TRIP ATTRACTION MODEL OF HOSPITALS IN PROBOLINGGO

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Abstract: The hospital is one type of land use utilization which could cause vehicle attraction. It is estimated that the existence of the new Ar-Rozy Hospital would become a trip attraction. For this reason, it is necessary to conduct research to anticipate the magnitude of the movement attraction which would occur in the future due to the existence of the new Ar-Rozy Hospital. This study uses trip generation analysis at 3 existing hospitals located around downtown Probolinggo. The primary data used is a survey of vehicles entering and leaving the hospital, and the secondary one is data consisting the number of polyclinics$_{(X1)}$, practicing doctors$_{(X2)}$, medical staff$_{(X3)}$, land area$_{(X4)}$, rooms$_{(X5)}$, beds$_{(X6)}$. The result shows that all independent variables affect the occurrence of vehicle attraction. The best model suitable for representing the conditions of the hospital vehicle attraction is chosen based on the results of a significant regression model and consideration of the highest R^2, the best model is : Y = 174,256 + (-14,735) Number of Polyclinics$_{(X1)}$ + (13,081) Practicing Doctor$_{(X2)}$. R^2 = 0.940.

Keywords: *Attraction, modeling, hospital, regression model, variables*

Submitted: 09 February 2023; Revised: 18 April 2023; Accepted: 18 April 2023

INTRODUCTION

Probolinggo City encompasses an area of 56.67 square kilometers and is divided into five districts: Kademangan, Kedopok, Wonoasih, Mayangan, and Kanigaran [1]. According to data released by the Central Bureau of Statistics in 2020, the population of Probolinggo City has reached 239,649 individuals [1]. The density of the population is recorded as 4,229 persons per square kilometer [1]. A high population density generally leads to increased demand for healthcare services, including hospitals. Therefore, it is essential to enhance the quality of health services to ensure that hospitals can provide optimal care. The government has taken steps to improve the facilities and resources of the healthcare sector by constructing a new hospital in Probolinggo City, RSUD Ar-Rozy. The new hospital, built on a 3.85-hectare plot, provides improved infrastructure and facilities, enhancing the quality of healthcare services. This development is expected to increase the attractiveness of healthcare services in the area. However, increased attraction can impact the level of traffic around the hospital location, potentially leading to traffic congestion and delays. Traffic problems in the hospital area generally occur during the practice hours of the outpatient services, as a large number of patients and their families enter and exit the hospital. The high number of patient vehicles in the parking lot can cause inconvenience to road users. The number of trips and movements that occur due to the hospital's presence can be estimated through studies that determine the model of attraction of such movements. Currently, no research has been conducted on the level of attraction of vehicle trips at hospitals in Probolinggo City, making such research necessary.

RESEARCH SIGNIFICANCE

The primary objective of this study is to identify factors that can potentially influence the occurrence of traffic congestion around hospitals in Probolinggo City. Additionally, the study aims to establish a trip attraction model to estimate the number of vehicle trips generated by the presence of hospitals in the area. The findings of this research will serve as valuable inputs for the Probolinggo City Government in formulating regional and transportation planning policies. Specifically, the study will help the government anticipate the potential magnitude of the pull of movement that may occur in the future due to the construction of the new Ar-Rozy Hospital.

METHODOLOGY

The study focuses on three hospitals located in downtown Probolinggo, namely dr. Mohamad Saleh Hospital (type B), Dharma Husada Hospital (type D), and Wonolangan Hospital (type C). The selection of these hospitals was based on their proximity to the downtown area. Data collection was carried out using both primary and secondary data collection methods. The primary data collection involved conducting a survey of hospital visitor vehicles, specifically motorcycles and cars, entering and leaving the hospital premises [2], [3], [4]. The survey was conducted at each hospital door point during working hours for polyclinic services, from 6:00 a.m. to 9:00 p.m. Secondary data was obtained from existing sources, including the number of polyclinics$_{(X1)}$, practicing doctors $_{(X2)}$, medical staff$_{(X3)}$, land area$_{(X4)}$, rooms$_{(X5)}$, beds$_{(X6)}$, schedules of practicing doctors, and polyclinic patient visitors.

The data was analyzed using multiple linear regression. The multiple linear regression analysis is a statistical technique that aims to establish a regression model that connects a dependent variable with two or more independent variables. This method is used to identify the potential influence of multiple factors on the dependent variable. In this study, multiple linear regression analysis is employed to investigate the relationship between the number of vehicle trips and various independent variables, such as the number of polyclinics$_{(X1)}$, practicing doctors $_{(X2)}$, medical staff$_{(X3)}$, land area$_{(X4)}$, rooms$_{(X5)}$, beds$_{(X6)}$. The aim of this analysis is to identify which independent variables have a significant effect on the dependent variable, and to what extent. The analysis is:

$$Y = a + b1x1 + b2x2 + ... + bnxn + e \quad (2)$$

Note:

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Y = dependent variable
$x1 \ldots x_n$ = independent variable
a = parameter constant means, if x is the same with zero in the sense of not changing or fixed, then Y is the same with a
b = coefficient parameters
e = the error value that represents all of the factors we have think it doesn't matter [5].

The correlation test was conducted using bivariate correlation analysis in SPSS. The results of the correlation analysis are presented in Table 1. The decision regarding the correlation value is based on established criteria for interpreting correlation coefficients.

Table 1 Correlation value intervals [6]

Correlation Intervals	Relationship Level
0,00 – 0,199	Very Low
0,20 – 0,399	Low
0,40 – 0,599	Moderate
0,60 – 0,799	Strong
0,80 – 1,000	Very Strong

The significance test and ANOVA test in this study were standardized using error values expressed in intervals of 1%, 5%, and 10% [7], with an error rate of 10% chosen for this study. The multicollinearity test was performed using Tolerance and Variance Inflation Factor (VIF) values, with Tolerance values required to be greater than 0.1 and VIF values less than 10 [8].

The coefficient of determination (R^2) ranges between zero and one, with a small value indicating limited ability of independent variables to explain variation in the dependent variable [9]. The best model is selected based on the highest R^2 value [5].

Normality test is performed based on the spread of data around the diagonal line and the direction of the histogram graph [10].

ANALYSIS AND DISCUSSIONS

The results of the primary data survey are presented in Table 2, which shows the volume of hospital traffic. This data was collected through a survey of hospital visitor vehicles entering and leaving the hospital, including motorcycles and cars. The survey was conducted at each hospital door point during working hours for polyclinic services from 6.00 a.m. to 9.00 p.m.

Table 2 Primary data

Location	Average Daily Traffic (Motorcycle & Car)	Peak Hour (Motorcycle & Car)	
Dr. Mohamad Saleh Hospital	355	Morning	528
		Afternoon	429
		Evening	369
Dharma Husada Hospital	146	Morning	159
		Afternoon	165
		Evening	208
Wonolangan Hospital	148	Morning	150
		Afternoon	173
		Evening	210

The results of secondary data from each hospital can be seen in Table 3

Table 3 Secondary Data

Variables	dr. Mohamad Saleh Hospital	Dharma Husada Hospital	Wonolangan Hospital
Polyclinics$_{(X1)}$	23	11	19
Doctor's Practices$_{(X2)}$	55	23	41
Medical Staff$_{(X3)}$	421	70	110
Land Area$_{(X4)}$	9982	2296	8735
Rooms$_{(X5)}$	79	36	50
Beds$_{(X6)}$	231	138	101

Based on Tables 2 and 3, it is possible to analyze the factors that may influence the occurrence of trip attraction and to perform trip attraction modeling. The first step involves calculating the factors that may influence trip attraction occurrence, which is achieved through SPSS bivariate correlation. The results of this analysis are presented in Table 4. Based on the findings presented in Table 4, it is evident that all independent variables demonstrate a correlation value above 0.6, indicating a strong relationship with trip attraction. Consequently, the factors influencing the occurrence of trip attraction include the number of polyclinics$_{(X1)}$, practicing doctors$_{(X2)}$, medical staff$_{(X3)}$, land area$_{(X4)}$, rooms$_{(X5)}$, and beds$_{(X6)}$.

The second analysis involves modeling based on hospital peak hours, using three methods: enter, stepwise, and forward methods. The independent variable data included in the analysis comprise solely the number of polyclinics$_{(X1)}$ and the number of practicing doctors$_{(X2)}$, as these variables display data variations at each peak hour. Data on the number of practicing doctors$_{(X2)}$ were obtained from the polyclinic practice schedule at each hospital. The dependent variable data and independent variables in this peak-hour analysis are presented in Table 5.

Table 5 Data dependent and independent variables

Hospital Name	Vehicle Peak Hour (Motorcycle & Car) (Y)		Polyclinics (X1)	Practicing Doctors (X2)
dr. Mohamad Saleh Hospital	Morning	528	23	49
	Afternoon	429	22	48
Dharma Husada Hospital	Morning	159	1	1
	Afternoon	165	4	4
	Evening	208	4	5
Wonolangan Hospital	Morning	150	5	5
	Afternoon	173	12	16
	Evening	210	8	9

Based on the data presented in Table 5, a multiple linear regression analysis was conducted using the enter, stepwise, and forward methods. The results of this analysis are displayed in Table 6.

Upon examining the results in Table 6, it is observed that the enter method did not pass the multicollinearity test. To provide further clarification, the difference between the

Table 4 Correlation results from SPSS analysis correlation bivariate

		Average Daily Traffic	Polyclinics	Doctor's Practices	Medical Staff	Land Area
Average Daily Traffic	Pearson Correlation	1	0,761	0,832	0,995	0,632
	Sig. (2-tailed)		0,449	0,374	0,061	0,565
	N	3	3	3	3	3
Polyclinics	Pearson Correlation	0,761	1	0,993	0,82	0,984
	Sig. (2-tailed)	0,449		0,075	0,388	0,116
	N	3	3	3	3	3
Doctor's Practics	Pearson Correlation	0,832	0,993	1	0,882	0,955
	Sig. (2-tailed)	0,374	0,075		0,313	0,191
	N	3	3	3	3	3
Medical Staff	Pearson Correlation	0,995	0,82	0,882	1	0,703
	Sig. (2-tailed)	0,061	0,388	0,313		0,504
	N	3	3	3	3	3
Land Area	Pearson Correlation	0,632	0,984	0,955	0,703	1
	Sig. (2-tailed)	0,565	0,116	0,191	0,504	
	N	3	3	3	3	3
Rooms	Pearson Correlation	0,95	0,925	0,964	0,76	0,842
	Sig. (2-tailed)	0,202	0,248	0,172	0,14	0,363
	N	3	3	3	3	3
Beds	Pearson Correlation	0,959	0,546	0,641	0,927	0,385
	Sig. (2-tailed)	0,183	0,633	0,557	0,245	0,748
	N	3	3	3	3	3

Table 6 Multiple linear regression analysis

Model	R (R > 0,5)	R^2 (R^2 > 0,5)	Significance (a < 0,10)	Tolerance (> 0,1)	VIF (< 1)
Enter Method: Y = 174,256 + (-14,735) Polyclinics$_{(X1)}$ + (13,081) Practicing Doctor$_{(X2)}$	0,969	0,940	0,001	0,030	33,050
Stepwise and Forward Method: Y = 134,337 + 6,915 Practicing Doctor$_{(X2)}$	0,958	0,917	0,000	1,000	1,000

Table 7 Comparison of survey results with regression model results

Location	Peak Hour	Trip Attraction Existing (Peak Hours)	Trip Attraction Model (Enter Method)	Difference	Trip Attraction Model (Stepwise and Forward Method)	Difference
dr. Mohamad Saleh Hospital	Morning	528	476	52	473	55
	Afternoon	429	478	-49	466	-37
Dharma Husada Hospital	Morning	159	173	-14	141	18
	Afternoon	165	168	-3	162	3
	Evening	208	181	27	169	39
Wonolangan Hospital	Morning	150	166	-16	169	-19
	Afternoon	173	207	-34	245	-72
	Evening	210	174	36	197	13

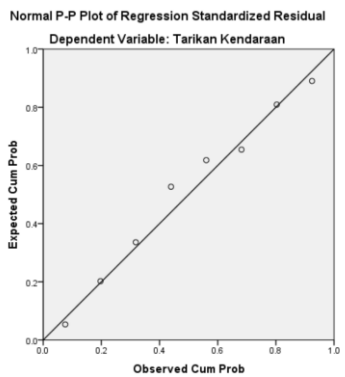

Figure 1 P-plot enter method

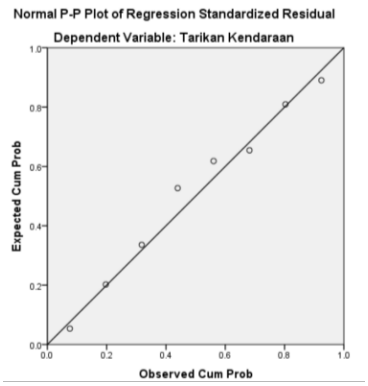

Figure 2 P-plot stepwise method

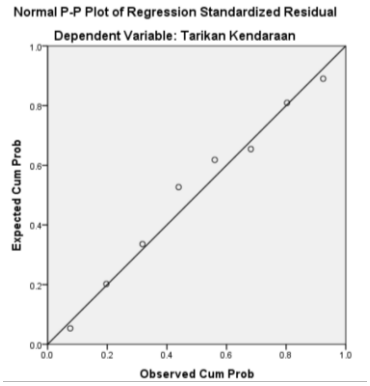

Figure 3 P-plot forward method

actual total trips and the trips obtained from the model was calculated, as presented in Table 7.

The subsequent step involves testing the normality of the P-Plot. Figures 1, 2, and 3 illustrate the P-Plot normality test.

Based on Figures 1, 2, and 3, it is observed that 2-3 out of 8 data points fall on a linear line, while the remainder cluster around the line. From a normality perspective, the model appears to be reasonably viable.

CONCLUSIONS

In summary, this study aimed to analyze the factors influencing trip attraction at hospitals in Probolinggo and to develop trip attraction models based on hospital peak hours and daily traffic volume. Based on the data analyzed, it was found that the number of polyclinics$_{(X1)}$, practicing doctors$_{(X2)}$, medical staff$_{(X3)}$, land area$_{(X4)}$, rooms$_{(X5)}$, and beds$_{(X6)}$. were significant factors influencing trip attraction at hospitals in Probolinggo.

Multiple linear regression analysis using enter, stepwise, and forward methods resulted in two models, namely Y = 174,256 + (-14,735) Number of Polyclinics$_{(X1)}$ + (13,081) Practicing Doctor$_{(X2)}$ and Y = 134,337 + 6,915Practicing Doctor$_{(X2)}$.

The best model suitable for representing the conditions of the hospital vehicle attraction is chosen based on the results of a significant regression model and consideration of the highest R^2. The best model is: Y = 174,256 + (-14,735) Number of Polyclinics$_{(X1)}$ + (13,081) Practicing Doctor$_{(X2)}$ R^2 = 0,940. This suggests that the number of polyclinics and practicing doctor working at the hospital is the most important factor influencing trip attraction, with higher numbers leading to increased levels of trip attraction.

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