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# Spot Speed Study at Jalan Tun Fuad Stephens, Kota Kinabalu in Sabah

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**Abstract**

Spot speed study is crucial in the development of traffic and highway engineering since the data obtained from this study required for establishment of speed trends, traffic control planning, accident and geometry design. An interval of 100m long path at Jalan Tun Fuad Stephens, 88200 Kota Kinabalu in Sabah selected as the study area and peak hour is avoided to assure the accuracy of the study. The result shows 85th percentile of vehicle speed set as the speed limit. However, strengthening on law enforcement, as well as other possible and useful options, shall be taken in order to reduce the probability of accidents to happen. This study will be beneficial especially for the use of transportation planning in the nearby area.

***Keywords: Spot Speed Study, Arithmetic Mean Speed, Speed Limit, Pedestrian Signal Timing, Law Enforcement***

## 1. Introduction

Speed is the ratio of travelled distance and time spent during a given period [1]. Speed is also one of the macroscopic parameters for fundamental traffic stream parameters which used to characterise the traffic as a whole [2]. Commonly, speed is used to describe the quality of journey and the performance of the road network in accommodating traffic demand as it is related to safety, comfort, time, economics and convenience.

There are various factors will affect the speed such as characteristics of the driver, traffic composition and type of area. For example, increased speed limits at the areas with severe conditions of weathers are found to have a straightforward positive relationship with accident occurrence. Regarding the effects of weather, the impact of precipitation is considered persistent and generally leads to escalated accident frequency [3]. Besides, maladjusted driving such as delayed reactions and aggressive driving is also one of the causes that affect the driver increases the speed and leads to the traffic accident. Strong emotions in the driver are the keys that influence such behavioural pattern of the driver. Based on the past study, anger causes to fast acceleration and higher speeds even for 2 km after the emotion-eliciting event such as slow car or obstacle on the road [4]. It showed that the emotion of a driver would primarily affect the driving behaviour and increase the probability of traffic accident to occur.

Several types of speed such as running speed, time mean speed and space mean speed is essential for traffic engineering, spot speed certainly will be one of them as well. Spot speed studies are essential in the determination of speed distribution for a traffic stream at a particular location [5]. It is also known as the instantaneous speed of a vehicle pass through a point on the roadway. One of the objectives to conduct spot speed study is to determine existing traffic operations and evaluate the devices for traffic control. Proper speed limits have to be evaluated and identified in order to avoid the occurrence of traffic accidents. Sudden changes in speed limit might lead to unfavourable traffic operational characteristics such as erratic decelerations, high speed and high-speed variances [6]. Each of them are related to a higher probability of crash occurrence.

Besides, spot speed study plays a crucial role in establishing roadway design elements. A proper roadways design is desired to construct a roadway that having a harmonious relationship between actual operating speed, desired operating speed and posted speed limit. With the assist of significant data from spot speed study, geometric conditions consist of persistent operating speed with driver expectation and commensurate with the function of the roadway can be produced [7]. For example, comfortable design for road alignments and stopping sight distance can

be established with high accuracy data from spot speed study. Moreover, spot speed study helps in measuring the effectiveness of traffic programs or traffic control devices such as speed enforcement programs, traffic operational changes, signs and markings [8] — advisory speed limits that posted at critical locations determined by spot speed study. In order to ensure the considerable margins of safety mainly utilised to design speed is still applicable, regular testing for spot speed is needed as well as carefully conduct since it related with lives.

Since the data collected from the spot speed study is vital, hence it is be collected, analysed and presented excellently. During the process of data collection, the method procedures must be strictly followed to avoid any error which will decrease the accuracy of the data. In this study, the selected study area is at Jalan Tun Fuad Stephens, 88200 Kota Kinabalu in Sabah.

## 2. Methodology

The data is obtained manually by the assist of a mobile phone and analysed using several formulas. The apparatus and instruments needed for this study are mobile phones, notepad and pen. The detail of the location chosen is next to the statue of "The Jaw" in Teluk Likas in the direction from Kota Kinabalu to University Malaysia Sabah as this location fulfils the condition to conduct the study. After that, the exact location within this path is then selected based on the two conditions in which the path have to be 100 m long, and vehicle should be able to speed along that pathway. The time for this study to conduct is set at 3 pm at noon in order to avoid peak hour, since the traffic jam might occur during peak hour and causes the delay of the whole experiment.

An interval of 100 m long is then measured and coordinated with the help of Samsung Health Data with Google Fit. This apps allows smartphones owners to collect and show data from fitness wearables that supported it as well as provide information such as walking distance [9]. With measured distance on hand, two groups of people are required to stand on the beginning and final point of the path. The minimum requirement of people to form a group is two people. Then, two groups were synchronised to start recording the experiment at the same time for 100 vehicles passed along the path. The sample size collected should fulfil the minimum requirement where the number of vehicles has to be larger than 80 but less than 150.

After finishing recording, the time for a vehicle to travel from the beginning to the final point, then identified by comparing with both videos for all 100 vehicles. The speed (km/h) of each vehicle is then calculated based on distance in kilometre (km) divided by time (h). Based on the calculated values of speed, data are tabulated, and then histogram, ogive and frequency distribution were plotted to determine the critical parameters of this study. Descriptive speed characteristics such as mean, mode, median, 15th percentile speed, 85th percentile speed and standard deviation were computed to answer the primary questions for the spot speed study.

The arithmetic mean speed is determined by using formula below:

$$\bar{u} = \frac{\sum fu}{\sum N} \quad (1)$$

Where,

u is speed of vehicle
N is number of vehicle
f is frequency of vehicle at specific range of speed

The arithmetic mode speed is determined by using formula below:

$$Mode\ speed = L + h\left(\frac{f_m - f_1}{2f_m - f_1 - f_2}\right) \quad (2)$$

Where,

L is lower boundary of modal class
h is size of modal class
$f_m$ is frequency corresponding to modal class
$f_1$ is frequency preceding to modal class
$f_2$ is frequency proceeding to modal class

The arithmetic median speed is determined by using formula below:

$$Median\ speed = L_m + \left(\frac{\frac{n}{2} - cf_m}{f_m}\right)i \quad (3)$$

Where,

$L_m$ is lower boundary of the range of median
n is number of samples overall
$cf_m$ is cumulative frequency of all cell below $L_m$

$f_m$ is frequency of median cell
i is cell interval

The standard deviation is determined by using formula below:

$$s = \sqrt{\frac{\sum f(u-\bar{u})^2}{\sum(N-1)}} \quad (4)$$

Where,

u is speed of vehicle
N is number of vehicle
ū is mean speed
f is frequency of vehicle at specific range of speed

## 3. Results and Discussion

The data obtained were tabulated into table 1 and results were presented and discussed below.

Table 1: Frequency distribution of 100 vehicles in Jalan Tun Fuad Stephen

| Speed Class (km/h) | Class Mid-value (u) | Class Frequency (f) |
|---|---|---|
| 0-9 | 5 | 0 |
| 10-19 | 15 | 0 |
| 20-29 | 25 | 3 |
| 30-39 | 35 | 10 |
| 40-49 | 45 | 34 |
| 50-59 | 55 | 35 |
| 60-69 | 65 | 16 |
| 70-79 | 75 | 2 |
| Total | | 100 |

Based on the tabulated data, a histogram and a frequency distribution were established and presented in figure 1 and figure 2 respectively. By using the formulas above, the values for the mean, median, and mode of motorcars speed obtained for the experiment are 50.7 km/h, 50.38 km/h and 50 km/h respectively. The mean speed of 50.7 km/h indicates that the road users around Jalan Tun Fuad Stephen drive with an average speed of 50.7 km/h along that specific 100 m road. The mode speed of 50 km/h represents that 50 km/h is the speed that most of the vehicles travelled with along that 100 m length of the road. The median is the value dividing the 50 % higher value from the 50 % lower value of a data sample. The median speed of 50.38 km/h shows the typical driving speed at the 100 m road at Jalan Tun Fuad Stephen. Furthermore, the calculated standard deviation of 10.37 km/h indicates the data is slightly spread out over a broader range of values.

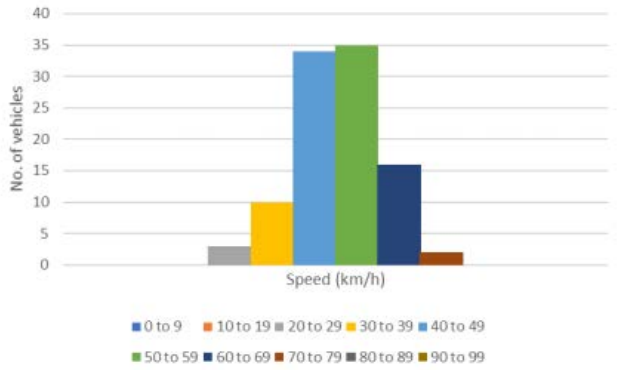


Figure 1: Histogram of number of vehicles vs speed.

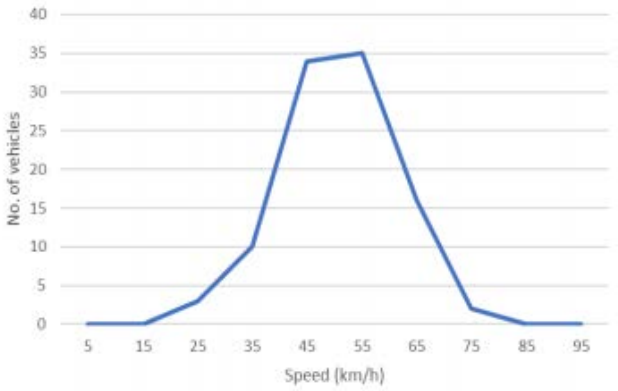


Figure 2: Frequency distribution of number of vehicles vs speed.

The 50th percentile and 85th percentile are crucial to understanding because they are the method to identify the practical and suitable aped limits. Based on the ogive is figure 3, the 50th percentile found as 50.38 km/h shows the average speed of the traffic stream at the 100 m road selected is 50.38 km/h. On the other hand, the 85th

percentile is the standard used to determine the highest speed limits. From the result of this experiment, the value for 85th percentile is 56 km/h. The maximum vehicle speed recorded is 72 km/h which is higher than the value for 85th percentile. However, since there are only 18 vehicles (18%) exceeding the vehicle speed for the 85th percentile, and there are only a few vehicles drive with the maximum speed. Therefore speed limit can still be set with the value of 85th percentile which is 56 km/h since it is because 56 km/h is still higher than the mean vehicle speed, 50.7 km/h and the mode vehicle speed, 50 km/h. Moreover, the 15th percentile is also one of the critical information that should be known for pedestrian signal timing design. Based on the result, the value of 15th percentile vehicle speed is 36 km/h which fulfils the requirement for pedestrian signal timing design since it is higher than the minimum speed obtained with a value of 26 km/h.

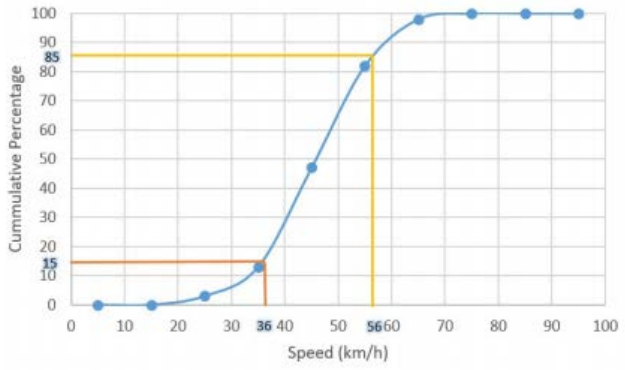


Figure 3: Ogive of cumulative percentage vs speed.

Even though the experiment is carried out successfully, the data collected cannot be said entirely correct due to human error. The accuracy of data can be increased by using a proper instrument such as a radar gun. Another possible factor that will cause the data to become less accurate is due to the actions of drivers. Some of the drivers may notice about the task we did so they will slow down the cars instead of drive like usual speed. This situation can be solved by secretly taking the time without being noticed by the drivers. Besides, this data can only be used when the road condition is dry because the speed may be different when the road condition is wet. Moreover, the duration of the experiment is too short for a complete and accurate set of data. In order to obtain a more accurate set of data, the experiment should conduct for a few more times under different road conditions, weather conditions and at different times of the day.

## 4. Conclusions

In summary, a study to find out the distribution of vehicles speeds in a stream of traffic at Jalan Tun Fuad Stephen, Kota Kinabalu was conducted. The objectives of this study achieved as a table of required data then constructed and three figures which consist of the histogram, frequency distribution and ogive were developed. A final summary of essential parameters then tabulated in table 2 in order to let readers have a better understanding regarding the result.

Table 2: Summary of result

| Element | Value (km/h) |
|---|---|
| **Mean** | **50.70** |
| **Median** | **50.38** |
| **Mode** | **50.00** |
| **15$^{th}$ Percentile** | **36.00** |
| **85$^{th}$ Percentile** | **56.00** |
| **Standard Deviation** | **10.37** |
| **Maximum speed** | **72.00** |
| **Minimum speed** | **26.00** |
| **Speed Range** | **46.00** |

Based on the data collected, 85th percentile of vehicle speed can be set as a speed limit because it is still higher than the mean vehicle speed. However, law enforcement still can be strengthened due to a few of the vehicles travel with higher vehicle speeds. On the other hand, the pedestrian signal timing design is acceptable in order to ensure the safety.

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