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Analysis of Trip Attraction Models in Morotai CBD (*Central Business District)*

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ABSTRACT

The development of an area in land use can increase along with the increase in population in Morotai Island Regency, including the Morotai CBD area. In terms of urban transportation systems, generation and attraction have an important role in defining the development of a city, region, or area. The purpose of this research is to analyze of trip attraction modeling in the CBD area of Morotai. The concept of trip attraction modeling is analyzed using regression analysis, with various independent variables. The modeling analysis was carried out with the help of SPSS software using Stepwise multiple linear analysis methods. The results of the study show that the factors that influence the attraction of vehicle in the Morotai CBD area are **:** the number of visitors (X_4), the ratio of visitors against the building area (X_{10}), the ratio of employees against the number of rooms (X_{13}), the number of rooms(X_5), the ratio of employees against the building area (X_{11}), as well as the ratio of employees against the number of rooms(X_{12}). And from the results of linear regression analysis, the best transport attraction model was found to be $Y_1 = 86.790 + 0.422X_4 - 558.735X_{10} + 1.949X_{13}$ for the motorcycle (SM) attraction model and $Y_2 = 12.183 + 0.091X_5 - 26.265X_{11} + 0.292X_{12}$ for the light vehicle (KR) model.

Keywords: Attraction, Mobility, Models, Morotai CBD, Transportation

ABSTRAK

Pembangunan suatu daerah pada suatu tata guna lahan dapat meningkat seiring dengan peningkatan jumlah penduduk di Kabupaten Pulau Morotai, tidak terkecuali kawasan CBD Morotai. Dalam hal sistem transportasi perkotaan, bangkitan dan tarikan mempunyai peran penting dalam mendefinisikan perkembangan suatu kota, wilayah ataupun kawasan. Tujuan penelitian ini yaitu untuk membuat suatu analisis pemodelan tarikan pergerakan di kawasan CBD Morotai. Konsep model tarikan pergerakan di analisis menggunakan analisis regresi, dimana terdapat banyak variabel bebas. Analisis pemodelan dilakukan dengan bantuan software SPSS dengan analisis linear berganda metode Stepwise. Hasil penelitian menunjukan bahwa faktor-faktor yang mempengaruhi tarikan pergerakan kendaraan di kawasan CBD Morotai yaitu banyak pengunjung (X_4), rasio jumlah pengunjung terhadap luas bangunan (X_{10}), rasio jumlah karyawan terhadap jumlah ruangan (X_{13}), jumlah ruangan (X_5), rasio jumlah karyawan terhadap luas bangunan (X_{11}), serta rasio jumlah karyawan terhadap jumlah ruangan (X_{12}). Dan dari hasil analisis regresi linear, model tarikan pergerakan transportasi yang terbaik adalah $Y_1 = 86{,}790 + 0{,}422X_4 - 558{,}735X_{10} + 1{,}949X_{13}$ untuk model tarikan sepeda motor (SM) dan $Y_2 = 12{,}183 + 0{,}091X_5 - 26{,}265X_{11} + 0{,}292X_{12}$ untuk model tarikan kendaraan ringan (KR).

Kata kunci: CBD Morotai, Pergerakan, Pemodelan, Tarikan, Transportasi

INTRODUCTION

The process of people, goods or other objects mobilizing from one place (origin) to another (destination) is called transportation. This mobility process utilizes transportation facilities in the form of a vehicle or can be done without a vehicle (Puspito, 2017). According to Adisasmita (2011), transportation is a means of connecting production areas and markets or bringing production areas and markets closer. Humans need a means of transportation called a mode of transportation (Raharjo in Fatimah, 2019). Transportation plays an important role in human life, including in the economy and development of a region (Aminah, 2018).

Infrastructure in Morotai Island Regency began to develop rapidly. Morotai Island Regency, which is also amongst the 3T areas, is highly cared for by the central government through various programs. The development of Morotai CBD (Central Business District) area is one of the programs that have been implemented to support the economy in border areas. The development of Morotai CBD seems to be starting to have an impact on the area. Improving the community's economy and the potential for increasing urban development in the surrounding area are some of the prevailing impacts. Based on observations, the Morotai CBD area which is currently being built covers trade industry sector (traditional market), offices, public facilities such as the Great Mosque, as well as other public service facilities such as health centers, terminals, and the convention center building. Office buildings are one of the land uses that can cause large traction of movement (Saputro *et al.*, 2014).

The development of an area in land use can increase along with the increase in population (Prabowo *et al.*, 2020). Likewise with Morotai Island Regency. Accessibility in the area is also predicted to be directly proportionally interrelated. In addition, the movement that occurs in this region causes an increase in the generation and attraction of trips. The factors that influence changes in land use are internal and external factors that affect the surrounding area (Tampi, 2015). In terms of urban transportation systems, generation and attraction have an important role in defining the development of a city, region, or area (Nur *et al.*, 2021). For trade sector, the people's market, which was previously located in Gotalamo Village, has been relocated to the Morotai CBD area, which has greatly affected the movement of transportation. Likewise, several office buildings, terminals, and other public service facilities greatly increase transportation movements after the entire development in the CBD area is completed. City expansion that is not followed by infrastructure development can result in problems, one of which is the problem of transportation (Yahya, 2007). So, based on this background it is very important to conduct research in the form of analyzing or modeling trip attraction in new land use areas. The purpose of this research is to make a modeling analysis of the trip attraction of transportation in the Morotai CBD area.

The process that aims to develop a transportation system that allows people and goods to move safely and efficiently with available resources is transportation planning (Azis, 2019). The transportation planning model consists of four stages, namely trip generation, trip distribution modal choice, and traffic assignment (Rudi, 2014). Movement generation and attraction is a modeling step that estimates the number of movements originating from a zone or land use and the number of movements attracted to a land use or zone (Tamin, 2000).

Previous research that became a comparison of this study included, (1) Trip Generation Model of Population in Residential Areas (Putra, 2013). The purpose of this study is to determine the generation model as a result of changes in land use in residential areas which are analyzed by zone. The results of the study show that trip generation is influenced by car ownership, mode type, and the purpose of leaving the house. Meanwhile, what really influences the center of activity is the type of mode used, (2) Analysis of Trip Attraction and Generation Due to Mix-used Plan Development (Mix-Used Jogja One Park) with Comparative Methods (Muchlisin, 2016). The aim of this research is to determine the impact of traffic on travel costs and trip attraction both in existing and operational conditions in 2020 and 2025 due to the construction of the Mix-Used Jogja One Park (JOP), (3) Trip Generation and Attraction in Binjai City Against Transportation Movement Patterns (Syahputra, 2017). The aim of the study was to examine the effect of land use on the generation and attraction of movement along the roads of Binjai City. The results of the study show that the factors that influence trip generation in Binjai City are the number of family members who work and the number of family members who go to school.

Trip Generation Model in Outskirt Areas to the City Center (Studies in Areas Experiencing Spatial Change) (Bria *et al.*, 2019). The results obtained are that the factors that appear to have the most dominant influence on traveling are household factors such as the number of family members, income, and vehicle ownership. Analysis of Trip Attraction Model of the Vehicle to Tidar University in Magelang (Jannah *et al.*, 2021). The research variables used include land area, total building area, number of employees, number of lecturers, and number of students. The results showed that the trip attraction model was influenced by land area (X1) using the regression equation analysis to give the attraction model Y=69.514 + 0.029 X1.

Analysis of Trip Attraction Modeling in Department Store (Case Study in Soloraya Region) (Legowo, 2020). The results showed that the greatest influence of the attraction of movement is influenced by the area of the building with the best regression model using the stepwise method with the result Y = 14.455 + 0.005 X2 where X2 is the total area of the building. Analysis of Trip Attraction and Generation Model of Vehicles in Pemulutan District, Ogan Ilir Regency (Mauliana *et al.*, 2021). The results showed that using the multiple linear regression approach with the stepwise method resulted that the current entry and exit routes had not affected the activity of the activity system in Jalan Buaya, Pemulutan District, Ogan Ilir Regency. The equation for generation is Y(generation) = 13.275 + 0.832 X8 and for attraction is Y(attraction) = 39.394 + 0.641 X8 with X8 being the number of motorbikes owned. Trip Generation and Attraction in the Education Area of Bandar Lampung City (Fuady *et al.*, 2021). The results of the research show that the factors that affect the arousal and movement in the study area are the number of classrooms, the number of teachers and education staff and the student's daily allowance. The generation equation is Y=509.971 + 24.280X1 – 0.026X2 and the attraction equation is Z = 494.835 + 11.330X1 – 0.029X2 where X1 is the number of classrooms and X2 is the amount of pocket money per day.

Originality of this research is on the characteristics of the research location. Where the location of this research has several zones that have different functions and services. such as office zones, people's markets, health services (puskesmas) as well as places of worship and meeting halls. This provides an opportunity for quite varied movements between each zone. In addition, the methods and data analysis are also different, namely using only the most influential vehicle groups in the traffic movement in the CBD area.

METHODOLOGY

This research is located in the Morotai CBD area as shown in Figure 1. To determine the boundaries of the research, this area is divided into several areas based on the function and placement of entrances and the importance of each of these areas. There are 6 areas consisting of the market area, health center, offices, PJKC area, religious tourism area, and CBD marketing office.

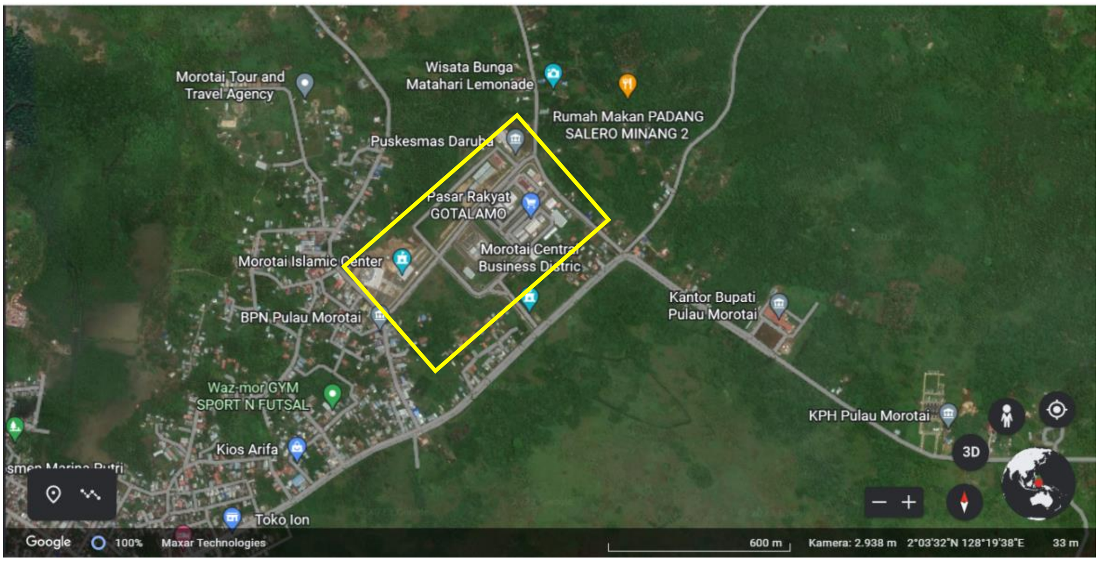

Figure 1. Research location, Morotai CBD area (source: google earth)

Primary data collection in the form of the number of vehicles was carried out for 3 days in 1 week which can represent the activities of the population during the week. Traffic volume survey in each plotted area of the Morotai CBD area as a whole. The survey was carried out by counting the number of vehicles entering and leaving an entrance in 1 area. Observations at the research location began at 07.00 WIT until 18.00 WIT.

While the secondary data needed is data on the number of employees/traders, the number of visitors/buyers as well as the number and area of the building, and the number and area of the rooms. This data is obtained from management parties who are fully responsible for all activities in their respective agencies.

The initial survey was carried out, namely calculating the type and number of vehicles entering and leaving the research location. The types of vehicles observed were grouped into 3 groups of vehicles based on PKJI'14 (Indonesian Road Capacity Guidelines 2014), namely:

1. Motorcycle (SM)
   Two or three-wheeled motor vehicles. Included here are motorcycles, *scooters*, tricycles (*bentor*).
2. Light vehicles (KR)
   Motor vehicles with two four-wheel axles, the length of the vehicle is not more than 5.5 m with a width of up to 2.1m. These types of vehicles include sedans, minibuses (*angkot*), microbuses, pick-ups, and small trucks.
3. Heavy vehicles (KB)
   Motor vehicles with two or more axles, 6 or more wheels. These types of vehicles include large buses, 2 or 3-axle large trucks, and others.

The concept of the trip attraction model can be analyzed using multiple linear regression analysis (Frans *et al*., 2016), where there are many independent variables. This is because several variables related to land use simultaneously affect the attraction of movement. This multiple linear regression equation is an equation that states the relationship between a dependent variable and several independent variables (Yudiaatmaja, F., 2013). The general form of this equation is;

$$Y = a + b_1X_1 - b_2X_2 + \cdots + b_nX_n \quad (1)$$

where:
Y = dependent variable (bound)
a = constant
$b_1, b_2, \ldots, b_n$ = coefficient of independent variables
$X_1, X_2, \ldots X_n$ = independent variables

RESULTS AND DISCUSSION

From the results of observing traffic flow at the research location as a whole in the Morotai CBD area, the 3 groups of vehicles observed, namely motorbikes (SM), light vehicles (KR) and heavy vehicles (KR) are shown in Figure 2.

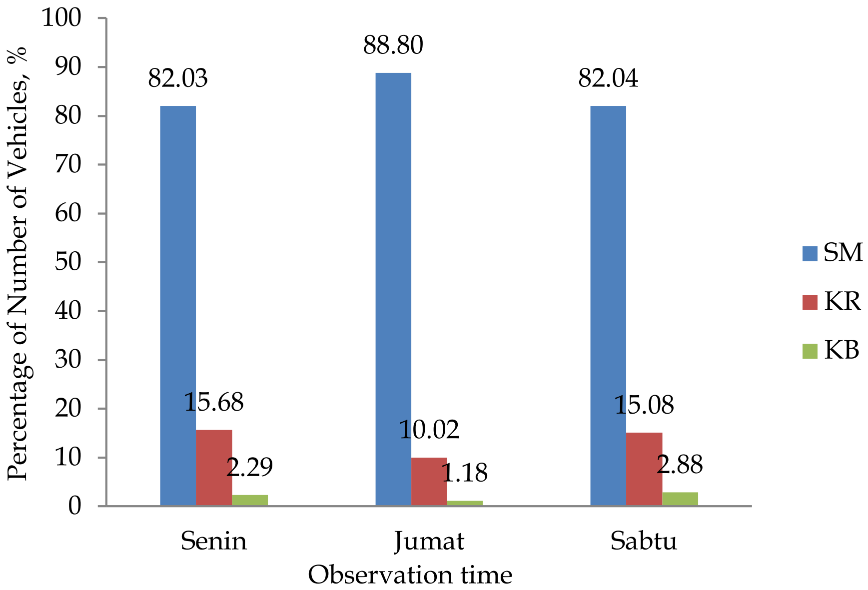

Figure 2. Results of a traffic flow survey in the CBD Morotai area

Figure 2 above shows that the flow of traffic at the research location shows that the motorcycle and light vehicle category vehicles quite influence the attraction of transportation movements with the highest percentage of each type of vehicle, namely 88.8% for SM and 15.68% for KR. Meanwhile, KB is only 2.88% of the total transportation movements in the Morotai CBD. So, to analyze the trip attraction model is only analyzed based on the categories of motorcycles (SM) and light vehicles (KR).

The results of collecting primary data and secondary data at research locations that have been recapitulated are shown in Table 1. From the description of the primary data and secondary data above, it is expanded by adding research data variables in the form of the ratio of the number of visitors to the number of employees (x_7), the ratio of the number of visitors to the building area (x_8), the ratio of the number of visitors to the number of rooms (x_9), the ratio of the number of visitors to the area of the room (x_{10}), the ratio of the number of employees to the area of the building (x_{11}), the ratio of the number of employees to the number of rooms (x_{12}) and the ratio of the number of employees to the area of the room (x_{13}).

Then the data is inputted into the SPSS program, to be processed and analyzed. This study uses linear regression analysis with the *stepwise method* with the aim of knowing which variables are selected in the modeling. This *stepwise* method begins by entering the independent variables that have the strongest correlation with the dependent variable, then the independent variables that do not have a correlation with the dependent variable are excluded and not entered in the modeling.

Table 1. Data collection results

Var.	Data Description	Market	Public health center	Office Area	PJKC Area	Religious tourism Area	CBD Marketing office
Y_1	SM attraction	249	83	91	77	140	95
Y_2	KR attraction	51	10	11	16	13	14
X_1	Land Area	10833,48	3179,69	4089	2780	9049,15	8893
X_2	Building Area	4297,62	950	1065	1068	3203	1925
X_3	Lost of Employees	264	68	90	46	10	55
X_4	Many Visitors	550	80	45	115	213	42
X_5	Number of rooms	446	13	24	56	12	35
X_6	Room Size	6,95	9,20	14	21	146,70	51

Source: researcher, 2022

Trip attraction on SM

Of all the variables used in the analysis, there were 3 independent variables that deserved to be included in the attraction model due to SM. Successively these variables are the number of visitors (x_4), the ratio of the number of visitors to the building area (x_{10}) and the ratio of the number of employees to the number of rooms (x_{13})

Table 2. Entered variable test results

Variables Entered/Removed			
Model	**Variables Entered**	**Variables Removed**	**Method**
1	Lots of visitors/buyers	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Ratio of number of visitors & building area	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Ratio Number of employees & number of rooms	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: SM Attraction

The relationship between the independent variables above and the dependent variable is shown in table 3 below.

Table 3. Autocorrelation test results for the SM trip attraction model

Summary models				
Model	**R**	**R Square**	**Adjusted R Square**	**std. Error of the Estimate**
1	.973a	.947	.933	17.00833
2	.999b	.998	.996	4.19875
3	1,000c	1,000	1,000	1.37030

a. Predictors: (Constant), Lots of Visitors/buyers

b. Predictors: (Constant), Number of Visitors/buyers, Ratio of number of visitors & building area

c. Predictors: (Constant), Number of visitors/buyers, Ratio of number of visitors & building area, Ratio of number of employees & number of rooms

The linearity test with α 5% are shown in Table 4 below. Based on Table 4 of the following ANOVA, it shows that the $F_{count\ is}$ greater than the F_{table}. This shows that the model is linear between the dependent variable and the independent variable.

Then from Table 4, choose one of the models that give more influence to the independent variables. Taking into account the magnitude of the coefficient of each variable in the modeling as shown in Table 5 below.

Table 4. Simultaneous testing of the SM travel attraction model

ANOVA [d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	20530.367	1	20530.367	70.970	.001[a]
	Residual	1157.133	4	289.283		
	Total	21687.500	5			
2	Regression	21634.611	2	10817.306	613.591	.000[b]
	Residual	52.889	3	17.630		
	Total	21687.500	5			
3	Regression	21683.745	3	7227915	3849,293	.000 [c]
	residual	3,755	2	1878		
	Total	21687500	5			

a. Predictors: (Constant), Lots of Visitors/buyers

b. Predictors: (Constant), Number of Visitors/buyers, Ratio of number of visitors & building area

c. Predictors: (Constant), Number of visitors/buyers, Ratio of number of visitors & building area, Ratio of number of employees & number of rooms

d. Dependent Variable: SM Attraction

Table 5. Results of heteroscedasticity testing of the trip attraction model of SM

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	std. Error	Betas		
1	(Constant)	65,140	9,725		6,698	003
	Lots of visitors/buyers	.329	039	.973	8,424	001
2	(Constant)	91,816	4.138		22,187	.000
	Lots of visitors/buyers	.410	014	1210	29,265	.000
	Ratio of number of visitors & building area	-540,751	68,326	-.327	-7,914	.004
3	(Constant)	86,790	1,670		51,966	.000
	Lots of visitors/buyers	.422	005	1,248	81162	.000
	Ratio of number of visitors & building area	-558,735	22,574	-.338	-24,751	002
	Ratio Number of employees & number of rooms	1949	.381	057	5.115	.036

a. Dependent Variable: SM Attraction

Based on the model shown in Table 5 above, using model 3 a multiple linear regression equation can be made, namely $Y_1 = 86,790 + 0,422X_4 - 558,735X_{10} + 1,949X_{13}$ (2)

Trip Attraction of KR

From the results of the linear analysis using the stepwise method, it was found that 3 independent variables were feasible to be included in the drag model due to KR. Successively these variables are the number of rooms (x_5), the ratio of the number of visitors to the building area (x_{11}), and the ratio of the number of employees to the number of rooms (x_{12}).

Table 6. entered variable test results

Variables Entered/Removed [a]			
Model	**Variables Entered**	**Variables Removed**	**Method**
1	Number of rooms/shops/kiosks	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	The ratio of number of employees & building area	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Ratio Number of employees & number of rooms	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: KR attraction

The relationship between the independent variables above and the dependent variable is shown in Table 7.

Table 7 Autocorrelation test results of the KR trip attraction model

Summary models				
Model	**R**	**R Square**	**Adjusted R Square**	**std. Error of the Estimate**
1	.997 [a]	.994	.992	1.37702
2	1,000b –	1,000	.999	.36414
3	1,000c –	1,000	1,000	.13491

a. Predictors: (Constant), Number of Rooms/ Shops/ Kiosks

b. Predictors: (Constant), Number of rooms/shops/kiosks, the ratio of the number of employees & building area

c. Predictors: (Constant), Number of rooms/shops/kiosks, the ratio of number of employees & building area, the ratio of number of employees & number of rooms

The linearity test with α of 5% is shown in Table 8 below. Based on Table 8 of the following ANOVA, shows that the F count is greater than the F table. This shows that the model is linear between the dependent variable and the independent variable. Then from Table 8, choose one of the models that give more influence to the independent variables. Taking into account the magnitude of the coefficient of each variable in the modeling as shown in Table 9.

Table 8. Simultaneous testing results of the KR travel attraction model

ANOVA [d]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	1231249	1	1231249	649,333	.000 [a]
	Residual	7,585	4	1896		
	Total	1238.833	5			
2	Regression	1238.436	2	619.218	4669.843	.000[b]
	Residual	.398	3	.133		
	Total	1238.833	5			
3	Regression	1238.797	3	412.932	22689.289	.000[c]
	Residual	.036	2	.018		
	Total	1238.833	5			

a. Predictors: (Constant), Number of Rooms/ Shops/ Kiosks

b. Predictors: (Constant), Number of rooms/shops/kiosks, ratio of number of employees & building area

c. Predictors: (Constant), Number of rooms/shops/kiosks, ratio of number of employees & building area, ratio of number of employees & number of rooms

d. Dependent Variable: KR attraction

Table 9. Results of the heteroscedasticity test of the KR trip attraction model

Coefficients [a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**std. Error**	**Betas**		
1	(Constant)	10,226	.663		15,432	.000
	Number of rooms/shops/kiosks	092	.004	.997	25,482	.000
2	(Constant)	12,076	.306		39,426	.000
	Number of rooms/shops/kiosks	093	001	1012	95,948	.000
	Ratio of number of employees & building area	-40,651	5,522	-.078	-7,362	005
3	(Constant)	12.183	.116		105034	.000
	Number of rooms/shops/kiosks	091	001	.991	162,451	.000
	Ratio of number of employees & building area	-26,265	3,822	-.050	-6,872	.021
	Ratio Number of employees & number of rooms	-.292	.065	-.035	-4,456	047

a. Dependent Variable: KR attraction

Based on the model shown in Table 9 above, using model 3 a multiple linear regression equation can be made, namely:

$$Y_2 = 12,83 + 0,091X_5 - 26,265X_{11} - 0,292X_{12} \quad (3)$$

CONCLUSION

From the results of the analysis and discussion, it is concluded that there are several factors that influence the attraction of vehicle movement in the Morotai CBD area, namely the number of visitors (X_4), the ratio of the number of visitors to the building area (X_{10}), the ratio of the number of employees to the number of rooms (X_{13}), the number of rooms, the ratio of the number of employees to the building area, and the ratio of the number of employees to the number of rooms. And from the results of linear regression analysis, the best transport trip attraction model is $Y_1 = 86.790 + 0.422X_4 - 558.735X_{10} + 1.949X_{13}$ for the motorcycle (SM) attraction model and $Y_2 = 12.183 + 0.091X_5 - 26.265X_{11} + 0.292X_{12}$ for the light vehicle (KR) model.

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