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Red Light Running at Uthm Intersection, Batu Pahat, Johor.

Nurul Nadia Mat Sani[1], Basil a/l David Daniel[2]*

[1]Faculty of Civil Engineering and Built Environment,
University Tun Hussein Onn Malaysia, Parit Raja, 86400, Malaysia

[2]Smart Driving Research Center (SDRC), Faculty of Civil Engineering and Built Environment,
Universiti Tun Hussein Onn Malaysia, Parit Raja, 86400, Malaysia

*Corresponding Author Designation

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Abstract: Red lights running at intersections often steal the attention of the Malaysian public, which could result in road accidents. Although various alternatives have been introduced such as campaigns, education and law enforcement, they are still unable to address this problem. Indirectly, the red light violation at this intersection has contributed to an increase in accidents in Malaysia. Therefore, a study of red light running at the UTHM intersection was conducted to investigate whether these red light running violations occurred during peak or off-peak times and also to determine whether these red light running violations were associated with time and green cycles. The study area was conducted at the UTHM intersection which focused on vehicles that violated red traffic lights by class vehicles such as motorcycles, cars, small trucks and trucks and buses. Video recording methods have been used for the data collection process and analyzed using several formulas such as Descriptive Statistical Analysis, Chi-Squared Contingency Analysis, Two-Sample t-Test and Regression Analysis. The results of this study found that red light running violations often occur during peak hours but still did not obtain solid evidence due to no significant difference between the number of violations during peak hours and outside peak hours at UTHM junction. In conclusion, the installation of automatic cameras is one of the easiest ways to control the occurrence of traffic light violations at the UTHM junction and improvements in the cycle time and green time by certain parties need to be done based on current road capacity to increase safety for road users.

Keywords: Red Light Running, Intersection, Traffic Light

1. Introduction

Red light running at intersections are one of the leading causes of accidents that can cause death, injury, and destruction of property in a country. Based on a study in Malaysia, road accidents contribute to the most significant injuries and deaths. For the last five years, the number of accidents at intersections

* *Corresponding author: basil@uthm.edu.my*

recorded in Malaysia has been increasing [1]. One of the causes of accidents at intersections is due to red light running. The issue of red traffic light running often occurs when the festive season arrives. The police have issued a total of 281 summonses in conjunction with the launch of the Op Chinese New Year to road users who do not comply with the red light signal and followed by several other summonses [2].

Red light running at intersections can be attributed to several key factors namely intersection factors such as time and green cycle intervals, human factors such as driver negligence driving in a hurry and environmental factors at the intersection area which is also one of the causes where traffic light violations in user circles apply. Referring to the title of the study that is being conducted, namely the red light running at the intersection of Universiti Tun Hussein Onn Malaysia, it is possible that the red light running occurs due to these factors. This can be seen in the study at Malaysia, almost 6% of motorcycle accidents occur at intersections where the cause of this problem is various and complex, among the most notable is because motorcyclists do not want to comply with traffic lights and commit offenses red traffic light [3].

In this study, red light running at intersections can pose a danger to other road users and result in accidents. Although various alternatives have been introduced such as through campaigns, education and law enforcement it is still not able to address this problem. In general, the main cause of red light running at intersections controlled by traffic lights is due to human and environmental factors. the question is whether the violation of the red traffic light is due to the cycle time and green time that drives the driver to drive dangerously so as to violate the red light or due to other factors. This study was conducted to determine the relationship between red light running with cycle time and green time. In addition, this study is also to investigate where violations of red traffic lights intersect at UTHM during peak hours and off peak hours and their causes.

2. Literature Review

This chapter discusses some of the key components associated with red light running at intersections. In addition, the factors that contribute to the red light running are also discussed based on previous studies. According to the previous research, although the installation of traffic lights aims to control and reduce conflicts between other vehicles, the risk of collisions still exists between vehicles that intersect and involve other road users including pedestrians and bicycles [3].

2.1. Factors That Cause Red Light Running

Driving a vehicle on the road is an activity that can cause stress or emotional disturbance to the driver in general when the driver is faced with various situations that can lead to red light running. Drivers who violate red traffic lights have different characteristics under different traffic flows. During the morning and evening peak hours there will also be an increase in red light running caused by driver behavior, working days, speed limits, vehicle speed at yellow start and distance to stop lines affected by driver behavior violating red traffic lights and finding driver rates which violates the red traffic light below the off-peak hour is greater (0.38%) than the peak hour (0.30%) But from the test results, statistically this difference is not significant. Thus, peak hours cannot affect driver behavior that violates red traffic lights [4].

2.2. Road accidents involving intersections

Intersections are areas where accidents occur frequently because intersections are locations where two or more roads meet each other and there are several activities such as turning left, crossing, and changing directions that can lead to conflict and cause accidents [5]. There are various factors that influence the occurrence of accidents among these factors including the characteristics of traffic and road infrastructure, environmental conditions, vehicles, design and human factors [6].

2.3. Impact and Safety Impact on Red Light Running

Safety at intersections is a hot issue often faced by large countries in the traffic safety management system. Red light running are a major factor contributing to accidents at the store. This is supported by previous study, where nearly 800 deaths and 137,000 injuries occur each year due to red traffic light violations in the United States. In fact, accidents at intersections marked in Australia in Victoria, Western Australia, and Queensland during 1994–98, found that 15% to 21% of accidents occurred in connection with red light running [7]. Around 1992–98, nearly 6,000 people (nearly 850 each year) died in accidents involving red light running in the United States, and another 1.4 million were injured in accidents involving red light running [8].

2.4. Methods of Preventing Red Light Running

Based on the impact and impact of safety it is clear that this red light running leads to an increase in deaths and injuries to road users. Due to that, various methods and alternatives have been implemented to reduce the risk of accidents due to violations of red traffic lights. As has often been done since long ago enforcement from the traffic police has been done to prevent the occurrence of red light running. This is also discussed in the study of Retting et al. (2003), where the main preventive action for accidents caused by red light running is enforcement from the traffic police. Although the control from the traffic police is still not enough because the control from the police does not happen all the time. Due to that, there is a need for the production of systems from the field of engineering to prevent or reduce the occurrence of red traffic light violations.

3. Material and 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. The data obtained were analyzed descriptively by sending qualitative and quantitative data.

3.1. Descriptive Statistical Analysis

This method of analysis provides data in the form of frequency of vehicles committing violations of red traffic light violations as well as numerical and graphical methods to determine the pattern of the data set, summarize the information from the data set and present the information collected from the sample in interesting form. data taken from the vehicle that committed the offense is according to the class set to obtain other data such as the number of types of vehicles that are high in committing the offense.

Class 1 = Motorcycles
Class 2 = Cars
Class 3 = Vans and Small Trucks
Class 4 = Trucks (2 axles and 5 or 6 wheels) and Buses

By conducting an analysis using this method as well as achieving the first objective in this study which is to investigate the rate of red light running at the intersection where the vehicle data that violates red traffic light will be taken and collected to form a graph to identify which class of vehicles are more likely to commit violations red traffic light.

3.2. Chi-Squared Contingency Analysis

This contingency analysis method is used to determine the relationship between vehicle type and non-compliant vehicles and red traffic lights. By using two hypotheses namely H_0 (null hypothesis) and H_1 (alternative hypothesis) for red traffic light violations as follows:

H_0: Adherence to red traffic lights is not affected by the type of vehicle being driven
H_1: Adherence to red traffic lights is influenced by the type of vehicle being driven.

3.3. Two Sample t-test

This Two-Sample t-Test Method is used when each vehicle in the sample is measured twice and the two measurement data are used for comparison. Two sample tests were used to identify whether red light running often occur during peak hours or off peak hours as well as to analyze whether vehicles from Class 1 tend to violate red traffic lights compared to vehicles from Class 2 and beyond for Class 3 and Class 4 vehicles. Using the H_0 hypothesis (null hypothesis) is as follows:

$$H_0 : \mu_1 = \mu_2 \text{ or}$$
$$:\mu_1 - \mu_2 = 0 \text{ or created } (x_1 - x_2)$$

Sample 1
μ_1: red traffic light violations do not occur during peak hours or outside peak hours
μ_2: violations of red traffic lights often occur during peak hours or outside peak hours

Sample 2
μ_1: Vehicles from Class 1 or 2 or 3 or 4 are less likely to violate red traffic lights than vehicles from Class 1 or 2 or 3 or 4
μ_2: Vehicles from Class 1 or 2 or 3 or 4 tend to violate red traffic lights compared to vehicles from Class 1 or 2 or 3 or 4

3.4. Regression Analysis

Linear Regression Analysis is a basic and commonly used type of predictive analysis. This regression estimate is used to explain the relationship between one dependent variable and one or more independent variables. The simplest form of the regression equation with one dependent variable and one independent is determined by the formula y = c + b x, where y = the estimated dependent variable score, c = constant, b = regression coefficient, and x = score on the independent variable.
Linear regression uses two tests to test whether the model used and the estimated coefficient can be found in the general population of the sample taken. First, the F-test tests the entire model. The null hypothesis is that the independent variable has no influence on the dependent variable. In other words the F-test from linear regression tests whether $R^2 = 0$. Second, various t-tests analyze the importance of each coefficient and bypass. The t-test has the null hypothesis that the coefficient / bypass is zero.
Regression Analysis that has been conducted in this study is a Multiple Regression Analysis involving variables Y (number of violations) with variables X1 (time cycle) and X2 (green time), Regression Analysis using variable Y (number of violations) with variables X1 (time cycle) and Regression Analysis using variable Y (number of violations) with variable X2 (green time). These three analyzes will be discussed in the next chapter to find out the relationship between the variables.

4. Result and Discussion

The results of the analysis are discussed based on the data of vehicles that tend to do red light running by vehicle class. 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 analyze cycle time and green time with red light running to ensure the objectives of the study are achieved.

4.1. Descriptive Statistical Analysis

The data were presented in the form of a pie chart in Figure 1 where the data were collected as a whole by vehicle class and formed a percentage and in Table 1 and Table 2 show the data that have been categorized according to peak hours and off peak hours.

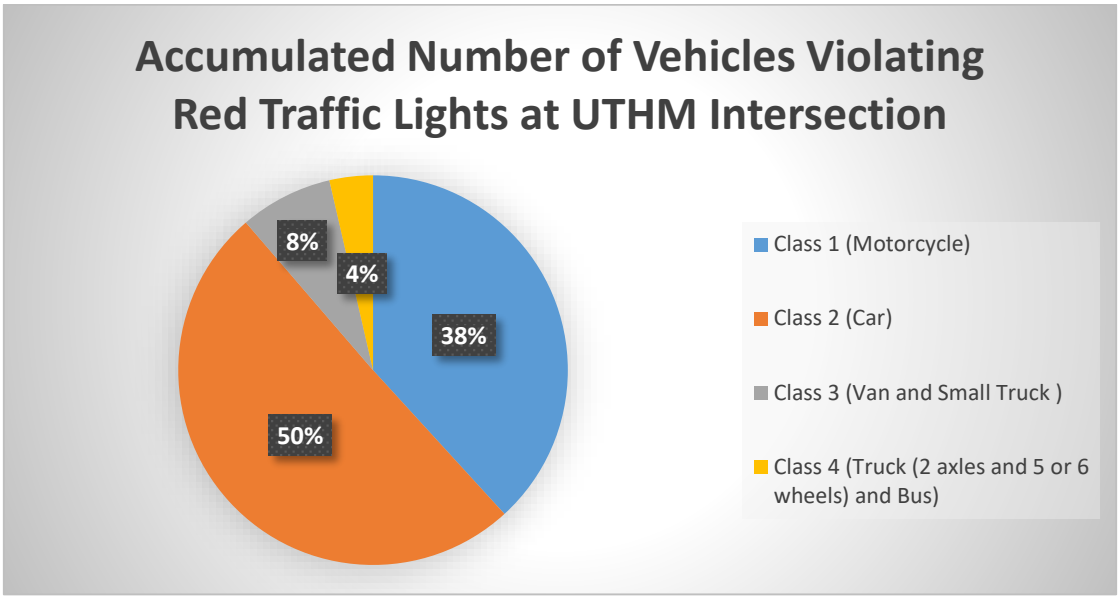

Figure 1: Accumulated Number of Vehicles Violating Red Traffic Lights at UTHM Intersection

The data in Figure 1 can clearly be seen that the accumulated number of vehicles committing the highest traffic light violations was recorded by Class 2 which is 50% and followed by Class 1 by 38% of the total number of vehicles. This is due to the fact that the composition of the vehicle owned by the car and the motorcycle itself is smaller and lighter and allows this vehicle to violate the red traffic light more easily. . For Class 3 and Class 4 respectively recorded a record of red traffic light violations of 8% and 4% respectively because the larger and heavier vehicle composition makes this class of vehicles less red traffic violations.

Table 1: Number of Vehicles Violating Red Traffic Lights at UTHM Intersection Peak Hour

Morning		**Afternoon**		**Evening**	
Average	227	Average	215	Average	235
Minimum	46	Minimum	55	Minimum	1
Maximum	522	Maximum	405	Maximum	525
Total	907	Total	861	Total	939
Day Count	6	Day Count	6	Day Count	6

Table 2: Number of Vehicles Violating Red Traffic Lights at UTHM Intersection Off Peak Hour

Morning		**Afternoon**		**Evening**	
Average	203	Average	165	Average	253
Minimum	40	Minimum	26	Minimum	23
Maximum	352	Maximum	331	Maximum	516
Total	812	Total	660	Total	1012
Day Count	6	Day Count	6	Day Count	6

The number of vehicles violating red traffic lights at UTHM Intersection have been categorized according to peak hours and off peak hours are shown in the Table 1 and Table 2. According to Table 1, the data shows the number of vehicles that violated the red traffic lights at the UTHM intersection during peak hours. The highest average was recorded in the evening of 235 vehicles having violated traffic lights compared to in the morning (227 vehicles) and noon (215 vehicles). The data obtained also shows the minimum and maximum value of the occurrence of red light running occurred in the evening of one vehicle and 525 vehicles compared to morning and noon. This has made the evening as a time where there are many violations of red traffic lights at the intersection of UTHM.
Table 2 shows the number of vehicles that violated red traffic lights at the UTHM intersection off peak hours. The highest average was recorded in the evening of 253 vehicles followed by in the morning of 203 vehicles and in the afternoon of 165 vehicles. The highest total was recorded in the afternoon of 1012, in the morning of 812 vehicles and in the afternoon 660 vehicles. This shows that road users tend to commit offenses of red light running off of peak hours due to weather factors.

4.2. Chi-Squared Contingency Analysis

The analysis found that there was a correlation between the type of vehicle driven and the red light running at the UTHM intersection. This was proved by the calculations made which is the value of χ^2 calculated in Table 3 (26.13) is greater than the critical χ^2 (7.815), *H*o (null hypothesis) will be rejected and *H*1 (alternative hypothesis) has a correlation of the type of vehicle driven and the red light running at UTHM intersection is accepted. The relationship between the vehicle class and the red light running is obvious, this is due to several factors that have been taken into account during the observation process. Among them is the vehicle factor because each vehicle has its own physical characteristics. In addition, the human factor itself is the main driver of the red traffic light running at the UTHM intersection

Table 3: χ^2 Calculation

Observation value (O)	**Prediction Value (E)**	**(O - E)**	**(O - E)²**	**(O - E)² / E**
970	1034.40	-64.40	4147.19	4.01
1452	1366.26	85.74	7350.65	5.38
183	208.82	-25.82	666.67	3.19
102	97.52	4.48	20.09	0.21
1056	991.60	64.40	4147.19	4.18
1224	1309.74	-85.74	7350.65	5.61
226	200.18	25.82	666.67	3.33

89	93.48	-4.48	20.09	0.21
			∑ Total	**26.13**

4.3. Two Sample t-test

This test is done to achieve the first objective which is to investigate the rate of red light running at UTHM intersection at peak hours and ouff peak hours as well as to find out the cause of red light running at UTHM intersection.
Samples were tested and data obtained from the first sample based on the null hypothesis (Ho) made red light running at peak hours are fewer than off-peak hours and Ha found that vehicles committing red light running are more common at peak hour. As a result of these data findings, the F-test was performed and there was no variance equation in the data. Two Sample t-Test Differences Variance shows that the average data for peak hours is 677 vehicles and outside peak hours 649 vehicles. The value of p (0.48) obtained is greater than the value of α (0.05) therefore the null hypothesis (Ho) should be accepted this makes the data obtained is a violation of red light running often occurs off-peak hours. The second sample data found that car drivers were more likely to commit red traffic light violations at the UTHM intersection followed by motorcyclists than drivers from medium to heavy vehicles and other heavy vehicles. The results of observations in the data observation area found that the capacity of the majority of road users is from among car drivers and motorcyclists due to the frequent violations of red traffic lights.

4.4. Regression Analysis

This analysis is divided into two namely violations that occur during peak hours with off peak hours. The data used in this analysis is the number of red light running, the total cycle time and the green time occurring every 15 minutes were recorded. The results of the findings can be seen in Table 4 for peak hours as well as Table 5 for off-peak hours.

Table 4 Multiple Regression (Total Violations with Total Cycles Time and Green Time at Peak Hour)

Multiple R	0.55
R^2	0.30
Adjusted R Square	0.23
Standard Error	35.38
Total Set Data	24

	Coefficients	**P-Value**
Intercept	-664.08	0.18
X1	46.98	0.19
X2	47.76	0.25

Based on the data obtained after conducting regression analysis for peak hours, the R^2 value of the three analyzes recorded 30%, 25% and 24% stating that the cycle time and green time were not too strong to influence from the occurrence of red light running at UTHM intersection. The highest coefficient value

recorded in the green time indicates that the green time more influences the occurrence of red light running at the UTHM intersection at peak hours than the time cycle. To further strengthen the data, the P-value has played an important role where the data results show 0.01 and 0.02 in the second and third regression analysis. This, making the correlation between the number of violations with the cycle time and green time is also a cause of red light running at the UTHM intersection.

Table 5 Multiple Regression (Total Violations with Total Cycles Time and Green Time at Off-Peak Hour)

Multiple R	0.18	
R^2	0.03	
Adjusted R Square	-0.06	
Standard Error	52.11	
Total Set Data	23	
	Coefficients	**P-Value**
Intercept	-885.45	0.49
X1	86.19	0.43
X2	-199.48	0.51

Regression analysis data for off-peak hours found that the R^2 value for all three analyzes recorded very low values of 3%, 1% and 0%. This clearly indicates that there is no correlation stating that the cycle time and the green time affect from the occurrence of red light running at the UTHM intersection. The coefficient value of the three data recorded positive values for variable X1 and negative for variable X2. It can be explained that the time cycle time still affects the number of red light running at the UTHM intersection compared to the green time which has nothing to do. The strength of the data can be ascertained by looking at the P-value where the value obtained is too far from the value of 0.05 which is a measure in ensuring that there is a strong correlation in this correlation.

5. Conclusion and Recommendation

The results of the data that have been analyzed for red traffic light violations at the UTHM intersection show that most red light running occur during peak hours of 2707 vehicles compared to off-peak hours of 2595 vehicles but there are still errors in the data done which causes Hypothesis zero (Ho) had to be accepted in the Two-Sample t-Test because the study found no significant difference between the number of violations during peak hours and off-peak hours. In addition, the study found that the cycle time and green time still affect the number of red traffic light violations, especially at peak hour such as the data obtained in the Regression Analysis which recorded a positive coefficient value.

Based on the conclusions that have been made, traffic light violations often occur regardless of peak hours or off-peak hours. It is natural for a human being if the law is tightened they will start to obey something just like road users, users will abide by the rules of a road if in the area has a strict control system therefore the installation of automatic cameras is a way that easiest to control from the occurrence of traffic light violations at the UTHM intersection. The conclusions that have been made show that the effects of the cycle time and the green time also to some extent affect the violation of red traffic lights at the UTHM junction. Therefore, the parties involved need to make or review the cycle time and the green time at the UTHM intersection which is now sufficient with the density of road capacity, especially during peak hours.

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