of Surapati – Majapahit, Surapati – Wirayuda Timur, and Surapati – Sentot Alibasyah. This year's Annual average daily traffic (AADT) growth analysis is planned to use multiple regression equations with several variables [7]. The variables taken are sourced from BPS data from the City of Bandung. The method of this research is presented in Fig. 1.

### 2.1. Traffic Data

Traffic data is taken using video recordings from the air to make vehicle calculations more accurate and able to calculate vehicle movements in one cycle. Later the recording is played back to be calculated manually. To facilitate the calculation, sketch the traffic flow as shown in Fig. 2. The survey was conducted at peak hours in the Gasibu area, precisely on Surapati Street, Majapahit Street, Sentot Alibasyah Street, and Wirayuda Timur Street. The calculation result is presented in Table 1.

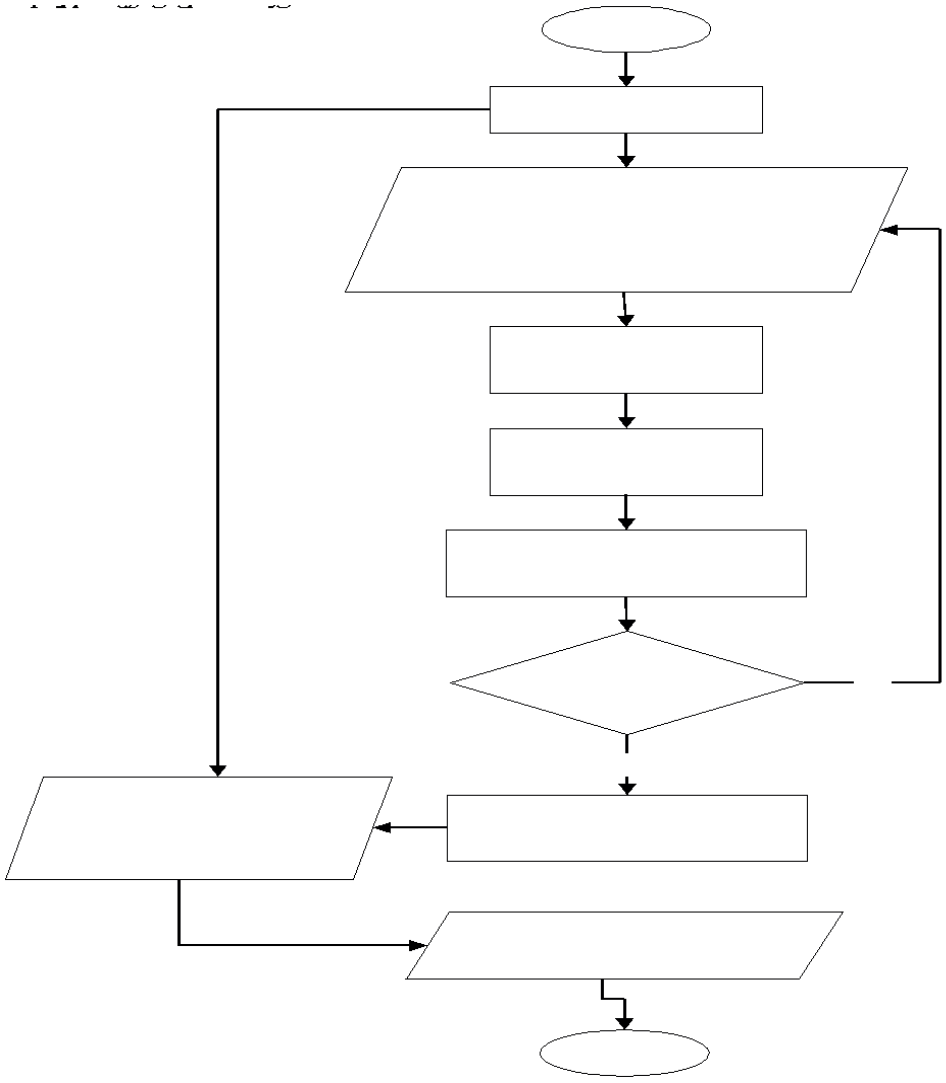

**Figure** 1: Flow chart.

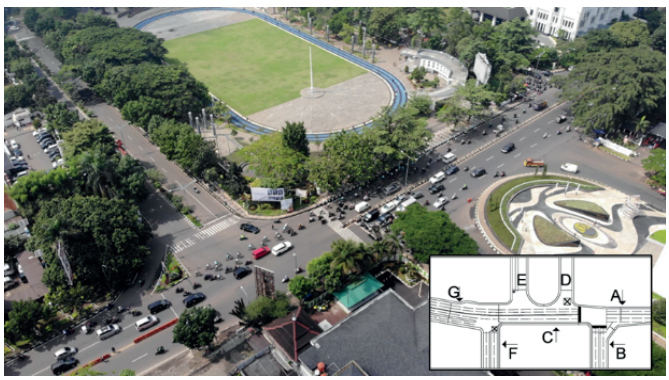


**Figure** 2: Traffic flow sketch.

Table 1: 2021 Annual average daily traffic.

| Direction | Vehicle/hour | | | | | | |
|---|---|---|---|---|---|---|---|
| | A-C | A-B | B-C | E-B | E-A | G-B | G-A |
| LV | 637 | 150 | 385 | 262 | 116 | 1091 | 669 |
| HV | 37 | 3 | 10 | 2 | 4 | 29 | 47 |
| MC | 2.542 | 562 | 620 | 762 | 347 | 2.102 | 2.268 |
| UM | 1 | 4 | 0 | 4 | 2 | 1 | 1 |

## 2.2. Socioeconomic Data

Socio-Economic data was obtained through the publication of the Central Statistics Agency from 2011 to 2020 (the last 10 years) [8]. The data was taken in the form of population, the number of vehicles, Gross regional domestic product (GRDP), and the number of domestic tourists. Some of these variables are considered supportive to determine the projected traffic growth. The data recapitulation is presented in Table 2.

Table 2: Socioeconomic data.

| No | Year | Number of vehicles (Y) | Population (X1) | Domestic tourists (X2) | GRDP (X3) |
|---|---|---|---|---|---|
| | | Unit | Person | Person | Million Rupiah |
| 1 | 2011 | 1,252,230 | 2,424,957 | 3,024,666 | 95,612,863 |
| 2 | 2012 | 1,355,815 | 2,455,517 | 3,882,010 | 111,121,551 |
| 3 | 2013 | 1,443,217 | 2,483,977 | 3,354,857 | 130,209,649 |
| 4 | 2014 | 1,443,217 | 2,470,802 | 3,726,447 | 172,629,382 |
| 5 | 2015 | 1,617,022 | 2,481,469 | 4,242,294 | 195,844,956 |
| 6 | 2016 | 1,716,698 | 2,490,622 | 4,827,589 | 216,863,639 |
| 7 | 2017 | 1,811,498 | 2,497,938 | 4,889,682 | 240,109,626 |
| 8 | 2018 | 1,738,672 | 2,503,708 | 5,188,741 | 264,551,902 |
| 9 | 2019 | 1,747,255 | 2,507,888 | 5,239,509 | 288,460,880 |
| 10 | 2020 | 1,571,795 | 2,444,160 | - | 283,616,640 |

The 10-year data will later be processed to determine the value of traffic growth through the Gasibu area. However, in 2020 there is a data defect that may be a result of the Covid-19 pandemic, so the data for that year is not included in the data processing. In this study, the number of vehicles will be the dependent variable, this dependent variable will be used as a generation. Meanwhile, the independent variables are the population, GRDP, and the number of domestic tourists.

## 2.3. Linear Regression Method

Regression is a mathematical equation that allows forecasting the values of a dependent variable from one or more independent variables [9]. The equation is formulated as follows:

$$Y = A + BX$$

## 2.4. Multiple Regression Method

Multiple regression has the same definition as linear regression, namely to forecast an equation value, but multiple regression can involve more than two variables [9]. The multiple regression equation is formulated in the:

$$Y = A + B_1X_1 + B_2X_2 + \cdots + B_nX_n$$

## 2.5. Correlation Coefficient

The correlation coefficient is a quantity that shows the high degree of relationship between the independent variable X and the dependent variable Y in the observed regression model [10]. The equation to calculate the correlation is:

$$r = \frac{n\Sigma XY - \Sigma X\Sigma Y}{\sqrt{n\Sigma X^2-(\Sigma X)^2}\sqrt{n\Sigma Y^2-(\Sigma Y)^2}}$$

TABLE 3: Correlation coefficient.

| R | Interpretation |
|---|---|
| 0.00 – 0.19 | Very weak |
| 0.20 – 0.39 | Weak |
| 0.40 – 0.59 | Medium |
| 0.60 – 0.79 | Strong |
| 0.80 – 1.00 | Very strong |

## 2.6. Determination Coefficient ($R^2$)

The coefficient of determination is a coefficient that states the percentage of deviation (diversity) of the dependent variable Y that can be explained by the independent variable X in the regression model being discussed [10]. The coefficient of determination is formulated as follows:

$$R^2 = 1 - \frac{\Sigma(Y_i-Y)^2}{\Sigma(Y_i-\underline{Y})^2}$$

## 3. RESULTS AND DISCUSSION

The vehicle growth rate in this study is used as a prediction of traffic flow growth in the planned year. In this study, a 30-year long-term evaluation plan is set, so that the growth value for 30 years is sought from 2021 to 2051 using multiple regression modeling. Multiple regression analysis using the help of a data analyst found in Microsoft Excel. To find out the relationship between variables, a correlation test was carried out using the help of a data analyst in Microsoft Excel. The independent variable must meet the requirements of having a high correlation value against the generation variable, but not highly correlated with other independent variables [10].

TABLE 4: Correlation matrix between variables.

| No | Variables | Y | X1 | X2 | X3 |
|---|---|---|---|---|---|
| 1 | Generation | 1.000 | | | |
| 2 | Population | 0.911 | 1.000 | | |
| 3 | Domestic Tourist | 0.935 | 0.849 | 1.000 | |
| 4 | GRDP | 0.939 | 0.888 | 0.945 | 1.000 |

From the matrix in Table 4, it can be concluded that the correlation between variables is of high value to be used for data analysis. Furthermore, multiple regression tests were carried out for all variables. Multiple regression was carried out using a data analyst with the Y variable being the number of vehicles, the X1 variable being the population, X2 domestic tourists, and X3 GRDP. The regression equation obtained is Y = -5583821.425 + 2.657 X1 + 0.101 X2 + 0.001 X3 with a magnitude of $R^2$ = 0.885. The t stat for each variable is as follows, t X1 = 1.332; t X2 = 1.117; t X3 = 0.566. Because the value of t stat X3 < 1, is considered to have no effect, then the regression is carried out again without including the X3 variable.

TABLE 5: Regression statistics Y, X1, X2, and X3.

| Regression Statistics | |
|---|---|
| Multiple R | 0.963 |
| R Square | 0.928 |
| Adjusted R Square | 0.885 |
| Standard Error | 68024.850 |
| Observations | 9.000 |

Multiple regression was carried out by excluding the X3 variable, the result of the equation Y = -7003565.898 + 3.213 X1 + 0.142 X2 with a magnitude of $R^2$ = 0.898. This means that without including the X3 variable (GRDP) the value of $R^2$ becomes larger

Table 6: Results Y, X1, X2, and X3.

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | -5583821.425 | 4808072.140 | -1.161 | 0.298 |
| X1 | 2.657 | 1.994 | 1.332 | 0.240 |
| X2 | 0.101 | 0.091 | 1.117 | 0.315 |
| X3 | 0.001 | 0.001 | 0.566 | 0.596 |

and highly correlated. This equation is used to project the number of vehicles in the plan year. The value of t in both variables is still > 1 so the equation can be used [11].

Table 7: Regression statistics Y, X1, and X2.

| Regression Statistics | |
|---|---|
| Multiple R | 0.961 |
| R Square | 0.923 |
| Adjusted R Square | 0.898 |
| Standard Error | 64,056.948 |
| Observations | 9.000 |

Table 8: Results Y, X1, and X2.

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | -7003565.898 | 3862851.075 | -1.813 | 0.120 |
| X1 | 3.213 | 1.634 | 1.967 | 0.097 |
| X2 | 0.142 | 0.053 | 2.699 | 0.036 |

The results of the ANOVA test on the multiple regression equation are presented in the Table 9. Significance F value < alpha (0.05) and calculated F value > F table means that the resulting model is very significant.

Table 9: The results of ANOVA regression equations Y, X1, and X2.

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 2.00 | 2.963E+11 | 1.482E+11 | 36.105 | 4.515E-04 |
| Residual | 6.00 | 2.462E+10 | 4.103E+09 | | |
| Total | 8.00 | 3.209E+11 | | | |

To find out the number of vehicles in 2051, it is necessary to know in advance the projected number of residents and domestic tourists in 2051. To find out, a simple regression analysis is carried out for each variable. The equation for the population is Y = -15119323.306 + 8733.983 X and for domestic tourists is Y = -564985500.276 + 282505.944 X. By entering the value of X into 2021 (year survey) and 2051 (year plan), a large number of residents and tourists are presented in Table 10.

TABLE 10: Generation results for X1 and X2.

| No | Year | Y | X1 | X2 |
|---|---|---|---|---|
| 1 | 2021 | 1978462 | 2532057 | 5,959,013 |
| 2 | 2051 | 4023204 | 2794077 | 14434191 |

After obtaining the magnitudes of the variables X1 and X2 in the survey and planned years, the magnitudes of Y are obtained in 2021 and 2051 using the equation Y = -7003565.898 + 3.2133 X1 + 0.1419 X2. The magnitude of Y (the number of vehicles) in 2021 is 1978462 units and in 2051 is 4023204 units. To find out the value of the amount of growth used the formula:

$$i = \sqrt[n]{\frac{Pn}{P0}} - 1$$

It is found that the growth rate is,

$$i = \sqrt[30]{\frac{4023204}{1978462}} - 1 = 2.39\ \%(7)$$

The results of the projected traffic flow on each arm for the year 2051 obtained through the equation formulated by Iskandar[4], with K = 0.50 and F = 0.85, are presented in Table 11.

TABLE 11: 2051 Annual average daily traffic.

| Direction | Vehicle/hour | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A-C | A-B | B-C | F-G | E-B | E-A | G-B | G-A |
| LV | 761 | 179 | 460 | 1188 | 313 | 138 | 1305 | 800 |
| HV | 44 | 3 | 11 | 25 | 2 | 4 | 34 | 56 |
| MC | 3040 | 672 | 741 | 2026 | 911 | 415 | 2514 | 2712 |
| UM | 1 | 4 | 0 | 0 | 4 | 2 | 1 | 1 |

## 4. CONCLUSION

The generation model of the movement of traffic flows through the Simpang Gasibu in Bandung City is Y = -7,003,565.898 + 3.213 X1 + 0.142 X2 with an $R^2$ value of 0.898. Traffic flow growth is at a value of 2.39%. Based on this study, it was found that traffic development in the Gasibu area will increase by 20% in the next 30 years. The results of this study are expected to be a reference in planning and improving the Gasibu intersection.

With the limited time of the study, the data obtained were also limited. So it is hoped that similar research can improve the quality and quantity of research data to have a high level of accuracy.

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