Analysis of Trip Generation and Attraction Model in South Tangerang City

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Article Info

Article history:

Submitted September 2, 2024
Reviewed September 12 , 2024
Published October 30, 2024

Keywords:

trip generation-attraction, linear regression, stepwise method type 1

ABSTRACT

South Tangerang City encounters a significant increase of population every year, due to the rapid development of South Tangerang City. The increase in population causes a high demand for housing, jobs, and more. These needs cause many land uses changing function. Land use change must be accompanied by transportation planning so it does not cause traffic problems like congestion. The generation model is the early stage of urban transportation planning, the modelling of trip generation and attraction in South Tangerang City is carried out to find out the factors causing the trip generation and attraction in this city and to gain the best model. The parameters of the model is the land use in the city that was received from the government of South Tangerang City. The analysis was made in stages starting from validity and reliability test, correlation test, linearity test, and the final one is multiple linear regression test with stepwise method type 1. Based on the analysis result, the factor that has the greatest influence on trip generation in South Tangerang City is number of primary educational facilities (elementary school, islamic elementary school, junior high school, and islamic junior high school) (X_3) with the selected model is Y_1 = 1129,265 + (383,198) X_3 and the value of R^2 = 0,809. Furthermore, the factor that has the greatest influence on trip attraction in South Tangerang City is number of hospitals (X6) with the selected model is Y_2 = 69668,640 – (3372,120) X_6 and the value of R^2 = 0,826.

Available online at http://dx.doi.org/10.36055/fondasi

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1. INTRODUCTION

One of the major projects in Indonesia today is the development of Special Economic Zones, one of them built in BSD which is an independent city that located in Tangerang Regency and South Tangerang City. The development of the BSD special economic zone, which takes up the land area of 59.68 ha, has also been selected as one of the National Strategic Projects that will be prioritized in the development process. The massive construction and development in South Tangerang City is one of the reasons why BSD was chosen as a special economic zone in the fields of health, education and technology.

South Tangerang City is the youngest city in Banten Province, but the economic growth rate of this city is very rapid. Several advances in the Orchid City have attracted commuter workers to live and work in South Tangerang City. This can be seen from the significant increase in population in South Tangerang

City every year. The increase in population causes the demand for city facilities to increase. It is not surprising that many rice fields and plantations in South Tangerang City have been converted into residential areas or trade and service areas. However, the diversion of land use functions in this city is not balanced with a good transportation movement system, resulting in severe congestion points in several areas and gaps in good transportation facilities and infrastructure.

The urban transportation system is a process that needs to be planned in an effort to provide urban transportation that can be used by man and material to move places safely, comfortably, and quickly [1]. The transportation planning process is dynamic and must be responsive to changes in land use, economic conditions, and traffic flow patterns [2]. Urban transportation planning is popularly known for its concept of four stages of modeling with trip generation being the first stage. After movement generation, there are stages of movement distribution, route selection, and mode selection [2].

The concept of the trip generation stage is to obtain a model that is able to predict the movements that will occur and to determine the level of correlation between land use and traffic patterns [2]. The modeling of trip generation and attraction in South Tangerang City was analyzed to obtain a model of the movement that occurs and to identify the factors that have the greatest influence on the trip in this city. Land use is characterized by its ability to generate traffic movements [3]. Each land use will generate different movements because it has various socio-economic characteristics depending on the activities that can be carried out on the land use such as work, school, shopping, recreation and others.

Trip generation is the trip that comes from a zone, while trip attraction is the trip that goes to a zone. Some factors that can be considered for movement generation are income, household size and structure, and also land value, while factors that can be considered for movement attraction are industrial and office land area [2]. The generation model predicts the trips that will be made by each person in each land use by including several parameters that are able to cause such trips, such as socio-economic attributes and land use functions.

Based on research [4] several factors that influence the generation and attraction of home-based movements in Ratahan District are the number of family members, vehicle ownership, and income. The education area is one of the land uses that generate considerable traffic movements as in research [5] which explains that the number of classrooms and the amount of pocket money affect the generation in the education area on Jalan Cendana - Jalan Ir. H. Juanda Bandarlampung City, and the number of tendik teachers and the amount of pocket money are factors that affect the movement pull in the area. The largest increment is generated in residential areas as in research [6] located on Jalan Urip Sumaharjo Bandarlampung City produces a model that explains that the number of family members, travel time, and car vehicle ownership are factors that influence the generation of movement. In research [7] the number of family members, the number of family members who work, the last education, the number of vehicle ownership, and the amount of income are factors that influence the generation of movement in Turminting District. In research [8] several models were produced based on vehicles heading to SMAN 1 Taman and SMPN 2 Taman Sidoarjo Regency, such as motorcycles, shuttles, and public transportation, then the best model was obtained to forecast traffic movements around the two schools was the motorcycle model.

2. METHODS

2.1 Research Sites

The research was located in South Tangerang City, Banten Province, Indonesia. The movements being analyzed in this research include movements between sub-districts in South Tangerang City which is divided into 7 (seven) sub-districts, namely:

1. Setu
2. Ciputat
3. Ciputat Timur
4. Pamulang

5. Pondok Aren
6. Serpong
7. Serpong Utara

The trips to other cities or from other cities will not be included in the model analysis in this research. The map of South Tangerang City can be seen in figure 1.

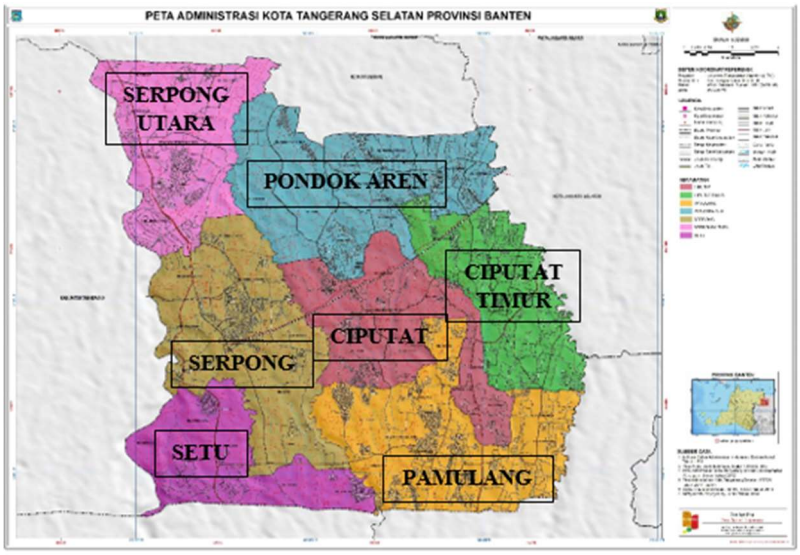

Figure 1. Map of South Tangerang City

2.2 Stage of Research

In the model of trip generation and attraction in this research used multiple linear regression analysis method with step-by-step method type 1. Multiple linear regression analysis has several mathematical terms, so there are several tests that will be carried out before the regression analysis. Before entering into the test, the preliminary stage is to determine the socio-economic parameters that will become independent variables. Independent variables are parameters that can influence the dependent variable or can also be said to be the variable that causes the appearance of the dependent variable. The dependent variables in this research are trip generation (Y_1) and trip attraction (Y_2) which are obtained from the Origin-Destination (OD) Matrix received from the Banten Provincial Department of Transportation. Meanwhile, there are 20 (twenty) candidates for the independent variable (X) in this research.

The method for determining the independent variables is based on the superior sectors in South Tangerang City and the availability of data from relevant government departments. The sources of data in this research were obtained from several agencies such as the Banten Provincial Department of Transportation, Banten Provincial Department of Highways, South Tangerang City Central Bureau of Statistics, South Tangerang City Department of Tourism, South Tangerang City Department of Public Housing, South Tangerang City Department of Settlement and Land, and One-stop Administration Services Office of South Tangerang City. After receiving several parameters that will be used as independent variables, several tests will be conducted to eliminate any variable that cannot be included in the model because it does not qualify for multiple linear regression analysis using the step-by-step type 1 method. Some of the tests carried out before the regression analysis stage are validity and reliability tests, correlation coefficient analysis, and linearity tests. All testing stages will use the help of the SPSS (Statistical Product and Service).

After the validity and reliability tests, correlation coefficient analysis, and linearity test are completed, there will be selected independent variables that can be included in the model. These variables will be the factors that influence the generation and/or attraction of trips in South Tangerang City. The multiple linear regression analysis in this research uses the step-by-step (stepwise) method type 1, which means

that the analysis will be carried out in steps while removing the independent variables one by one that have the lowest correlation to the dependent variable at each stage until there is only one independent variable left. Then a review will be made for each stage of the analysis on several values such as the coefficient of determination, regression constant, and regression coefficient to determine the best model.

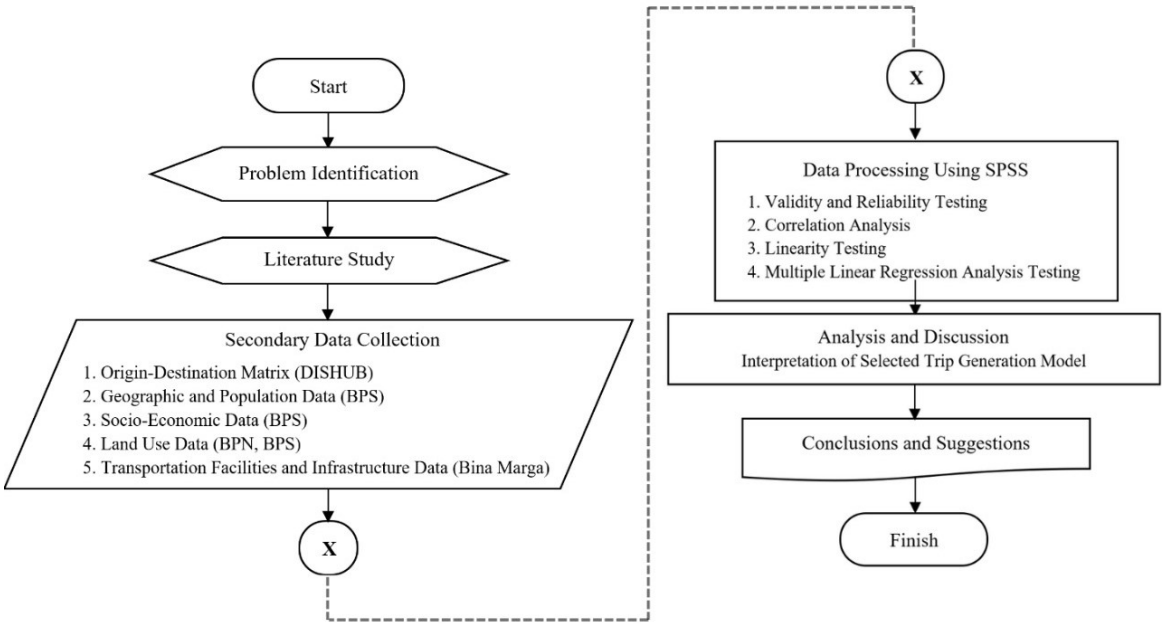

Figure 2. Research Flow Chart

3. RESULTS AND DISCUSSION

Trip generation modelling will contribute to the planning of land use in the future because it is closely related to human activities in a particular area [9]. Therefore, the candidate of independent variables that will be inserted into the model are the various types of land use in South Tangerang City such as schools, hospitals, hotels, and many others that have the possibility to generate movements. The total manpower is also one of the candidate independent variables in this research because manpower absorption is one of the socioeconomic factors that can influence movement in an area. In addition, household socioeconomic factors such as vehicle ownership and accessibility are also candidates for independent variables because they can affect movement from home [2]. The research [10] shows that the most influential factors on trip generation in the residential area of Griya Taman Asri Soragan Yogyakarta are 4-wheeled vehicle ownership and the number of working family members. The dependent variable in this research, namely the generation and attraction of movement, is the number of trips that occur between sub-districts in South Tangerang City. The movement data was gotten from the Banten Provincial Department of Transportation in the form of an origin-destination matrix.

The model produced must be able to describe the facts that exist in South Tangerang City. Thus, the instruments that will be included in the model need to be tested for validity first. In the stepwise method type 1 multiple linear regression analysis method, the mathematical term that needs to be considered is that the value of the correlation coefficient between independent variables should not have a high correlation. Therefore, correlation testing is needed to see the correlation among the independent variables and to see the correlation between the independent variables and the dependent variable. Furthermore, to get a model that fully qualifies the BLUE (Best Linear Unbiased Estimation) criteria, it is necessary to do a linearity test. After obtaining several selected independent variables that pass the previous tests, then the multiple linear regression analysis stage using the stepwise method type 1 can proceed. The model is a mathematical equation and there are 2 (two) models, which are the trip generation model (Y_1) and the trip attraction model (Y_2). There are 20 candidate independent variables in this research.

Table 1. Value of Variables

No	Variables	Variable Para-meters	Sub-district						
			Setu	Serpong	Pamulang	Ciputat	Ciputat Timur	Pondok Aren	Serpong Utara
1	Number of Trip Generation	Y_1	10466	40837	65600	41675	31828	49352	19525
2	Number of Trip Attraction	Y_2	55610	21049	19025	26242	44518	11011	43828
3	Area (hectare)	X_1	1480.00	2404.00	3182.00	2338.00	2043.00	3488.00	2284.00
4	Number of Population	X_2	89825	191968	359810	245727	215186	405316	188476
5	Number of Primary Education Facilities (Elementary - Middle School)	X_3	32	107	135	114	62	150	56
6	Number of Higher Education Facilities (High School)	X_4	10	38	43	33	24	48	28
7	Number of University Education Facilities	X_5	1	4	6	5	2	7	1
8	Number of Hospitals	X_6	0	14	14	11	11	17	9
9	Number of Hotels	X_7	2	11	11	11	12	31	11
10	Number of Recreation Areas	X_8	5	15	17	11	10	24	14
11	Number of Restaurants	X_9	299	956	976	707	597	1736	831
12	Number of Supermarkets	X_{10}	29	63	110	86	72	98	89
13	Number of Worship Facilities	X_{11}	146	222	413	307	235	392	197
14	Number of Cooperatives	X_{12}	22	64	128	134	45	115	46
15	Total Manpower	X_{13}	61225	131153	254502	171625	155605	283883	128428
16	Area of Rice Fields (hectare)	X_{14}	23.43	29.87	34.24	39.79	36.49	91.67	33.53
17	Area of Plantation (hectare)	X_{15}	66.74	411.84	443.83	655.75	388.61	634.98	311.92
18	Area of Industrial and Office (hectare)	X_{16}	26.32	38.48	36.72	45.18	31.61	55.61	31.45
19	Number of Residental Areas	X_{17}	110	1365	1992	1785	1325	2219	1146
20	Number of Two-Wheeled Motorized Vehicles	X_{18}	65253	35069	65420	128497	105670	184050	43005
21	Number of Four-Wheeled Motorized Vehicles	X_{19}	33466	7582	21745	36143	21494	120828	35631
22	Length of Road (km)	X_{20}	24.017	52.121	85.653	56.245	59.095	96.203	32.330

Based on the data that can be seen in Table 1, Pamulang has the highest total amount of generation among other sub-districts, while the highest total amount of attraction is Serpong. This is due to the fact that Pamulang has many residential areas, the land use that generates the most movement is residential areas [2]. Serpong has a variety of culinary and recreational places and also comprehensive shopping centers, so that many people travel and are attracted to Serpong.

3.1 Validity and Reliability Test

The variable declared valid if it has the value of r_{count} which is higher than the value of r_{table} that is obtained from the normal distribution table [11]. The value of r_{count} is obtained from the output results from SPSS. The data shown in the research must be valid, which can measure what should be measured [12]. The result of the validity test can be seen in Table 2.

Table 2. Result of Validity Test

Variables		r_{count}	r_{table}	Declaration
X_1	Area (hectare)	0.905	0.754	Valid
X_2	Number of Population	0.964	0.754	Valid
X_3	Number of Primary Education Facilities	0.843	0.754	Valid
X_4	Number of Higher Education Facilities	0.807	0.754	Valid
X_5	Number of University Education Facilities	0.860	0.754	Valid
X_6	Number of Hospitals	0.790	0.754	Valid
X_7	Number of Hotels	0.890	0.754	Valid
X_8	Number of Recreation Areas	0.841	0.754	Valid
X_9	Number of Restaurants	0.858	0.754	Valid
X_{10}	Number of Supermarkets	0.757	0.754	Valid
X_{11}	Number of Worship Facilities	0.908	0.754	Valid
X_{12}	Number of Cooperatives	0.765	0.754	Valid

Variables		r_{count}	r_{table}	Declaration
X_{13}	Total Manpower	0.964	0.754	Valid
X_{14}	Area of Rice Fields (hectare)	0.886	0.754	Valid
X_{15}	Area of Plantation (hectare)	0.780	0.754	Valid
X_{16}	Area of Industrial and Office (hectare)	0.858	0.754	Valid
X_{17}	Number of Residental Areas	0.872	0.754	Valid
X_{18}	Number of 2-Wheeled Motorized Vehicles	0.794	0.754	Valid
X_{19}	Number of 4-Wheeled Motorized Vehicles	0.764	0.754	Valid
X_{20}	Length of Road (km)	0.933	0.754	Valid

After all variables have been declared valid, then the reliability test must be carried out to determine if the measuring instrument can be used repeatedly to measure the same object with the same results (consistent) [12]. An instrument can be labeled reliable if it has Cronbach's alpha value greater than 0.6 [13]. The Cronbach's alpha value is obtained from the output of the SPSS application. In Table 3, it can be seen that the result of the reliability test in this research has a Cronbach's alpha value on 0.709, this value is greater than 0.6 so it can be stated that the measuring instrument in this research is reliable. The result of the reliability test can be seen in Table 3.

Table 3. Result of Reliability Test

Cronbach's Alpha	N of items
0,709	22

3.2 Correlation Coefficient Analysis

The correlation value will be a reference at the stage of multiple linear regression analysis using the step-by-step (stepwise) method type 1, because the variable excluded from the model at each stage is the independent variable that has the lowest correlation value against the dependent variable. The result of the correlation coefficient analysis among the independent variables can be seen in Table 4.

Table 4. Correlation of Independent Variables

Variable	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20
X1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X2	0.849	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X3	0.901	0.900	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X4	0.772	0.718	0.913	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X5	0.559	0.470	0.590	0.685	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-
X6	0.853	0.861	0.898	0.897	0.651	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X7	0.734	0.811	0.710	0.606	0.093	0.797	1	-	-	-	-	-	-	-	-	-	-	-	-	-
X8	0.922	0.877	0.832	0.686	0.396	0.894	0.889	1	-	-	-	-	-	-	-	-	-	-	-	-
X9	0.898	0.849	0.814	0.682	0.276	0.864	0.943	0.983	1	-	-	-	-	-	-	-	-	-	-	-
X10	0.636	0.860	0.737	0.534	0.477	0.751	0.594	0.753	0.662	1	-	-	-	-	-	-	-	-	-	-
X11	0.77	0.960	0.841	0.641	0.548	0.751	0.630	0.737	0.682	0.838	1	-	-	-	-	-	-	-	-	-
X12	0.660	0.813	0.896	0.753	0.451	0.683	0.500	0.596	0.567	0.766	0.819	1	-	-	-	-	-	-	-	-
X13	0.835	0.999	0.892	0.714	0.476	0.856	0.804	0.863	0.834	0.857	0.965	0.809	1	-	-	-	-	-	-	-
X14	0.480	0.365	0.260	0.061	-0.239	0.367	0.756	0.695	0.715	0.385	0.155	0.067	0.339	1	-	-	-	-	-	-
X15	0.304	-0.173	0.219	0.432	0.384	0.162	-0.128	0.049	0.068	-0.349	-0.223	-0.005	-0.189	-0.107	1	-	-	-	-	-
X16	0.747	0.788	0.865	0.792	0.160	0.789	0.871	0.794	0.857	0.570	0.628	0.764	0.776	0.454	0.110	1	-	-	-	-
X17	0.765	0.930	0.920	0.830	0.552	0.925	0.756	0.829	0.790	0.896	0.862	0.866	0.928	0.299	-0.088	0.817	1	-	-	-
X18	-0.505	-0.127	-0.307	-0.405	-0.537	-0.247	-0.020	-0.195	-0.193	0.221	-0.173	-0.018	-0.125	0.179	-0.760	-0.062	0.006	1	-	-
X19	-0.556	-0.284	-0.430	-0.651	-0.731	-0.628	-0.303	-0.437	-0.414	-0.069	-0.229	-0.053	-0.285	0.009	-0.628	-0.233	-0.318	0.750	1	-
X20	0.838	0.966	0.899	0.796	0.562	0.878	0.781	0.817	0.800	0.743	0.942	0.768	0.971	0.199	-0.058	0.765	0.896	-0.291	-0.448	1

If in a model there are independent variables that are correlated (having a high correlation coefficient value), then the correlation between the independent variable and the dependent variable will be interrupted, this can be called a multicollinearity condition. Therefore, it is necessary to conduct a correlation analysis to see the strength of the relationship among the independent variables [13]. The correlation value can be considered low if it ranges from 0 - 0.399, can be considered moderate or sufficient if it ranges from 0.40 - 0.599, and can be considered high if it ranges from 0.60 – 1 [12]. In other words, some independent variables that are highly correlated with other independent variables will be eliminated.

The stage of eliminating independent variables is based on the correlation between the independent variables and the dependent variable. The independent variable that has the highest correlation value to the dependent variable will be included in the model, while other independent variables that correlate with that dependent variable will be eliminated and cannot be included in the model. The eliminating of the independent variables is analyzed separately for the generation and attraction models. The selected independent variables for the generation model can be seen in Table 5.

Table 5. Selected Independent Variables for Trip Generation Model

No		Variables	R
1	X_3	Number of Primary Education Facilities	0.917
2	X_5	Number of University Education Facilities	0.807
3	X_{10}	Number of Supermarkets	0.772
4	X_7	Number of Hotels	0.495
5	X_{19}	Number of Four-Wheeled Motorized Vehicles	-0.478
6	X_{18}	Number of Two-Wheeled Motorized Vehicles	-0.355

The minus sign (-) indicates the direction of the correlation is inversely proportional and has not affected the value of the correlation (R). The selected independent variables for the attraction model can be seen in Table 6.

Table 6. Selected Independent Variables for Trip Attraction Model

No		Variables	R
1	X_6	Number of Hospitals	-0.985
2	X_{12}	Number of Cooperatives	-0.827
3	X_5	Number of University Education Facilities	-0.615
4	X_{19}	Number of Four-Wheeled Motorized Vehicles	0.525
5	X_{18}	Number of Two-Wheeled Motorized Vehicles	0.355
6	X_{14}	Area of Rice Fields	-0.324

The selected independent variables that have passed the correlation test will proceed to the next test, namely the linearity test. Since there are already a few selected independent variables that will enter the model, it is certain that the resulting model will not experience multicollinearity phenomena. The reason is that the impact of variables that are not included in the model has been represented by the selected independent variables that are included in the model [14].

3.3 Linearity Test

In order to use linear regression analysis, the selected independent variables and the dependent variable must have a significantly linear relationship. The linear relationship between the independent variable and the dependent variable can be seen from the Sig. value which is obtained from the output of SPSS. If the Sig. value obtained is greater than 0.05, it can be stated that there is a significant linear relationship between the independent variable and the dependent variable [15]. The result of the linearity test between the independent variable and the dependent variable for the generation model can be seen in Table 7.

Table 7. Result of Linearity Test of Selected Independent Variables for Trip Generation Model

No	Selected Independent Variables*Generation		Value of Sig.	Declaration
1	X_3	Number of Primary Education Facilities	0.700	Linear
2	X_5	Number of University Education Facilities	0.465	Linear
3	X_{10}	Number of Supermarkets	0.152	Linear
4	X_7	Number of Hotels	0.572	Linear
5	X_{19}	Number of 4-Wheeled Motorized Vehicles	0.236	Linear
6	X_{18}	Number of 2-Wheeled Motorized Vehicles	0.096	Linear

The result of the linearity test between the independent variable and the dependent variable for the attraction model can be seen in Table 8.

Table 8. Result of Linearity Test of Selected Independent Variables for Trip Attraction Model

No	Selected Independent Variables*Attraction		Value of Sig.	Declaration
1	X_6	Number of Hospitals	0.173	Linear
2	X_{12}	Number of Cooperatives	0.213	Linear
3	X_5	Number of University Education Facilities	0.840	Linear
4	X_{19}	Number of 4-Wheeled Motorized Vehicles	0.523	Linear
5	X_{18}	Number of 2-Wheeled Motorized Vehicles	0.191	Linear
6	X_{14}	Area of Rice Fields	0.678	Linear

Based on Table 7 and Table 8, it can be stated that all selected independent variables for both the generation model and the attraction model have a linear relationship. Thus, the testing stage can proceed to the multiple linear regression analysis stage using stepwise method type 1.

3.4 Multiple Linear Regression Analysis Using Stepwise Method Type 1

The method chosen for the regression test in this research is the stepwise method type 1. The stepwise method chooses the independent variable with the highest correlation with the variables that have been included in the model [16], This method will gradually remove the independent variables in the model until only one variable remains. Some previous researchers had also used this method, such as in research [17] who re-analyzed a multiple linear regression model that had previously been produced but did not use the stepwise method, the results of re-analysis on related data using the stepwise method obtained a greater coefficient of determination. This can happen because the stepwise method itself prioritizes the predictive power of the model it produces [17]. In addition, in [18] compared the results of several methods, namely stepwise type 1, stepwise type 2, and trial and error method, the results showed that the model produced in the stepwise type 1 method fulfilled the criteria as the best model.

3.4.1 Analysis Of Trip Generation Model

An early candidate for independent variables was 20 (twenty) variables, but after analyzing the correlation coefficient, some variables were eliminated. The selected or non-eliminated independent variables are 6 (six) variables for the generation model. Therefore, the stages of the type 1 step-by-step analysis will be carried out as many as 6 (six) stages in this research referring to the number of selected independent variables. During the analysis process, the correlation values of the selected independent variables should be considered, so the variable to be excluded from the model can be known from the one with the smallest correlation value. The correlation values of the selected independent variables in the generation model can be seen in Table 5. The results of the analysis on the generation model are shown on Table 9.

Table 9. Result of Linear Regression Analysis for Trip Generation Model Using Stepwise Method Type 1

Model Parameters	Stage					
	1	2	3	4	5	6
Intercept (C)	-48987.359	-16598.511	-26908.001	-19122.724	-14425.973	1129.265
X_3	-230.491	178.943	133.95	250.16	309.310	383.198
X_5	16108.38	6246.194	8658.112	5346.817	5426.116	-
X_{10}	210.919	157.148	96.942	135.245	-	-
X_7	2165.236	229.343	625.338	-	-	-
X_{19}	0.72	-0.166	-	-	-	-
X_{18}	-0.246	-	-	-	-	-
R^2	-	0.786	0.884	0.909	0.906	0.809

3.4.2 Analysis Of Trip Attraction Model

Early candidates for independent variables were 20 (twenty) variables, but after analyzing the correlation coefficient, some variables were eliminated. The selected or non-eliminated independent variables are 6 (six) variables for the attraction model. During the analysis process, the correlation values of the selected independent variables should be considered, so the variable to be excluded from the model can be known from the one with the smallest correlation value. The correlation values of the selected independent variables in the attraction model can be seen in Table 6. The results of the analysis on the attraction model are shown on Table 10.

Table 10. Result of Linear Regression Analysis for Trip Generation Model Using Stepwise Method Type 1

Model Parameters	Stage 1	2	3	4	5	6
Intercept (C)	-48987.359	-16598.511	-26908.001	-19122.724	-14425.973	1129.265
X_3	-230.491	178.943	133.95	250.16	309.310	383.198
X_5	16108.38	6246.194	8658.112	5346.817	5426.116	-
X_{10}	210.919	157.148	96.942	135.245	-	-
X_7	2165.236	229.343	625.338	-	-	-
X_{19}	0.72	-0.166	-	-	-	-
X_{18}	-0.246	-	-	-	-	-
R^2	-	0.786	0.884	0.909	0.906	0.809

3.5 Interpretation of The Selected Model

The independent variables that enter the model have a different effect on the dependent variable, so it is not certain that all the independent variables that are included in the model can make that model is good [14]. Some criteria for selecting the best model according to [2] are:

a. The coefficient of determination (R^2) is large, the closer to 1 (one) the better.
b. The regression constant value is small (intercept), the closer to 0 (zero) the better.
c. The sign of the regression coefficient (+/-) is as expected.

3.5.1 The Selected Model Of Trip Generation

According to the stages of analysis that have been carried out, the best model that can describe the trip generation in South Tangerang City is the model produced at stage 6. The reason is that the model at stage 6 has a high coefficient of determination and the smallest regression constant (intercept) value among the other stages and the sign of the intercept is as expected. The coefficient of determination greater than 0.8 or 80% is categorized as having a very high influence on the dependent variable [12]. Seeing stages 4 and 5, which have a coefficient of determination greater than stage 6, but the intercept value is also large and the sign on the intercept is also not as expected.

Table 11. Trip Generation Model

Model	$Y_1 = 1129{,}265 + 383{,}198X_3$
Coefficient of Determination (R^2)	0,809

The regression constant value indicates that when variable X_3 is equal to zero, the amount of trip generation value will be 1129,265. The regression coefficient value shows that when variable X_3 increases by one unit, the amount of trip attraction value will increases by 383,198 units. The coefficient of determination explains that the independent variables in this trip generation model can explain the dependent variable for 80,9% and the rest are explained by other influential variables that are not included in the model.

From the generation model, it is found that the most influential factor on the generation of movement in South Tangerang City is the variable number of primary education facilities (X_3). This result is in accordance with research [5] regarding the number of classrooms affecting the amount of generation value. And in accordance with research [19] explains that going to school is one of the mandatory activities besides working. The model also describes what is in the real situation, because South Tangerang City has a variety of educational facilities available in all sub-districts. According to data of statistics on 2018, there are 319 elementary schools and 194 junior high schools in South Tangerang City, including public schools, private schools, religious schools, and international schools. The distribution map of primary education facilitites in South Tangerang City can be seen in Figure 3.

3.5.2 The Selected Model Of Trip Attraction

Referring to the stages of analysis that have been carried out and based on the criteria for selecting the best model, the best model that can describe the trip attraction in South Tangerang City is the model produced at stage 6. This is because the model at stage 6 has a high coefficient of determination and the smallest regression constant (intercept) value among the other stages. If looking at stage 2 which has a coefficient of determination greater than stage 6, the model at that stage has a regression constant value that is still relatively large as well.

Table 12. Trip Attraction Model

Model	$Y_2 = 69668{,}640 - 3372{,}120X_6$
Coefficient of Determination (R^2)	0,826

The regression constant value indicates that when variable X_6 is equal to zero, the amount of attraction value will be 69668,640. The regression coefficient value shows that when variable X_6 increases by one unit, the amount of attraction value will decrease by 3372,120 units. The coefficient of determination explains that the independent variables in this attraction model can explain the dependent variable for 82.6% and the rest are explained by other variables that are not included in the model.

From the attraction model, it is found that the most influential factor on the trip attraction in South Tangerang City is the variable number of hospitals (X_6) which has an inversely proportional relationship. This can occur because every sub-district in South Tangerang City already has a hospital except Setu [20]. Considering that South Tangerang City is one of the satellite cities that directly connects with DKI Jakarta, and also borders several areas such as Tangerang Regency, Bogor Regency, and Depok City, some people in South Tangerang City may travel to these areas. In this research, the trips observed are only between subdistrict zones in South Tangerang City, so that trips to areas outside South Tangerang City or trips from areas outside South Tangerang City are not detected or observed. For example, residents of Setu can find a closer hospital which is located in Tangerang Regency. The distribution map of hospitals in South Tangerang City can be seen in Figure 3.

3.6 Model Implementation in the Development of South Tangerang City

The model results obtained from the regression analysis can be used as the basis of a four- step transportation planning concept, in which the generation model is the first stage of the concept. The factors that have the most impact on trip generation and attraction can be used as a reference for the use of land use and transportation planning in South Tangerang City in the future. In the trip generation, the number of primary education facilities is the most influential factor. Meanwhile, in the trip attraction, the number of hospitals is the most influential factor. The increasingly widespread construction of schools and hospitals in South Tangerang City cannot be separated from the role of corporate developers who are currently building their own independent areas. This is one of the strong reasons behind the selection of BSD as an special economic zones with a focus on education, health, and technology. Figure 3 shows the distribution of primary education facilities and hospitals in South Tangerang City.

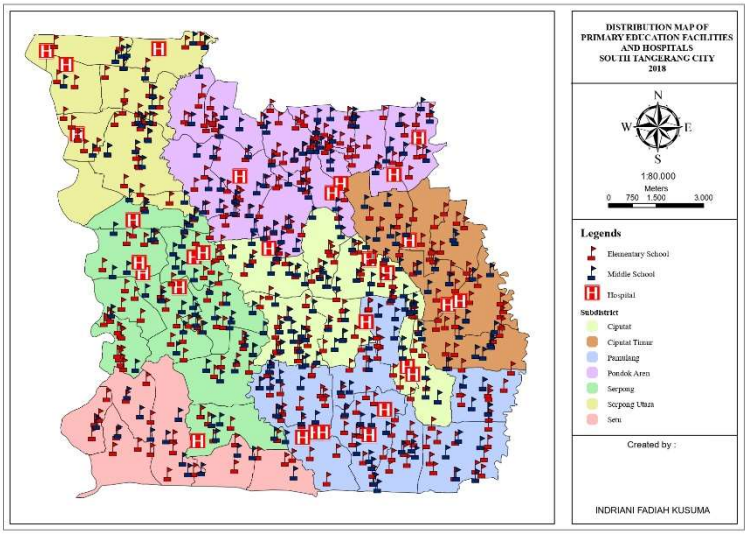

Figure 3. Distribution Map of Primary Education Facilities and Hospitals in South Tangerang City

Elementary schools generally do not have parking lots or spaces for dropping off passengers, and they are usually located on residential streets. Vehicles that deliver and pick up students often stop on the roadway, creating obstacles and reducing road capacity. Therefore, elementary schools are very prone to congestion especially during the morning rush hour, due to the large number of vehicles heading to school and coinciding with worker's vehicles going to the office [21]. As with hospitals, it can cause a high traffic movement which makes the traffic flows around the hospital congested [22]. The hospital is also one of the facilities that require proper accessibility, so that the public and medical staff can reach the hospital safely, comfortably, and easily. These two main factors can be considered by transportation planners in South Tangerang City to pay attention to traffic flows around schools and hospitals that can cause congestion.

4. CONCLUSION

Based on the results of the analysis, the factors that influence the generation of movement in South Tangerang City are the number of primary education facilities (X_3), the number of university educational facilities (X_5), the number of convenience stores (X_{10}), the number of hotels (X_7), the number of four-wheeled motorized vehicles (X_{19}), and the number of two-wheeled motorized vehicles (X_{18}). The best model generated for trip generation in South Tangerang City is $Y_1 = 1129{,}265 + 383{,}198\ (X_3)$ with the value of R^2 is 0,809. Then, the factors that influence the trip attraction in South Tangerang City are the number of hospitals (X_6), the number of cooperatives (X_{12}), the number of university education facilities (X_5), the number of four-wheeled motorized vehicles (X_{19}), the number of two-wheeled motorized vehicles (X_{18}), and the area of rice fields (X_{14}). The best model generated for trip attraction in South Tangerang City is $Y_2 = 69668{,}640 - 3372{,}120\ (X_6)$ with the value of R^2 is 0,826.

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