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Trip Generation At Grand Sememe Residence Housing In Delitua

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Abstract - *The development of new residential areas can lead to increased travel activity, known as trip generation. This study* aims to analyze the magnitude of trip generation occurring at Grand Sememe Residence, Deli Tua, and to examine the influence of residents' socioeconomic characteristics on the number of trips generated. Primary data were collected through questionnaires distributed to 70 household heads, covering variables such as number of family members, number of vehicles, and household income. The analysis was conducted using simple linear regression and multiple linear regression methods to determine the relationship between the independent variables and the number of trips. The results showed that the number of vehicles had the most significant influence on trip generation. Although the multiple regression model was not statistically significant overall, the results are still presented as an initial reference in the development of transportation planning models in residential areas. These findings are expected to serve as input for transportation planners and housing developers in designing efficient and sustainable transportation systems.

Keywords: Trip Generation, Residential Area, Linear Regression, Grand Sememe Residence, Transportation

1. INTRODUCTION

Transportation problems have become more widespread and the problems themselves are getting worse, the increase in traffic flow and transportation needs has resulted in congestion, delays, accidents and environmental problems that have reached above the threshold, these problems also arise due to the imbalance between residential growth and available transportation infrastructure.

The emergence of residential developments on trip generation has a significant impact on trip generation, increasing traffic volume and congestion, lack of adequate public transportation, inadequate road infrastructure, long distances to activity centers, imbalance between settlements and supporting facilities. The existence of the Grand Sememe Residence housing in Deli Tua sub-district as a generating area will increase traffic density on Jalan Besar Deli Tua Pamah.

The growth of residential areas in the suburbs of Medan, including the Grand Sememe Residence, has shown significant growth in recent years. Population growth in this area has directly impacted the volume of human and vehicle movement, particularly during rush hour. One of the main points of frequent congestion is in the Pajak Pusat Belanja area on Jl. Besar Delitua, which serves as a hub for economic activity in the surrounding area.

Grand Sememe Residence, as a rapidly developing housing complex, contributes to the daily travel generation of residents, whether for work, education, shopping, or other social activities. The dense and uneven traffic conditions necessitate a study of the travel patterns of residents in the complex. Understanding this travel generation is crucial for formulating traffic management strategies and sustainable transportation planning to mitigate the impact of congestion on Jl. Besar Delitua.

2. RESEARCH PURPOSES

Trip generation is a modeling stage that estimates the number of trips originating from a zone or land use or the number of trips attracted to a land use or zone (Tamin, 1997). Trip generation is the number of trips that occur in a unit of time in a land use zone (Hobbs, 1995).

According to Rukmana (2012), several main factors that influence travel generation are:

1. Population density and number: The larger the population in an area, the greater the number of trips generated.
2. Income level: People with higher incomes tend to make more trips.
3. Availability of transportation modes: Ease of access to public transportation or private vehicles influences trip frequency.
4. Supporting facilities: The presence of educational centers, shopping centers, and workplaces near residential areas also influences trip generation.

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1. Concept and Scope of Transportation Planning

The scope of transportation planning essentially forecasts and estimates the number of travel needs for people, goods, and vehicles, especially within urban areas in the future. This estimation is based on the results of data analysis obtained from the current year's data survey, which is analyzed through a statistical model calibration process. Transportation planning is part of the decision-making process or transportation policy to provide the best solution (Tamin, 2000). The sequence most often used in transportation studies using the four-stage transportation planning concept is: trip generation (G), trip distribution (D), transportation mode choice (MC), and route choice (A).

2. Traffic Generation Analysis

Traffic generation is used to estimate the number of trips originating from each area (trip origin) and the number of trips ending in a zone (trip end) for each destination. Trip intent is important to consider, not only to determine the factors that influence the number of trips that will occur, but also to influence the choice of mode of travel, which is very important in future transportation planning (Morlok, 1995). As the earliest stage in transportation modeling, the traffic generation model is a process that translates land use and the intensity of its activities into transportation quantities. (Tamin et al, 1999)

3. Impact of Travel Generation on traffic

Increased trip generation will directly impact traffic in the surrounding area, especially if road infrastructure capacity is not increased commensurately. The main impacts include increased vehicle volume, reduced travel speeds, congestion, decreased service levels, and an increased risk of traffic accidents.

According to Kadiresan & Prasetyo (2004), increased trip generation in residential areas without proper traffic management can put pressure on the main road network connecting the area. Furthermore, the impact of trip generation on traffic is also highly dependent on the socioeconomic characteristics of the population, such as the number of private vehicles, workplace location, and daily travel patterns.

Therefore, in transportation planning, understanding trip generation patterns is crucial for formulating traffic control strategies, improving road infrastructure, and developing sustainable transportation modes. Without trip generation analysis, the traffic system around new residential areas has the potential to experience significant performance declines.

4. Trip generation model

A model is a representation of something and is designed for a specific purpose. Transportation modeling explains the relationship between land use, traffic, and transportation facilities (Black, 1985). The purpose of modeling the magnitude of travel generation is to obtain a mathematical formulation that can be used to estimate the magnitude of travel generation based on zones. For the zones studied, the survey provides observational information on the magnitude of travel generation, the level of land use, and socio-economic variables that will be used for modeling travel generation.

Trip generation modeling can be done using several approaches. A common approach to trip generation modeling is regression analysis.

5. Multiple Linear Regression Method

To estimate the best parameters closely related to traffic generation in residential areas, the mathematical relationship between two or more variables is determined using the multiple linear regression method. In the multiple linear regression model, the variable to be predicted (dependent variable) has a linear relationship with the independent variables. Mathematically, this relationship can be formulated as follows (Sugiyono, 1997):

$$Y = b_o + b_1X_1 + b_2X_2 + \ldots + b_nX_n$$

Where:
Y: Dependent variable (variable being predicted or forecasted)
$X_1, X_2, \ldots, X_n$: Independent variable (predictor variable)
b_0: Constant (value of Y when all X = 0)
$b_1, b_2, \ldots, b_n$: Regression coefficient of each independent variable

In modeling movement generation, the multiple linear regression analysis method is most often used with both zone (aggregate) and household or individual (non-aggregate) data. The multiple linear regression analysis method is used to produce relationships in numerical form and to see how variables are related to each other.

6. Simple Linear Regression Method

Simple linear regression is a statistical method used to determine the relationship between one independent variable (X) and one dependent variable (Y). This model is used to predict the value of Y based on the value of X, assuming the relationship between the two is linear (straight line).

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The general form of a simple linear regression equation is as follows:

$$\mathbf{Y = a + bX}$$

Description:
Y = Dependent variable
X = Independent variable
a = Constant (intercept), which is the value of Y when X = 0
b = Regression coefficient, which shows the magnitude of the change in Y for every 1-unit change in X

This model is useful for determining the direction and strength of the relationship between two variables, as well as the extent of X's influence on Y in a quantitative context.

3. RESEARCH METHODOLOGY

This research was conducted at the Grand Sememe Residence, located in Delitua District, Deli Serdang Regency, North Sumatra Province. This location was chosen because it is a developing residential area and has significant trip generation potential, making it relevant as a study object for transportation analysis.

The research was carried out over a period of 4 months, from March to June 2025, which included the preparation stage, primary data collection through surveys and field observations, data processing, and analysis of the results.

Figure 1. Location and layout of housing

4. RESULTS AND DISCUSSION

4.1 Respondent Characteristics

a. Number of Family Members

Based on the questionnaire results, information was obtained regarding the distribution of the number of family members from the respondents as follows:

Based on the questionnaire results, the majority of respondents had families of 4–5 people, representing 50% of the total. Furthermore, 42.9% of respondents had families of 2–3 people. Meanwhile, only 7.1% of respondents

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had families of 6 or more people. This data indicates that the majority of respondents' families fall into the nuclear family category with a moderate number of members.

b. Average family income

Based on the questionnaire results, information was obtained regarding the distribution of the number of family members from the respondents as follows:

Based on the results of a questionnaire conducted on 70 respondents, it was found that the majority of families (55.7%) had an average monthly income in the range of Rp 2 million to Rp 5 million. Furthermore, 40% of respondents had an average income above Rp 5 million, and only 4.3% of respondents had an income below Rp 2 million. These findings indicate that the majority of respondent families fall into the middle-income category.

c. Number of private vehicle ownership (cars/motorcycles)

Based on the questionnaire results, information was obtained regarding the distribution of the number of vehicle ownerships from the respondents as follows:

The questionnaire results obtained data on the number of private vehicles (cars) owned by respondents. Based on data from 70 respondents, the majority owned 0 to 1 car, or 60%. Respondents owned 2 to 3 vehicles, amounting to 34.3%, while only 5.7% owned 4 or more vehicles.

Based on the questionnaire results, it was found that most respondents owned between one and three private vehicles. 49.3% owned between zero and one private vehicle, while 50.7% owned between two and three vehicles. No respondents owned four or more private vehicles.

Number of Respondents' Jobs

Based on the questionnaire results, the following information was obtained regarding the distribution of the number of Respondents' Jobs:

Respondents' parental occupation data was categorized into several main groups. Each category was weighted based on education level, job stability, and average income. Of the 72 respondents, the majority were in the private sector and self-employed. The total score for each category indicates its contribution to socioeconomic status in the analysis.

4.2 Correlation Analysis

The purpose of correlation analysis is to examine the bivariate relationship between independent variables, including family size, private vehicle ownership, income, employment, and education, and trip production (Y), the dependent variable. The correlation coefficients for each variable vary, as shown in the table below.

Table 1: Interpretation of Correlation Coefficients

Interval Koefisien	Tingkat hubungan
0,00 - 0,199	Sangat Rendah
0,20 - 0,399	Rendah
0,40 - 0,599	Sedang
0,60 - 0,799	Kuat
0,80 - 1,000	Sangat kuat

The correlation at Grand Sememe Residence shows that the dependent variable is the purpose of the trip, while the independent variables include the number of family members, income, number of motorcycles owned, number of cars owned, and number of jobs. Based on the results of the Pearson correlation analysis of 72 respondents, the relationship between each independent variable and the dependent variable (purpose of the trip) can be seen in Table 2.

Table 2.: Correlation Table of Dependent Variables with Independent Variables.

Correlations							
		Number of family members	Income	Motorcycle	Car	Work	Travel destination
Number of family members	Pearson Correlation	1	.997**	.999**	.991**	.268*	.198
	Sig. (2-tailed)		.000	.000	.000	.023	.095
	N	73	73	73	73	72	72
Income	Pearson Correlation	.997**	1	.989**	.884**	.218	.330**

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	Sig. (2-tailed)	.000		.000	.000	.066	.005
	N	73	74	74	74	72	72
Motorcycle	Pearson Correlation	.999**	.989**	1	.818**	.143	.217
	Sig. (2-tailed)	.000	.000		.000	.232	.067
	N	73	74	74	74	72	72
Car	Pearson Correlation	.991**	.884**	.818**	1	.198	.215
	Sig. (2-tailed)	.000	.000	.000		.095	.070
	N	73	74	74	74	72	72
Work	Pearson Correlation	.268*	.218	.143	.198	1	.214
	Sig. (2-tailed)	.023	.066	.232	.095		.071
	N	72	72	72	72	72	72
Travel destination	Pearson Correlation	.198	.330**	.217	.215	.214	1
	Sig. (2-tailed)	.095	.005	.067	.070	.071	
	N	72	72	72	72	72	72
**. Correlation is significant at the 0.01 level (2-tailed).							

Table 3. Correlation Table of Dependent Variables with Independent Variables.

		Tujuan perjalanan (Y)	Jumlah Penghuni (X_1)	Pendapatan (X_2)	Sepeda Motor (X_3)	Mobil (X_4)	Pekerjaan (X_5)
Pearson Correlation	Y	1.000	0.198	0.330**	0.217	0.215	0.214
	X_1	0.198	1.000	0.997**	0.999**	0.991**	0.268*
	X_2	0.330**	0.997**	1.000	0.989**	0.884**	0.218
	X_3	0.217	0.999**	0.989**	1.000	0.818**	0.143
	X_4	0.215	0.991**	0.884**	0.818	1.000	0.198
	X_5	0..214	0.268*	0.218	0.143	0.198	1.000
Sig. (-tailed)	Y	-	0.095	0.005	0.067	0.070	0.071
	X_1	0.095	-	0.000	0.000	0.000	0.023
	X_2	0.005	0.000	-	0.000	0.000	0.066
	X_3	0.067	0.000	0.000	-	0.000	0.232
	X_4	0.070	0.000	0.000	0.000	-	0.095
	X_5	0.071	0.023	0.066	0.232	0.095	-
N	Y	72	72	72	72	72	72
	X_1	72	72	72	72	72	72
	X_2	72	72	72	72	72	72
	X_3	72	72	72	72	72	72
	X_4	72	72	72	72	72	72
	X_5						

Y = Travel destination (Variabel Dependen)
X1 = Number of family members
X2 = Income
X3 = Motorcycle Ownership
X4 = Car Ownership
X5 = Work

From the correlation table between the dependent and independent variables at Grand Sememe Residence, correlation coefficients were obtained for the entire sample. The highest overall correlation value indicates that the income variable has the strongest and most significant relationship with the travel information variable. Therefore, the income variable can be used as one of the main variables in subsequent data analysis. A summary of the overall correlation values between the dependent and independent variables can be seen in Table 4.11.

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Table 4. Correlation Matrix Table

		Travel destination (Y)	Number of family members (X1)	Independent Variable			
				Income (X2)	Motorcycle Ownership (X3)	Car Ownership (X4)	Work (X5)
Travel destination (Y)		1					
Variable Bound	Number of family members (X1)	0.198	1				
	Income (X2)	0.330**	0.997**	1			
	Motorcycle Ownership (X3)	.0.217	0.999**	0.989**	1		
	Car Ownership (X4)	0.215	0.991**	0.884**	0.818	1	
	Work (X5)	0..214	0.268*	0.218	0.143	0.198	1

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Based on the results of the Pearson correlation analysis in Table 4.11, there is a relationship between the dependent variable Travel Purpose (Y) and the independent variables, namely number of family members (X1), Income (X2), Motorbikes (X3), Cars (X4), and Occupation (X5).

From these results, it is known that the Income variable (X2) has a significant relationship with Travel Purpose with a correlation value of 0.330 and a significance level of 0.005 ($p < 0.01$). This shows that the higher the respondent's income, the greater their tendency in determining travel purposes. Meanwhile, other variables such as Number of Occupants (X1), Motorcycles (X3), Cars (X4), and Occupations (X5) have a significance value above 0.05, which means they do not have a statistically significant relationship with Travel Purpose. However, the direction of the relationship shown is still positive, which indicates that an increase in these variables still tends to increase the tendency of travel purposes, but it is not statistically strong enough. The correlation value between other independent variables also shows a significant relationship, such as the relationship between the Number of Family Members and Motorcycles ($r = 0.999$, $p < 0.01$), as well as the relationship between Income and Cars ($r = 0.884$, $p < 0.01$). This indicates the possibility of multicollinearity between several independent variables.

4.3 F Test (Simultaneous)

The F test is used to determine whether the independent variables simultaneously (together) have a significant effect on the dependent variable.

Based on the SPSS output, the F test results are as follows:

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.191	5	.838	.645	.666[b]
	Residual	85.809	66	1.300		
	Total	90.000	71			
a. Dependent Variable: Informasi Perjalanan						
b. Predictors: (Constant), Pekerjaan, Sepeda Motor, jumlah anggota keluarga, Pendapatan, Mobil						

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Because the significance value (Sig.) = 0.666 > 0.05, then simultaneously, the variables Income, Number of Family Members, Motorbikes, Cars, and Occupation do not have a significant effect on Travel Purpose.

Linearity Test

The linearity test is carried out to determine whether the relationship between each independent variable and the dependent variable is linear, which is one of the assumptions in linear regression analysis.

Table 4. Results of Independent and Dependent Linearity Tests

Independent Variable	Sig. Linearity Value	information
Number of Family Members (X1)	0.090	Not Linear
Income (X2)	0.001	Linear (Signifikan)
Motorcycle (X3)	0.069	Not Linear
Car (X4)	0.074	Not Linear
Work (X5)	0.075	Not Linear

Based on the results of the linearity test between the independent variables and the Travel Purpose variable (Y), the following results were obtained:

The Income variable (X2) shows a significant linear relationship with Travel Purpose, with a significance value of 0.001 ($p < 0.05$). This indicates that the linearity assumption is met between X2 and Y.

Meanwhile, the variables Number of Family Members (X1), Motorcycles (X3), Cars (X4), and Occupation (X5) each have linear significance values above 0.05, namely 0.090; 0.069; 0.074; and 0.075. This indicates that the relationship between these four variables and Travel Purpose (Y) is not significantly linear.

Analysis of Income Variables on Travel Generation

Based on the results of a simple linear regression analysis, it was found that income significantly correlates with the number of trips taken by residents at Grand Sememe Residence. This means that the higher a person's income, the greater their tendency to travel.

However, it should be emphasized that this relationship is not directly related to motorbike or car ownership, but rather to the frequency or intensity of trips made, regardless of the mode of transportation used

While it's generally true that higher income can encourage people to own private vehicles such as motorcycles or cars, in the context of this study, the effect of income on the number of trips, not the type of vehicle, is being analyzed. This could be due to:

1. Not all high-income individuals choose to use private vehicles—some may still use public transportation, online motorcycle taxis, or walking for reasons of efficiency, mileage, or lifestyle.
2. The focus of a simple linear regression model is on the relationship between income and trips ($Y = a + bX$), not between income and mode of transportation. Therefore, while vehicle ownership may be relevant, it is part of another variable or a different regression model (e.g., multiple regression involving multiple factors).
3. Trip generation is more influenced by daily activities (such as work, school, shopping, etc.), which naturally increase with income, as people with higher incomes tend to have more activities outside the home.

5. CONCLUSIONS

Based on the results of the data analysis and discussion carried out in the previous chapter, the following conclusions can be drawn:

1. The variable that has the most influence on trip generation is family income (X2), which is proven to be significant in a simple linear regression model with a significance value of 0.005 ($p < 0.05$). This indicates that the higher the income, the greater the tendency to travel.
2. The multiple linear regression model tested produces the equation:
   $Y = 3.920 – 0.194(X1) – 0.013(X2) + 0.191(X3) – 0.002(X4) + 0.078(X5)$
   These results show that most variables are partially insignificant, and the model is also simultaneously insignificant. This indicates that the multiple regression model is not yet able to robustly explain the influence of variables on the number of trips.
3. From the results of the linearity test, only income (X_2) has a significant linear relationship with travel purpose (Y), while the other variables do not show a significant linear relationship.

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4. The impact of trip generation from the Grand Sememe Residence housing complex is evident in the increased traffic flow on surrounding roads and the potential for environmental disruption. This finding highlights the importance of transportation planning and environmental impact management efforts in the area.

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