Advance Sustainable Science, Engineering and Technology (ASSET)
Vol. 8, No.2, April 2026, pp. 02602032-01 ~ 02602032-012
ISSN: 2715-4211 DOI: https://doi.org/10.26877/asset.v8i2.2458

Motorcycle Passenger-Car Equivalents from Time-Headway Data with Lane-Occupancy Adjustment in Urban Indonesia

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Abstract. Motorcycles dominate traffic composition in East Surabaya, making the determination of Passenger Car Equivalent (PCE) values for motorcycles a crucial aspect of road performance assessment. This research evaluates motorcycle PCE value on six road sections on Raya Prapen Street, Jemursari Street, Jemur Andayani Street, Panjang Jiwo Street, Kali Rungkut Street, and Rungkut Industri Street, each observed in two directions (12 segments in total), with samples collected during peak hours on Monday (06:00–10:00) and Friday (15:00–19:00). The Time Headway method is used to calculate the PCE value, and followed by statistical procedures, including t-tests and the calculation of the coefficient of determination, were performed using SPSS software. Findings show a strong correlation between PCE values and the characteristics of each road section. The adjusted motorcycle PCE values range from 0.12 to 0.20 across all sections, with site-wise pairs for direction 1/direction 2 as follows: Raya Prapen 0.20/0.16, Jemursari 0.18/0.19, Jemur Andayani 0.14/0.12, Panjang Jiwo 0.20/0.19, Kali Rungkut 0.15/0.16, and Rungkut Industri 0.15/0.14. The result coefficient of determination of $R^2 = 0.817$ indicates a strong association between Time Headway and PCE Values. This research is limited by the assumption of a uniform motorcycle dimension factor across all sections.

Keywords: East Surabaya, headway-based PCE, lane-width adjustment, mixed traffic, urban arterials.

(Received 2025-08-15, Revised 2026-01-22, Accepted 2026-01-22, Available Online by 2026-04-30)

1. Introduction

Analysis of road section performance evaluation requires an approach that can simplify the various types of vehicles passing through into a uniform unit [1], [2]. One of the commonly used approaches is the Passenger Car Equivalent (PCE) concept. Passenger Car Equivalent (PCE) Value is used in heterogeneous traffic flows [3][4] to convert various types of vehicles such as heavy vehicles [5], medium vehicles, and motorcycles into light vehicle units [6] [7] allowing for homogeneous analysis [8]. PCE values are also applied to quantify the influence of different vehicle categories on traffic density along a roadway [9] and to estimate the total number of vehicles occupying the same road section simultaneously [10]. This vehicle conversion has an impact on the calculation of traffic volume to be uniform [11] and comparisons between road sections become more accurate. As a result, analysis of road capacity and service levels can be carried out more accurately and measurably, reflecting actual traffic conditions . The Passenger Car Equivalent (PCE) value is influenced by various factors, including the geometric characteristics of road sections [12], traffic conditions [13], and vehicle as well as driver behavior [14]. Several studies have examined PCE values by comparing alternative PCE estimation methods [15], and integrating the PCE concept into analytical delay models for multi-class, lane-free traffic [16]. In addition, some studies state that PCE values in heterogeneous traffic need to be locally calibrated [17], as demonstrated by field-based PCE estimation and basic saturation flow analysis at signalized intersections in Indonesia, as well as comparisons between motorcycle PCE values in PKJI 2023 and observed data [18]. The urgency of this research lies in the need to determine road-segment-specific Passenger Car Equivalent (PCE) values, as each road section exhibits distinct traffic characteristics that significantly influence traffic flow performance.

The novelty of this research lies in its focus on motorcycle-dominated traffic conditions and the local calibration of motorcycle PCE values under specific urban characteristics. Among the vehicle categories, heavy vehicles and motorcycles require conversion into passenger car units. Heavy vehicles demand more space and have reduced maneuverability compared to passenger cars [19]. In contrast, motorcycles differ from light vehicles in both size and movement patterns, being able to filter through traffic and accelerate quickly [20]. Due to their significant share of the total traffic volume, motorcycles are a crucial component in determining PCE values. In urban areas, they often dominate traffic counts, as seen in East Surabaya, East Java, Indonesia a region with offices, industrial estates, warehouses, and factories. The presence of these activity centers has a direct impact on increasing the volume of people and goods movement, especially during rush hours, which can also contribute to air pollution [21] and carbon emissions [22]. Motorcycles dominate local transportation due to their speef, dimention, [23] flexibility and efficiency in navigating congestion [24]. making the conversion of motorcycle-specific PCE values essential. Additionally, it is worth noting that every road section is characterized by specific vehicle movements and compositions, which in turn affect traffic characteristics [18]. Due to differences in traffic features, the Passenger Car Equivalent (PCE) value for a Motorcycle on road sections in East Surabaya will vary between the different road sections.

The objective of this research is to evaluate the role of motorcycles in heterogeneous traffic flow and to determine motorcycle PCE values based on actual field conditions. Due to the changing characteristics of traffic, the PCE (Passenger Car Equivalent) indicator for motorcycles on road segments in East Surabaya will vary from one to another. Therefore, a study is necessary to evaluate the role of motorcycles in traffic flow, which will contribute a PCE value for motorcycles based on actual traffic conditions. Especially on road sections in East Surabaya that have high levels of activity, such as around industrial areas, offices, and densely populated settlements, with high traffic intensity and a dominant composition of motorcycles, namely on Raya Prapen St, Jemursari St, Jemur Andayani St, Panjang Jiwo St, Kali Rungkut St, and Rungkut Industri St. One of the methods used to determine the Passenger Car Equivalent (PCE) value is the Time Headway Method [25][26]. This method calculates the time interval between vehicles. With this method, the Passenger Car Equivalent (PCE) value for Motorcycle is calculated by comparing the average headway

time between light vehicles and motorcycles [27] with an explicit dimension-based correction factor to account for the lateral space utilization of motorcycles on urban arterial roads.

2. Methods

This study employs a direct field survey method to collect traffic volume and time headway data. The data were obtained through on-site observations conducted at the study location. The research methodology used in this study is illustrated in Figure 1.

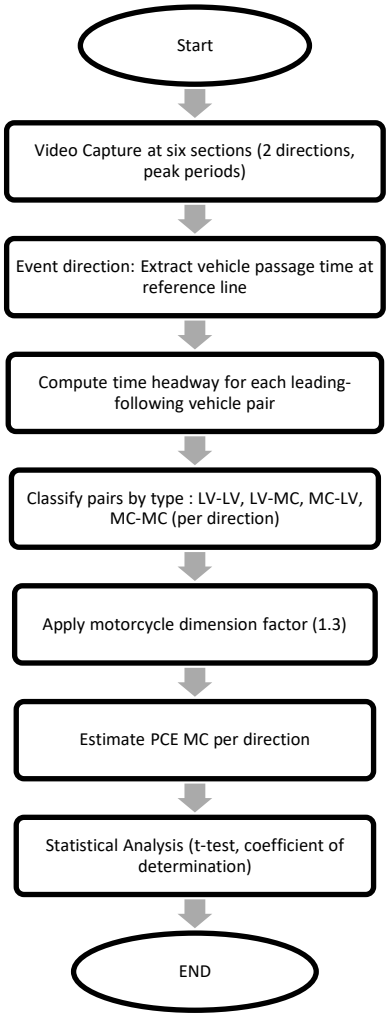

Figure 1. Workflow Figure

The research method for analysing the Passenger Car Equivalent (PCE) value for Motorcycle uses the Time Headway approach on six road sections in East Surabaya with two observation directions (a total of 12 segments). The data was collection was carried out through video recording during peak hours to capture the characteristics of actual traffic flow in all movement lanes. The camera was placed at a stable elevation position on the side road section with a view perpendicular to the traffic flow, equipped with a minimum recording resolution of 720-1080p to ensure the accuracy of time measurement. The time headway method enables the description of the contribution of motorcycles to traffic flow based on the time interval between vehicles. The stages of the research methodology consist of data collection, traffic volume analysis, time headway analysis, Passenger Car Equivalent value

analysis, and road section performance analysis. An explanation of each stage of the research methodology will be provided in the following subchapters.

2.1. Data Collection

The data used in this study are primary data and secondary data. Primary data is data directly obtained from the field based on a survey, namely traffic volume data, road geometric data, and time headway data between vehicles with 4 combinations, namely Light Vehicle (LV) followed by Light Vehicle (LV), Light Vehicle (LV) followed by Motor Cycle (MC), Motor Cycle (MC) followed by Light Vehicle (LV), Motor Cycle (MC) followed by Motor Cycle (MC). Traffic volume data were obtained from a survey conducted on Monday morning from 6:00 to 10:00 a.m. and on Friday from 3:00 to 7:00 p.m. Road geometric data consist of lane width, curb width, shoulder width, and the number of lanes. Time Headway data between vehicles is collected during rush hour by recording traffic flow using a video camera at specific observation points that have been determined on several road sections. Time Headway data between vehicles is taken based on vehicles crossing the same imaginary line. The arrival time of each vehicle is recorded as it passes through a specific line sequentially, and then the time difference between vehicles is calculated to obtain the time headway value. Secondary data in this study utilizes data obtained from existing sources, specifically population data for the city of Surabaya, which was obtained from the Surabaya Central Statistics Agency (BPS).

2.2. Analysis of Time Headway

The first analysis conducted was traffic volume analysis to determine peak hours on each road segment in East Surabaya. Traffic volume data was recorded every 5 minutes, then summed every hour. From the traffic volume data in vehicles/hour units, an analysis was conducted to determine the passenger car equivalent (PCE) value to be used based on the Guidelines of Indonesian Road Capacity (PKJI) 2023. The vehicle/hour traffic volume was multiplied by PKJI 2023 passenger car equivalent (PCE) value and summed to one pcu/hour to determine the peak hours that occur on each segment. The next analysis, namely time headway analysis, was conducted by recording the time interval between vehicles passing the same observation point. Time headway was analyzed based on the time difference between the arrival of the front of a particular vehicle and the front of the previous vehicle at the same point measured in seconds. Vehicle time headway surveys were conducted during peak hours in each direction on each road segment. Vehicle arrivals were extracted for video recordings using manual coding aided by time stamping the front of vehicles as they passed the reference line. In platooning conditions, only vehicles whose movements did not directly impede each other having a clearly measurable distance between them) were counted. Meanwhile, overtaking events were ignored if they disrupted the headway sequence. Time headway was analyzed based on the time difference between the arrival of the front of a particular vehicle and the front of the previous vehicle at the same point measured in seconds. Time headway analysis is carried out by finding the average time headway and number of vehicles in 4 combinations, namely Light Vehicle (LV) followed by Light Vehicle (LV), Light Vehicle (LV) followed by Motor Cycle (MC), Motor Cycle (MC) followed by Light Vehicle (LV), Motor Cycle (MC) followed by Motor Cycle (MC).

2.3. Analysis of Passenger Car Equivalent (PCE)

Passenger Car Equivalent (PCE) analysis is performed by comparing the average motorcycle headway to the average headway of passenger cars. The higher the PCE of a vehicle, the greater its impact on traffic density. The passenger car equivalent value will also be subjected to a T-test and Determination Coefficient analysis using SPSS to find the relationship between the headway value and the Motorcycles Passenger Car Equivalent (PCE) value.

3. Results and Discussion

The analyses conducted in this study included traffic volume analysis, time headway analysis, and Passenger Car Equivalent (PCE) analysis. Each analysis result is explained in the following subchapters.

3.1. Research Location

This research was conducted in Indonesia in the capital city of East Java Province, namely Surabaya, especially in the East Surabaya area, which is an urban area characterized by dense traffic activity and dominated by light vehicles and motorcycle. This research was conducted on six main roads, namely Raya Prapen St, Jemursari St, Jemur Andayani St, Panjang Jiwo St, Kali Rungkut St, and Rungkut Industri St. Each road section has a different level of density, vehicle composition, and road geometry, so that it can provide an appropriate analysis to determine the equivalent value of motorcycles to passenger cars. The location of the six road sections can be seen on the map shown in Figure 1.

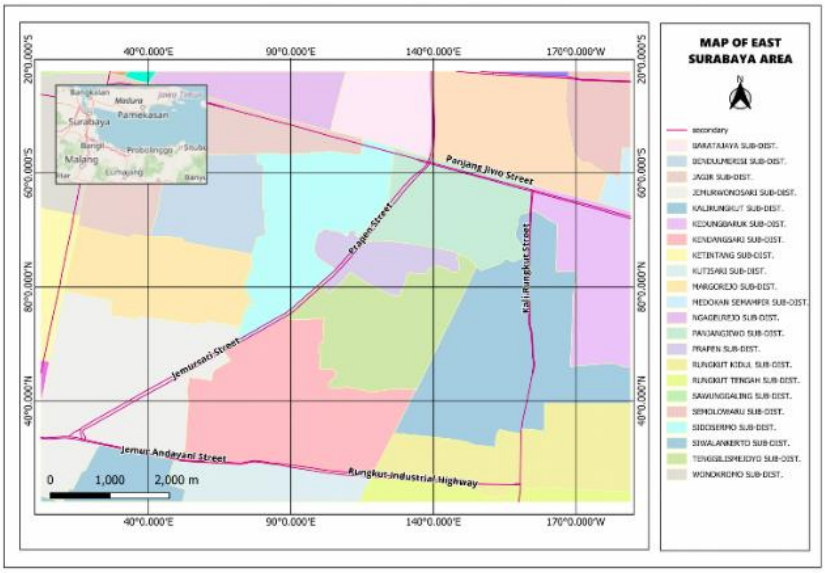

Figure 2. The Research Location Of The Six Road Sections

3.2. Road Section Geometry

Road geometry was obtained from direct field observations and measurements on several road sections in East Surabaya. The road geometry data in this study consisted of road type, road width, curb width, shoulder width, and the number of lanes in each direction. The geometry data for several road sections in East Surabaya are presented in Table 1.

Table 1. Data of Road Section Geometric

No.	Road Name	Road Type	Number of Lanes	Lane Width	
				Direc. 1	Direc. 2
1	Prapen St.	6/2 D	3	3.3	3.3
2	Jemursari St.	6/2 D	3	3.3	3.3
3	Jemur Andayani St.	4/2 D	2	3.5	3.5
4	Panjang Jiwo St.	6/2 D	3	3.3	3.1
5	Kali Rungkut St.	4/2 D	2	3.4	3.4
6	Rungkut Industri St.	4/2 D	2	3.7	3.7

3.3. Traffic Volume

A traffic volume analysis was conducted to determine the peak hours on each road segment in East Surabaya. Traffic volume in this study was recorded every 5 minutes and then accumulated into hourly

volumes. Initial traffic volume data will be analyzed using the Passenger Car Equivalent (PCE) Value in the 2023 PKJI, specifically the motorcycle PCE value of 0.25, to determine peak hours in passenger-car units per hour (pcu/hour). This selecting a representative time headway analysis period. In this study the PKJI Passenger Car Equivalent (PCE) is used to determine the highest peak hours which is then used to determine the time of the time headway survey to avoid circularity in the calculation. As a basis for determining peak hours for each road segment in East Surabaya, Traffic Volume data are presented in Table 2.

Table 2. Traffic Volume

No.	Road Name	Peak Hour Volume (Veh/hour)		Peak Hour Volume (pcu/hour)	
		Direc. 1	Direc. 2	Direc. 1	Direc. 2
1	Prapen St.	7816	6563	3336	2851
2	Jemursari St.	5308	6846	2195	3184
3	Jemur Andayani St.	4939	5538	1912	1861
4	Panjang Jiwo St.	13702	5196	6118	2066
5	Kali Rungkut St.	3808	6474	1630	2831
6	Rungkut Industri St.	2690	4872	1088	2078

3.4. Time Headway

Analysis of Vehicle time headway was obtained by observing all lanes in each direction on the Surabaya section, taking videos for 60 minutes during the specified peak hour periods on Monday mornings and Friday afternoons. Time headway was obtained from the time interval between vehicles passing sequentially at the same observation point. Time headway data collection was based on the number of vehicles and the average time interval between vehicles passing sequentially. In this study, time headway was grouped based on four combinations of vehicle types in sequence, namely Light Vehicle (LV) followed by Light Vehicle (LV), Light Vehicle (LV) followed by Motor Cycle (MC), Motor Cycle (MC) followed by Light Vehicle (LV), Motor Cycle (MC) followed by Motor Cycle (MC). Data on the average number of vehicles and the time headway for each sequential combination of vehicle types are presented in Tables 3 and 4.

Table 3. Number of Vehicles and Data of Time Headway Direction 1

No.	Road Name	Number of Vehicles				Time Headway			
		LV-LV (n)	LV-MC (n)	MC-LV (n)	MC-MC (n)	LV-LV (s)	LV-MC (s)	MC-LV (s)	MC-MC (s)
1	Prapen St.	465	781	784	4260	1.95	2.45	1.88	1.58
2	Jemursari St.	651	690	668	2833	3.13	3.86	4.49	2.36
3	Jemur Andayani St.	491	170	151	3281	4.94	3.78	3.21	1.49
4	Panjang Jiwo St.	174	256	353	2661	3.18	2.73	3.36	2.19
5	Kali Rungkut St.	295	186	187	1945	3.57	2.91	3.31	1.99
6	Rungkut Industri St.	139	319	324	1950	4.12	3.01	3.58	2.46

Table 4. Number of Vehicles and Data of Time Headway Direction 2

No.	Road Name	Number of Vehicles				Time Headway			
		LV-LV (n)	LV-MC (n)	MC-LV (n)	MC-MC (n)	LV-LV (s)	LV-MC (s)	MC-LV (s)	MC-MC (s)
1	Prapen St.	856	511	546	5188	2.55	1.96	2.51	1.48
2	Jemursari St.	511	725	717	3932	2.82	2.21	2.05	1.78
3	Jemur Andayani St.	105	163	131	5008	3.14	1.80	2.30	1.36
4	Panjang Jiwo St.	1751	2272	2120	4901	1.76	1.47	1.50	1.22
5	Kali Rungkut St.	714	176	452	1825	5.71	2.95	3.81	3.28

6 Rungkut Industri St.	167	432	427	1749	4.72	3.54	3.41	2.56

The varying characteristics of each vehicle and differences in driver ability will affect the calculation results. Therefore, adjustments to the average headway value are required using correction coefficients. The following is an analysis of the correction coefficient calculation for Rungkut Industri St Direction 1 using Equation 1.

Calculation :

$$\left(ta - \frac{k}{na}\right) + \left(td - \frac{k}{nd}\right) = \left(tb - \frac{k}{nb}\right) + \left(tc - \frac{k}{nc}\right) \quad (1)$$

Definition :
ta is Time Headway of LV–LV, tb is Time Headway of LV–MC, tc is Time Headway of MC–LV, td is Time Headway of MC–MC, na is Number of Vehicles of LV–LV, nb is Number of Vehicles of LV–MC, nc is Number of Vehicles of MC–LV, nd is Number of Vehicles of MC–MC, k is Correction Coefficient.

Based on the calculation results, the correction coefficient value at Rungkut Industri St Direction 1 is -37.541. The calculation of the k value has been reanalyzed and shows a smaller value of -0.67 for Rungkut Industri Street. This has been revised accordingly in Subsection 3.4. The average time headway value for each vehicle combination is analyzed using a correction factor to obtain the average time headway correction value at Rungkut Industri St Direction 1 using Equation 2.

Calculation:

$$ta_k = ta - \frac{k}{na} \quad (2)$$

Based on the calculation results, the average value of time headway correction at Rungkut Industri St Direction 1 for the combination of Light Vehicle (LV) followed by Light Vehicle (LV) is 4.12, Light Vehicle (LV) followed by Motor Cycle (MC) is 3.01, Motor Cycle (MC) followed by Light Vehicle (LV) is 3.58, and Motor Cycle (MC) followed by Motor Cycle (MC) is 2.46.

3.5. Passenger Car Equivalent (PCE) value for Motorcycle

The analysis of the equivalent value of passenger cars (emp) for motorcycles is obtained from a comparison of the average number of time headways of Motorcycle (MC) followed by Motorcycle (MC) and Light Vehicle (LV) followed by Light Vehicle (LV). The calculation of the equivalent Passenger Car Equivalent (PCE) value for Motorcycle at Rungkut Industri St Direction 1, is using Equation 3.
Calculation:

$$PCEmc = \frac{td_k}{ta_k} \quad (3)$$

Definition: (14)
PCEmc is Passenger Car Equivalent for Motorcycle.

The Passenger Car Equivalent for motorcycles (PCEmc) was calculated by dividing the average passenger car headway of 2.46 s by the average motorcycle headway of 4.12 s, resulting in a PCEmc value of 0.60. Based on the calculations, the Passenger Car Equivalent (PCE) value for motorcycles on Rungkut Industri St Direction 1, is 0.60. This value is considered less representative of actual conditions, where vehicles can still overtake during peak hours. The PCE calculation using the time headway method indicates that the motorcycle PCE is less significant, due to a mismatch between the method's primary assumptions and real-world traffic conditions. To improve accuracy, the motorcycle PCE should be adjusted using a dimension factor corresponding to vehicle size. This adjustment is made after considering the average dimensions of motorcycles most commonly used in Indonesia. The vehicle dimensions are based on a sample of motorcycles, which represent real-world conditions, and are provided for five (5) motorcycle brands. The vehicle dimensions, which are collected, are first multiplied by a Safety Factor (SF) of 1.3. The adjustment is designed to maintain a safe distance between motorcycles when they pass alongside each other in the same lane [28]. Additionally, the dimension factor is determined by comparing the vehicle dimension adjustment

results with the lane width at each road section. The analysis results of the vehicle dimension factor value and the Passenger Car Equivalent (PCE) value for the motorcycle on each road section are presented in Table 5.

Table 5. Analysis of Vehicle Dimension Factor Value and Passenger Car Equivalent (PCE) value for Motorcycle

No	Road Name	PCE MC		Dimension Factor		PCE MC x Dimension Factor		PCE Value Based on PKJI 2023	
		Direc. 1	Direc. 2	Direc. 1	Direc. 2	Direc. 1	Direc. 2	Direc. 1	Direc. 2
1	Prapen St.	0.71	0.56	0.29	0.29	0.20	0.16	0,25	0,25
2	Jemursari St.	0.64	0.66	0.29	0.29	0.18	0.19	0,25	0,25
3	Jemur Andayani St.	0.51	0.46	0.27	0.27	0.14	0.12	0,25	0,25
4	Panjang Jiwo St.	0.69	0.63	0.29	0.30	0.20	0.19	0,25	0,25
5	Kali Rungkut St.	0.54	0.59	0.28	0.28	0.15	0.16	0,25	0,25
6	Rungkut Industri St.	0.60	0.56	0.25	0.25	0.15	0.14	0,25	0,25

Based on the analysis results in Table 5, which show the calculation data for the Passenger Car Equivalent (PCE) value for Motorcycle adjusted for vehicle dimensions, there are variations in the values for each road segment and direction. On Prapen Street, the Passenger Car Equivalent (PCE) value for Motorcycle for direction 1 is the highest at 0.20, while direction 2 has a value of 0.16. Jemursari Street shows a Passenger Car Equivalent (PCE) value for Motorcycle of 0.18 for direction 1 and 0.19 for direction 2, with direction 2 slightly higher. The PCE value of motorcycles at Prapen St and Jemursari St differs because the traffic volume and the time headway distributions at the two sites are not identical. For Jemur Andayani Street, the Passenger Car Equivalent (PCE) value for Motorcycle is relatively lower than other sections, namely 0.14 in direction 1 and 0.12 in direction 2. The same value as Prapen Street is also found on Panjang Jiwo Street, namely 0.20 in direction 1 and 0.19 in direction 2. Meanwhile, Kali Rungkut Street has a value of 0.15 in both directions, indicating consistent traffic movement. Rungkut Industri Street shows a value of 0.15 in direction 1 and slightly lower, namely 0.14, in direction 2. According to PKJI (2023), the previously adopted Motorcycle PCE value is 0.25. However, based on the analysis in this study, the Motorcycle PCE values generally range from 0.12 to 0.20, which are lower than the PKJI standard. Nevertheless, the post-hoc adjustment using a width-based dimension factor (≈0.25–0.30) raises methodological concerns because multiplying headway-derived PCE values by a lateral-dimension coefficient implicitly mixes time-based and space-based effects without a formal derivation. To ensure validity, such adjustments should be supported by a theoretical framework—for example, a bivariate PCE model that jointly considers longitudinal headway and lateral lane occupancy, or through simulation or empirical validation demonstrating that applying the dimension factor improves predictive performance relative to headway-only estimates. Incorporating such a model or validation will strengthen the justification for combining temporal and spatial scaling in the final PCE values. This variation occurs because road segments and directions reflect differences in traffic conditions and geometric characteristics of each location.

3.6. Statistical Analysis of the Relationship between Time Headway and PCE Values

Statistical analysis of relationship between time headway and PCE values employed linear regression analysis to determine the relationship between the ratio of motorcycle time headway to light vehicle time and Passenger Car Equivalent (PCE) value for Motorcycle, multiplied by the vehicle dimension factor based on the lane width on each road segment. In this study, the statistical test was conducted specifically to examine the relationship between headway values and the resulting EMP values. Since the EMP is derived directly from headway through the established Time Headway formulation, the two variables are mathematically dependent, creating an inherently linear functional relationship. Therefore,

the regression analysis presented in the manuscript is not intended to test differences between independent groups (which would require normality or equal variance assumptions, as in t-tests), but rather to quantify the linear relationship between headway and EMP, where: EMP is computed from headway, Variability in EMP is a direct transformation of the variability in headway, and The relationship is structurally linear due to the nature of the formula. The linear regression analysis was based on hypothesis testing using t-tests and coefficient of determination analysis. The results of the t-test analysis are presented in Figure 3.

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.028	.021		1.359	.204
	X_TimeHeadway_Comparison	.223	.033	.904	6.674	.000

a. Dependent Variable: Y_PCE_MC

Figure 3. Analysis of T-test by SPSS

Based on the results of the linear regression analysis using the t-test in Figure 4, the significance value (0.000 < 0.05) indicates a significant influence of the comparison of the time headway value on the Motorcycle Passenger Car Equivalence (PCE) Value. Furthermore, the results of the Determination Coefficient analysis to analyze the influence of the time headway value variable on the Motorcycle Passenger Car Equivalence (PCE) Value are presented in Figures 4 and 5.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.904[a]	.817	.798	.01188

a. Predictors: (Constant), X_TimeHeadway_Comparison

Figure 4. Determination Coefficient analysis by SPSS

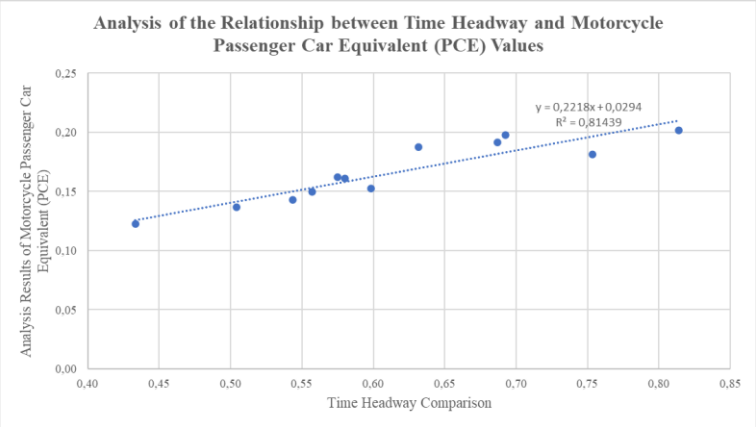

Figure 5. Graph of Linear Regression Analysis

Based on the results of the Determination Coefficient analysis test in Figure 5, the R^2 value is 0.817, indicating that the time headway value influences the Motor Cycle Passenger Car Equivalent (PCE) value by 81.7%, while 18.3% is influenced by other factors.

This research contributes to traffic flow analysis by providing motorcycle Passenger Car Equivalent (PCE) values for different road sections, demonstrating that each road segment has distinct traffic characteristics that cannot be represented by a uniform PCE value.

4. Conclusion

This study reveals the Motorcycle Passenger Car Equivalent (PEC) value for each direction and on each road segment in East Surabaya varies. These differences are influenced by various factors, especially the number of vehicles, road geometry, and time headway between vehicles. The Passenger Car Equivalent (PEC) value is not constant, but rather dynamic following the traffic characteristics and conditions of each road segment. Based on the study results on Prapen Street, the Passenger Car Equivalent (PCE) value for motorcycles in direction 1 is the highest, at 0.20, while direction 2 has a value of 0.16. Jemursari Street shows a Passenger Car Equivalent (PCE) value for Motorcycle of 0.18 for direction 1 and 0.19 for direction 2, with direction 2 slightly higher. For Jemur Andayani Street, the Passenger Car Equivalent (PCE) value for motorcycles is relatively lower compared to other sections, namely 0.14 in direction 1 and 0.12 in direction 2. The same value as Prapen Street is also found on Panjang Jiwo Street, namely 0.20 in direction 1 and 0.19 in direction 2. Meanwhile, Kali Rungkut Street has a value of 0.15 in both directions, indicating consistent traffic movement. Rungkut Industri Street shows a value of 0.15 in direction 1 and slightly lower, namely 0.14, in direction 2. In general, the Motorcycle PCE value ranges from 0.12 to 0.20, with variations between road sections and directions reflecting differences in traffic conditions and geometric characteristics of each location.

Declaration of AI and AI assisted technologies in the writing process

During the preparation of this work the author(s) used CLAUDE in order to assist in language editing and improving the clarity of the manuscript. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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