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Dangerous Driving Among Heavy Vehicle Drivers Along Jalan Batu Pahat-Kluang (FT050)

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Abstract: Dangerous driving behaviour among heavy vehicle drivers such as lorry and busses often becomes a hot topic of conversation due to the danger it causes to other road users such as speeding, especially in Jalan Batu Pahat-Kluang, which are one of the most lethal highways in Malaysia. This highway has one of the highest rates of accidents in Malaysia. Therefore, this study has been conducted on this highway. This research will help to identify the type and rate of dangerous driving among commercial vehicle and bus drivers as well as to determine the speed limit compliance among commercial vehicle and bus drivers during morning and afternoon at this highway. Video recording method has been used to obtained data before the data is analysed using the mathematical formula such as Poisson Probability Method and Hypothesis Testing. The Poisson Probability Method is applied to the data to get the likelihood of committing dangerous driving. Hypothesis Testing will be used to know the compliance of the speed limit, and t-test to test if the mean speed is equal to or below the speed limit. The result of this study found out that speeding is the most common type of dangerous driving that have an average of 76.92 vehicles per hour at Km-15 while at Km-24.5, speeding is committed at an average of 65.67 vehicles per hour. Besides that, drivers at Km-15 and Km-24.5 does not comply to the speed limit of 30 km/h.

Keywords: Speeding, Driving in Fast Lane, Heavy Vehicles, Dangerous Driving

1. Introduction

Highway is one of the important main roads in a country which connect a nation which can carry a high load of traffic at a time. However, the downside of highways and roads is that it involves a lot of accidents and the loss of lives. According to World Health Organisation (WHO), there are an estimated 1.35 million road traffic deaths every each [1]. Jalan Batu Pahat-Kluang (FT050) is one of the most lethal highways in Malaysia where a lot of commercial vehicle drivers who are driving lorry, trailer and bus can be seen driving dangerously on this highway [2]. The example of the types of commercial vehicle drivers is tailgating, overtaking without an indicator, carrying overloaded cargo, running a red

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light, and driving on the fast lane (right side of the lane) [3]. Most of the time, commercial vehicles drivers have a tight schedule. Therefore the drivers do not comply with the speed limit. Jalan Batu Pahat-Kluang are listed in the top 5 based on death recorded every year where the road recorded 554 death in three years which is between 2015-2017 [3]. Besides that, there are many types of traffic offences that are done by heavy vehicle driver in Malaysia. Among them is a lot of heavy vehicles are using the right lane, which is the fast lane in Malaysia [4][5].

The aim of this research is to identify the type and rate of dangerous driving among heavy vehicles as well as to determine the speed limit compliance among heavy vehicles. The study is conducted by focussing on commercial vehicles such as lorries, trailers and buses. Heavy vehicles are observed from a pedestrian footbridge at two locations located at the Jalan Batu Pahat-Kluang (FT050) on Km-15 and Km-24.5. Observation is done at a specific time in the morning and evening. The time for morning observation is 10.00 a.m until 12.00 p.m, whereas for the evening observation is 2 p.m until 4 p.m. Three days of data are recorded for each pedestrian footbridge during Sunday, Monday and Tuesday. Data is collected by recording videos from the pedestrian footbridge and after that the calculation and analysis will be done in Microsoft Excel. For the speed limit in this study, 30 km/h will be used due to the location of study are located at school zone. From the result of this research, the probability of heavy vehicle drivers drove dangerously, and the most common types of dangerous driving dangerously will be obtained.

2. Factors That Contribute to Accidents

Several factors can affect heavy vehicle's driver behaviour which could lead to an accident. Human behaviour can affect how someone can drive, which may be varied for every person. Human behaviour during driving can affect a person attitudes, perception, as well as driving character [6]. Therefore, the first factor involved in dangerous behaviour in heavy vehicle's drives is the human factor. The second factor that is involved would be a vehicle factor. Majority of the heavy vehicle has a larger dimension compared to pedestrian vehicles which makes heavy vehicles on of a dangerous vehicle to be near to which may obstruct vision, therefore, increase the probability of accidents [4]. The last factor would be an environmental factor. Sunrise, sunset, oily road surfaces and winding uphill/downhill road was hazardous environmental factors [7]. The human factor largely contributes to the factor of heavy vehicles accident with 60%, vehicle with 15% and the environment with 25% [8].

2.1 Human Factor

The human factor is the main reason for heavy vehicles accidents due to the nature of human which is prone to error and fatigue. The human factor can be in the form of fatigue, aggressive driving and distraction [9]. Besides that, past research have listed the main causes of an accident involving heavy vehicles due to human factor. The type of human factor and its percentages are shown in Table 1 [8].

Table 1: **Human factor [8]**

Types of human factor	Percentage (%)
Speeding	8.70
Falling asleep	0.42
Alcohol	0.08
Infringement of traffic rules	68.3
Other	22.5

2.2 Vehicle Factor

Due to the advancement of technology, heavy vehicles are equipped with better technology which will give heavy vehicles more horsepower to produce more speed, and this has contributed to much speeding by heavy vehicles driver [4]. Other causes of this factor are due to unscheduled maintenance and improperly maintenance by the drivers or the company that owns the fleet of heavy vehicles [10]

2.3 Environmental Factor

The environmental factor that significantly is related to road crash is scene light, weather condition, place of the crash, roadway defect, roadway geometric and roadway surface. Clear weather has the lowest rate of fatalities due to better visibility and better road condition. Stormy weather would cause the roads to be more slippery, which is dangerous for heavy vehicles [7]. Weather, or particularly adverse weather condition, is one of the environmental risk factors that affect the performance of all main components in a "moving vehicle" – which includes the driver, vehicle condition and its performance, and prevailing road condition [11].

2.4. Impact of Safety and Enforcement

Road accidents keep happening because of the lack of a systematic approach to road-user safety [12]. Most road traffic accidents are caused by the lack of enforcement to prevent human behaviour such as human error, the wrong decision when driving, disobey and breaking the road rules [13].

3. Methods

This process is an important process in making decision preparation. It requires a more thorough study to ensure that each data collected can be used and processed well in line with the objectives set at the beginning of the study.

3.1 Data Collection of Heavy Vehicles

The data collection are done by using video recording method. The site were observed and monitored by recording videos of the highway from the two selected pedestrian footbridge at the Jalan Batu Pahat-Kluang to obtain data at the site. The pedestrian footbridge was chosen to obtain a clearer view from above for video recordings. The points of the study are as follows:

i. Site A: Pedestrian footbridge near SMK Sri Gading at Km-15

ii. Site B: Pedestrian footbrigde near Masjid Sabak Uni at Km-24.5

Collections of field data were performed at selected locations using a video camera, tripod, and safety vest. Video cameras are being used to monitor the movement of traffic visually. The cameras are mounted on the pedestrian footbridge at an angle of 90 degrees to the road surface and supported using a tripod. The arrangement of cameras mounted on the pedestrian bridge is shown in Figure 1:

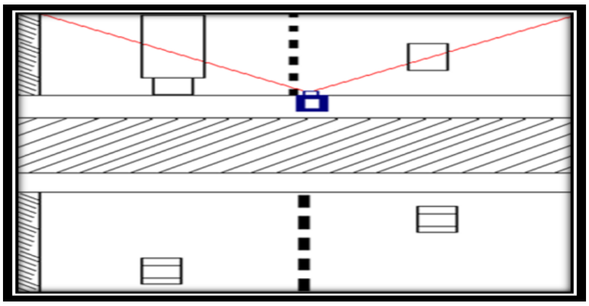

Figure 1: Camera layout on the pedestrian footbridge

3.2 Poisson Probability Method

Poisson probability method is a method to get the rate of the likelihood for heavy vehicle drivers committing dangerous driving which is speeding, driving in fast lane, no indicator, tailgating and overloaded cargo. Data on the type of offences need to be listed first and the number of offences being committed in an hour. After that, the Poisson probability method will be applied to the number of offences per hour, where it can describe mathematically using Equation 1.

$$P(x) = \frac{\lambda^x e^{-\lambda}}{x!} \qquad \text{Eq.1}$$

3.3 Hypothesis Testing

Hypothesis testing is a procedure based on sample evidence that were taken using video recording and probability theory to determine whether the hypothesis is a reasonable statement. One hypothesis statement will is used to obtain the objectives of this study which consists of a null hypothesis, H_0 and alternative hypothesis, H_α. The statements are as following:

H_0: The total number of heavy vehicles does not comply with speed limits.

H_α : The total number of heavy vehicles that comply with the speed limits.

By using the data that have been collected, the compliance of heavy vehicle drivers driving within the speed limit is calculated for each of the study areas. For compliance with the speed limit, calculate the frequency driving within the speed limit from the data extracted from the Microsoft Excel software by using one-sample hypothesis testing. the t-test is used to test if the mean speeds are equal to or below the speed limit. In one sample hypothesis testing, a sample will be tested by using equation 2 which is a normally distributed population with an unknown standard deviation and $n \geq 20$

$$t = \frac{\bar{x}-\mu_0}{s/\sqrt{n}} \qquad \text{Eq.2}$$

4. Results and Discussion

The results of the analysis are discussed based on the data of heavy vehicles that have been collected. This data analysis process is important in a study because the results of this study will determine whether the researcher can achieve the goals of the study or not. The use of Microsoft Excel software is needed to help analysing type and rate of dangerous driving as well as the compliance to the speed limit that will ensure the objectives of the study are achieved.

4.1 Type and Rate of Dangerous Driving

The data shows that there are five serious types and rates of dangerous driving are being committed daily by heavy vehicles drivers at Jalan Batu Pahat-Kluang which can be observed at both pedestrian bridge at Km-15 and Km-24.5 which are shown in Table 2 and Table 3.

Table 2: Types and frequency of dangerous driving by heavy vehicles at Km-15

	Speeding	**Driving in Fast Lane**	**No Indicator**	**Tailgating**	**Overloaded Cargo**	**Total**
Day 1	339	71	24	23	5	**446**
Day 2	298	68	21	10	10	**407**
Day 3	286	51	14	5	5	**361**
Total	923	190	59	38	20	**1230**
Average Per Hour	**76.92**	**15.83**	**4.92**	**3.17**	**1.67**	**102.5**

Table 3: Types and frequency of dangerous driving by heavy vehicles at Km-24.5

	Speeding	Driving in Fast Lane	No Indicator	Tailgating	Overloaded Cargo	Total
Day 1	272	58	15	11	5	**361**
Day 2	276	58	11	9	5	**359**
Day 3	240	59	15	10	3	**327**
Total	788	175	41	30	13	**1047**
Average Per Hour	**65.67**	**14.58**	**3.42**	**2.5**	**1.08**	**82.75**

Table 2 and Table 3 shows that there are five serious types of dangerous driving that are being committed daily by heavy vehicle drivers using the Jalan Batu Pahat-Kluang highway, they are speeding, driving in fast lane, no indicator, tailgating and carrying overloaded cargo. All these are considered to be dangerous for the driver of a heavy vehicle to commit due to the facts that they are exceeding the speed limit and endangering other road users.

From Table 2, speeding is the most committed by drivers observed from Km-15 with an average of 76.92 vehicles per hour followed by driving in fast lane with 15.83 vehicles per hour, no indicator with 4.92 vehicles per hour, tailgating with 3.17 vehicles per hour and the least is overloaded cargo with 1.67 vehicles per hour. For Km-24.5 which can be seen in Table 4.2, driving in fast last is the most committed type of dangerous driving with an average of 65.67 vehicles per hour, followed by speeding with 10.83 vehicles per hour, no indicator with 3.42 vehicles per hour, tailgating with 2.50 vehicles per hour and overloaded cargo with 1.08 vehicles per hour. Overall, there are more dangerous driving being committed at Km-15 with 102.5 total dangerous driving committed by vehicles per hour compared to 82.75 vehicles per hour at Km-24.5. This can be explained because Km-24.5 is a much busier highway than the traffic at the Km-15 with more commercial area nearby as well as more junctions and the drivers need to drive more carefully compared to Km-15 which are less busy and have fewer junctions.

4.2 Poisson Probability Method

Poisson Probability Method was used to analyse the data to get the rate of the likelihood for heavy vehicles driver committing certain dangerous behaviour at a certain time interval. Poisson probability method will be applied to the number of offences per hour for both locations at Km-15 and Km-24.5 but separated by morning peak and afternoon peak. To do this test, the average per hour for the morning peak (10 a.m. – 12 p.m.) and afternoon peak (2 p.m. – 4 p.m.) are calculated. The calculation is shown in Table 4, Table 5, Table 6 and Table 7:

Table 4: Frequency of Km-15 during Morning Peak

	Speeding	Driving in Fast Lane	No Indicator	Tailgating	Overloaded Cargo	Total
Day 1	190	38	11	9	2	**250**
Day 2	138	34	11	6	4	**193**
Day 3	152	27	7	1	4	**191**
Total	480	99	29	16	10	**634**

Average Per Hour	**80.00**	**8.25**	**2.42**	**1.33**	**0.83**	**105.97**

Table 5: Frequency of Km-15 during Afternoon Peak

	Speeding	Driving in Fast Lane	No Indicator	Tailgating	Overloaded Cargo	Total
Day 1	149	33	13	14	3	**212**
Day 2	160	34	11	6	4	**215**
Day 3	134	24	7	4	1	**170**
Total	443	91	31	24	8	**597**
Average Per Hour	**73.83**	**7.58**	**2.58**	**2.00**	**0.67**	**99.50**

Table 6: Frequency of Km-24.5 during Morning Peak

	Speeding	Driving in Fast Lane	No Indicator	Tailgating	Overloaded Cargo	Total
Day 1	135	32	8	3	2	**180**
Day 2	144	33	7	6	4	**194**
Day 3	144	35	10	6	2	**197**
Total	423	100	25	15	8	**571**
Average Per Hour	**70.50**	**16.67**	**4.17**	**2.50**	**1.33**	**95.71**

Table 7: Frequency of Km-24.5 during Afternoon Peak

	Speeding	Driving in Fast Lane	No Indicator	Tailgating	Overloaded Cargo	Total
Day 1	137	26	7	8	3	**181**
Day 2	132	25	4	3	1	**165**
Day 3	96	24	5	4	1	**130**
Total	365	75	16	15	5	**476**
Average Per Hour	**60.83**	**12.50**	**2.67**	**2.5**	**0.83**	**79.33**

Average per hour for each type of dangerous driving by heavy vehicles drivers are taken as μ that is used in the Poisson probability formula whereas e is equal to 2.71828 that is originally from the formula itself which will be constant through the analysis. At least 20 times dangerous driving will be committed where the statement will be written as $P(x \geq 20)$. By using the Poisson probability formula, graphs have been charted which shows the probability mass function for the number of dangerous driving in an hour as shown in Figure 2.

Figure 2 shows the highest and lowest likelihood of dangerous driving are being committed by heavy vehicles driver during the morning peak at Km-15. Speeding will be the most committed type of dangerous driving where it will have more than 20 vehicles per hour committing speeding followed by driving in the fast lane occurring eight times with the probability of 13.8%, no indicator occurring two times with the probability of 26% while the least committed will be tailgating and overloaded cargo occurring once with the probability of 35% and 36% respectively..

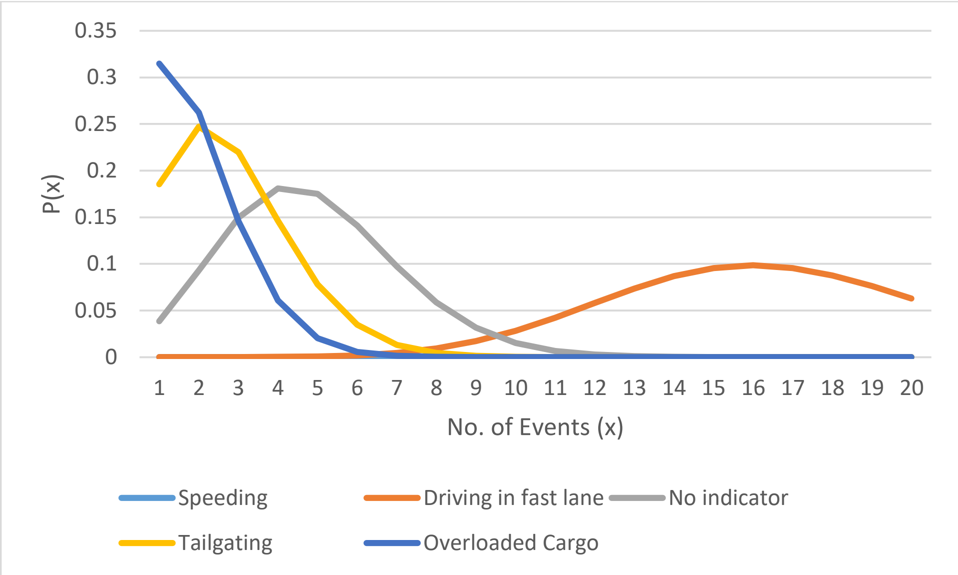

Figure 2: Likelihood of dangerous driving are being committed by heavy vehicles driver during the morning peak at Km-15

Figure 3 shows the highest and lowest likelihood of dangerous driving are being committed by heavy vehicles driver during the afternoon peak at Km-15. Speeding will be the most committed type of dangerous driving where it will have more than 20 vehicles per hour followed by driving in fast lane occurring seven times with the probability of 14.6%, no indicator occurring two times with the probability of 25%, tailgating will occur once or twice with the probability of 27.1 while the least committed will be overloaded cargo occurring once with the probability of 34.2%.

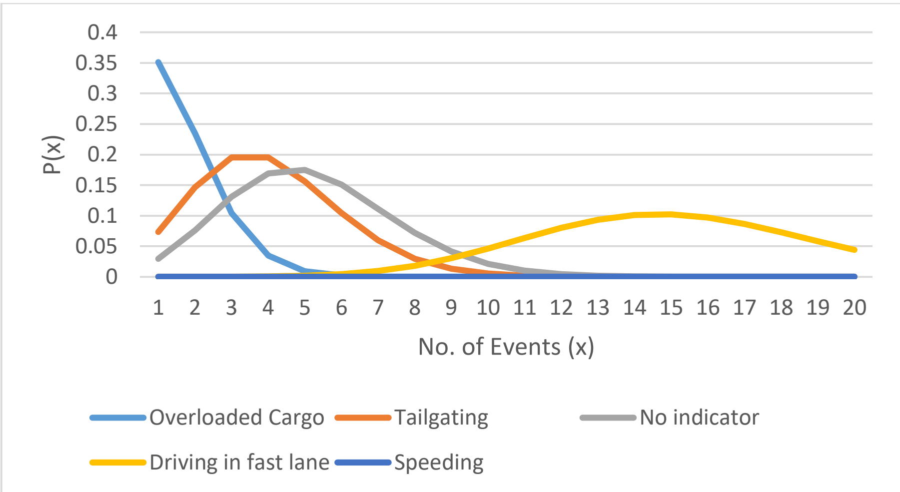

Figure 3: Likelihood of dangerous driving are being committed by heavy vehicles during the afternoon peak at Km-15

Figure 4 shows the highest and lowest likelihood of dangerous driving are being committed by heavy vehicles driver in an hour during the morning peak at Km-24.5. Speeding will be the most committed type of dangerous driving where it will have more than 20 vehicles per hour committing speeding followed by driving in the fast lane which occur 16 times with the probability of 9.8% followed by speeding 13 times with the probability of 10.9%, no indicator occurring four times with the probability of 19.5%, tailgating occurring twice with the probability of 25.7% while the least committed will be overloaded cargo occurring once with the probability of 35.1%.

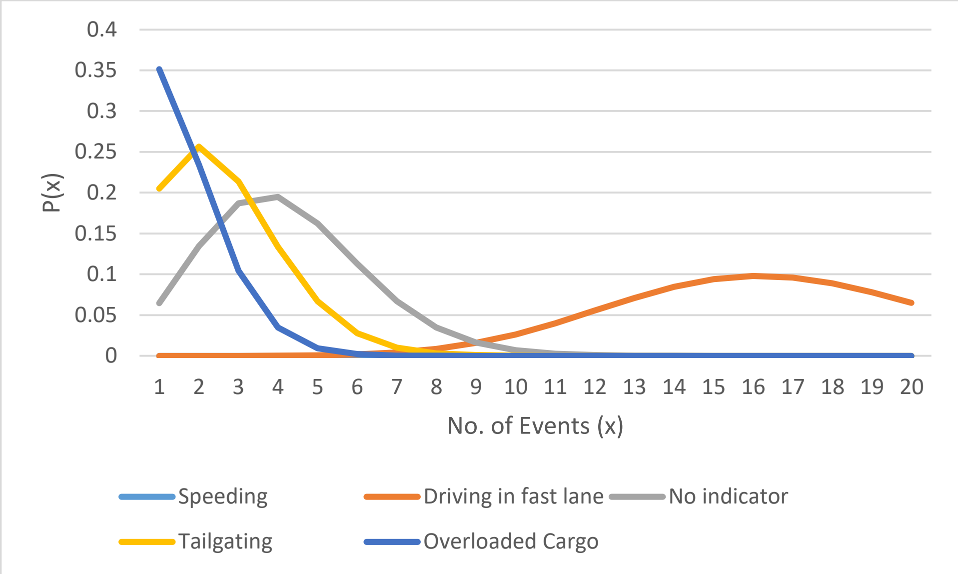

Figure 4: Likelihood of dangerous driving are being committed by heavy vehicles driver in an hour during the morning peak at Km-24.5

Figure 5 shows the highest and lowest likelihood of dangerous driving are being committed by heavy vehicles driver in an hour during the afternoon peak at Km-24.5. Speeding will be the most committed type of dangerous driving where it will have more than 20 vehicles per hour committing speeding followed by driving in the fast lane which occur 12 times with the probability of 11.3% followed by speeding eight times with the probability of 13.9%, tailgating occurring twice with the probability of 25.7%, no indicator occurring twice with the probability of 24.7% while the least committed will be overloaded cargo occurring once with the probability of 36.2%.

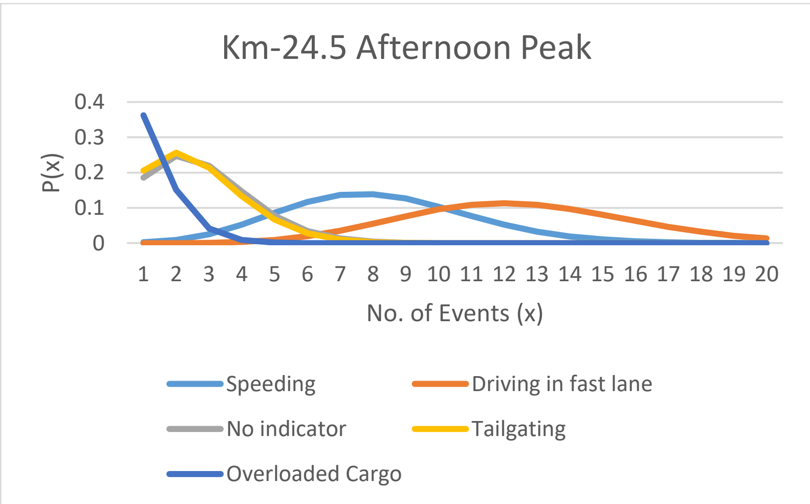

Figure 5: Likelihood of dangerous driving are being committed by heavy vehicles drivers in an hour during the afternoon peak at Km-24.5

4.3 Hypothesis Testing

Data collected have been analysed using a t-test to determine if the driver of the heavy vehicle comply with the highways speed limit of 30 km/h. This test is done to obtain the second objective which is to determine the speed limit compliance among commercial vehicle and bus drivers. The t-test is done to both data that are gathered from Km-15 and Km-24.5 separately. 50 random sample each day from Km-15 and Km-24.5 are used to get the mean speed and standard deviation. the mean speed and the standard deviation for Km-15 is 77.2 km/h and 15.1 respectively while for the mean speed and the standard deviation for Km-24.5 is 68.5 km/h and 18.3 respectively. If the H_0 is rejected, therefore heavy vehicles driver in the location comply with the speed limit of 30 km/h. A level of significance of 0.05 is used in this study to get a higher accuracy on the result. The result of the t-test are shown in Table 8 and Table 9 below:

Table 8: Km-15 t-test

Mean	77.2
Standard Deviation	15.1
Level of Significance	0.05
Degree of Freedom	49
Critical t-value	-1.677
Calculated t-value	22.088

Since the calculated t-value is greater than the critical t-value, therefore H_0 is not rejected and the driver of the heavy vehicle in Km-15 does not comply with the speed limit of 30 km/h.

Table 9: Km-24.5 t-test

Mean	68.5
Standard Deviation	18.3
Level of Significance	0.05
Degree of Freedom	49
Critical t-value	-1.677
Calculated t-value	14.85365

Since the calculated t-value is greater than the critical t-value, therefore H_0 is not rejected and the driver of the heavy vehicle in Km-24.5 does not comply with the speed limit of 30 km/h.

5. Conclusion

As a conclusion, this research found out that the probability of committing dangerous driving is still high. Therefore, the probability of accidents happening is still there while some drivers at Km-15 does not comply with the speed limit is a very dangerous behaviour. A speed trap should be installed to reduce the number of speeding. Hopefully, this research will help other researchers to further their research in road and traffic safety field.

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