Spot Speed Study

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I. INTRODUCTION

Speed –

Speed is an important measure of the quality of travel and safety of road network. By definition, it is the rate of movement of a vehicle in distance covered per unit time. When the time interval used is minimized, we get the Instantaneous Speed of a vehicle.

Speed, in a Transportation Engineering sense, is an important transportation consideration because it relates to safety, time, comfort, convenience, and economics.

Spot Speed –

Spot speed is defined as the average speed of vehicles passing a point. It is the instantaneous speed of a vehicle at a specified location. It is an indicator used by traffic engineers to measure the speed of vehicles under free flow conditions.

Measuring Spot Speed using Radar Gun

Spot Speed Study –

A spot speed study is performed by measuring the individual speeds of a sample of vehicles passing a given point (spot) on a street or highway.

The Vehicle Spot Speed Study is designed to measure the speed characteristics at a specified location under the traffic and environmental conditions prevailing at the time of the study. The speed characteristics of the samples are then used to estimate the speed distribution of the entire traffic stream.

Purpose of Spot Speed Studies –

Spot speed data are used in many traffic engineering activities such as determining traffic signal timing, roadway capacity, evaluating the effectiveness of improvements, and installing speed zones.

Spot speed can be used to design the geometry of road like horizontal and vertical curves, super elevation etc. Location and size of signs, design of signals, safe speed, and speed zone determination, require the spot speed data. Accident analysis, road maintenance, and congestion are the modern fields of traffic engineer, which uses spot speed data as the basic input.

II. DATA COLLECTION

Steps required to perform the study –

1. Organize Study Plan –
    a. It is essential to identify the reason for conducting the study and the nature of the problem to be evaluated.
    b. The timing of the study should be consistent with the reason for conducting the study.
    c. Speed data should be collected for a minimum of one hour and should observe at least 30 vehicles.

2. Select Data Collection Method –
    a. Some of the methods used to collect Spot Speed Data:
        i. Stopwatch Method
        ii. Radar Detectors/Speed Gun Method
        iii. Pneumatic Road Tube Method

b. This study was conducted using Radar Speed Gun, which works on the principle of Doppler Effect.

3. Select Appropriate Site for Data Collection –
    a. The specific location should be chosen carefully.
    b. Recorded speeds should reflect how vehicles typically travel along unimpeded sections of the road under free flow conditions.

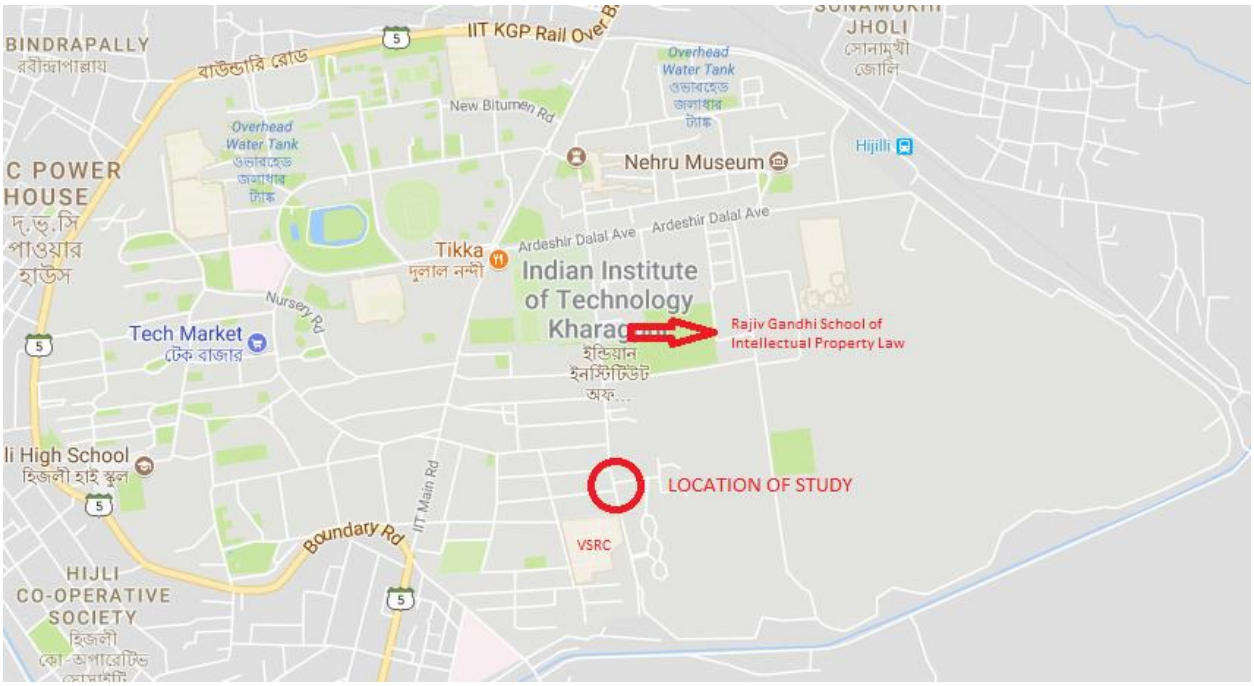
4. Precautions to be taken –
    a. During data collection, one should ensure that they are invisible to the drivers.
    b. The gun should be targeted as parallel to the direction of motion as possible. The maximum permissible angle for measurements is 10°.
    c. The readings should be taken when the vehicle is moving away from the observer.

5. Reduce and Analyse Data –
    a. Tabulate the collected data.
    b. Identify key parameters associated with roadways speed, which may include:
        i. Mean Speed
        ii. Speed Variance or Standard Deviation
        iii. Median Speed (50^{th} percentile speed)
        iv. 15^{th}, 85^{th}, 98^{th} percentile speeds
    c. 85th percentile speed is typically used as a baseline for establishing the speed limit.

6. Interpret and Report Findings –
    a. Answer the primary questions for which the study was originally initiated.
    b. Find relations between different factors that affect traffic flow.
    c. Suggest some recommendations and a state the functionality of current speed-curbing measures applied (e.g. speed bumps etc.).

III. STUDY LOCATION AND LOCATION CONDITIONS DURING THE TIME OF STUDY

Location of Study –



Description: Road stretch between Law School and VSRC Guest House – In front of the second speed bump.

Second Speed Breaker from Law School to VSRC – Location of Study

Performing Spot Speed Test

Date of Survey:	Tuesday, 14 August 2018
Start Time of Survey:	3:00 PM
End Time of Survey:	4:30 PM
Weather Conditions:	Overcast Sky, Drizzling
Traffic Conditions:	Free Flow – Very Light to Light Vehicular Flow
Posted Speed Limit:	30 km/hr
Instrument Used:	Radar Speed Gun

IV. ANALYSIS OF RECORDED DATA

For the purposes of the Spot Speed Study, 2 sets of data were taken:

i. Before the Speed Bump
ii. After the Speed Bump

The direction of vehicular flow was set as VSRC to Law School. The readings were taken when the vehicle was approximately 30m from the bump.

The data was further differentiated based on vehicle type:

a) Data for Motorbikes – e.g. bikes, scooters etc.
b) Data for Cars

The observed data should, in theory, help us identify the effectiveness of the speed bump at the given location.

I) Before Speed Bump (closer to VSRC):

1. OBSERVED DATA

Collected Raw Data			
MOTORBIKE		CAR	
Serial No.	Speed (KMPH)	Serial No.	Speed (KMPH)
1	37	1	42
2	32	2	20
3	32	3	32
4	30	4	21
5	36	5	41
6	21	6	31
7	35	7	40
8	31	8	38
9	28	9	35
10	34	10	25
11	36	11	29
12	31	12	37
13	38	13	26
14	24	14	30
15	20	15	30
16	29	16	31
17	33	17	32
18	28	18	24
19	39	19	30

20	30	20	40
21	23	21	40
22	33	22	34
23	35	23	24
24	31	24	29
25	36	25	31
26	28	26	37
27	31	27	31
28	29	28	29
29	28	29	26
30	34	30	28
Total Number of Readings	**30**	**Total Number of Readings**	**30**

2. CALCULATIONS ON COLLECTED DATA

a) MOTORBIKES

Data collection for Spot-Speed Study Experiment (MOTORBIKE)						
Serial No.	**Higher Speed**	**Mid Speed**	**Lower Speed**	**Frequency**	**Frequency (%)**	**Cumulative Frequency (%)**
1	16.5	17	17.5	0	0.000000%	0.000000%
2	17.5	18	18.5	0	0.000000%	0.000000%
3	18.5	19	19.5	0	0.000000%	0.000000%
4	19.5	20	20.5	1	3.333333%	3.333333%
5	20.5	21	21.5	1	3.333333%	6.666667%
6	21.5	22	22.5	0	0.000000%	6.666667%
7	22.5	23	23.5	1	3.333333%	10.000000%
8	23.5	24	24.5	1	3.333333%	13.333333%
9	24.5	25	25.5	0	0.000000%	13.333333%
10	25.5	26	26.5	0	0.000000%	13.333333%
11	26.5	27	27.5	0	0.000000%	13.333333%
12	27.5	28	28.5	4	13.333333%	26.666667%
13	28.5	29	29.5	2	6.666667%	33.333333%
14	29.5	30	30.5	2	6.666667%	40.000000%
15	30.5	31	31.5	4	13.333333%	53.333333%
16	31.5	32	32.5	2	6.666667%	60.000000%
17	32.5	33	33.5	2	6.666667%	66.666667%
18	33.5	34	34.5	2	6.666667%	73.333333%
19	34.5	35	35.5	2	6.666667%	80.000000%

20	35.5	36	36.5	3	10.000000%	90.000000%
21	36.5	37	37.5	1	3.333333%	93.333333%
22	37.5	38	38.5	1	3.333333%	96.666667%
23	38.5	39	39.5	1	3.333333%	100.000000%
24	39.5	40	40.5	0	0.000000%	100.000000%
25	40.5	41	41.5	0	0.000000%	100.000000%
26	41.5	42	42.5	0	0.000000%	100.000000%
27	42.5	43	43.5	0	0.000000%	100.000000%
28	43.5	44	44.5	0	0.000000%	100.000000%

b) CARS

Data collection for Spot-Speed Study Experiment (CAR)						
Serial No.	**Higher Speed**	**Mid Speed**	**Lower Speed**	**Frequency**	**Frequency (%)**	**Cumulative Frequency (%)**
1	16.5	17	17.5	0	0.000000%	0.000000%
2	17.5	18	18.5	0	0.000000%	0.000000%
3	18.5	19	19.5	0	0.000000%	0.000000%
4	19.5	20	20.5	1	3.333333%	3.333333%
5	20.5	21	21.5	1	3.333333%	6.666667%
6	21.5	22	22.5	0	0.000000%	6.666667%
7	22.5	23	23.5	0	0.000000%	6.666667%
8	23.5	24	24.5	2	6.666667%	13.333333%
9	24.5	25	25.5	1	3.333333%	16.666667%
10	25.5	26	26.5	2	6.666667%	23.333333%
11	26.5	27	27.5	0	0.000000%	23.333333%
12	27.5	28	28.5	1	3.333333%	26.666667%
13	28.5	29	29.5	3	10.000000%	36.666667%
14	29.5	30	30.5	3	10.000000%	46.666667%
15	30.5	31	31.5	4	13.333333%	60.000000%
16	31.5	32	32.5	2	6.666667%	66.666667%
17	32.5	33	33.5	0	0.000000%	66.666667%
18	33.5	34	34.5	1	3.333333%	70.000000%
19	34.5	35	35.5	1	3.333333%	73.333333%
20	35.5	36	36.5	0	0.000000%	73.333333%
21	36.5	37	37.5	2	6.666667%	80.000000%
22	37.5	38	38.5	1	3.333333%	83.333333%
23	38.5	39	39.5	0	0.000000%	83.333333%
24	39.5	40	40.5	3	10.000000%	93.333333%
25	40.5	41	41.5	1	3.333333%	96.666667%

26	41.5	42	42.5	1	3.333333%	100.000000%
27	42.5	43	43.5	0	0.000000%	100.000000%
28	43.5	44	44.5	0	0.000000%	100.000000%

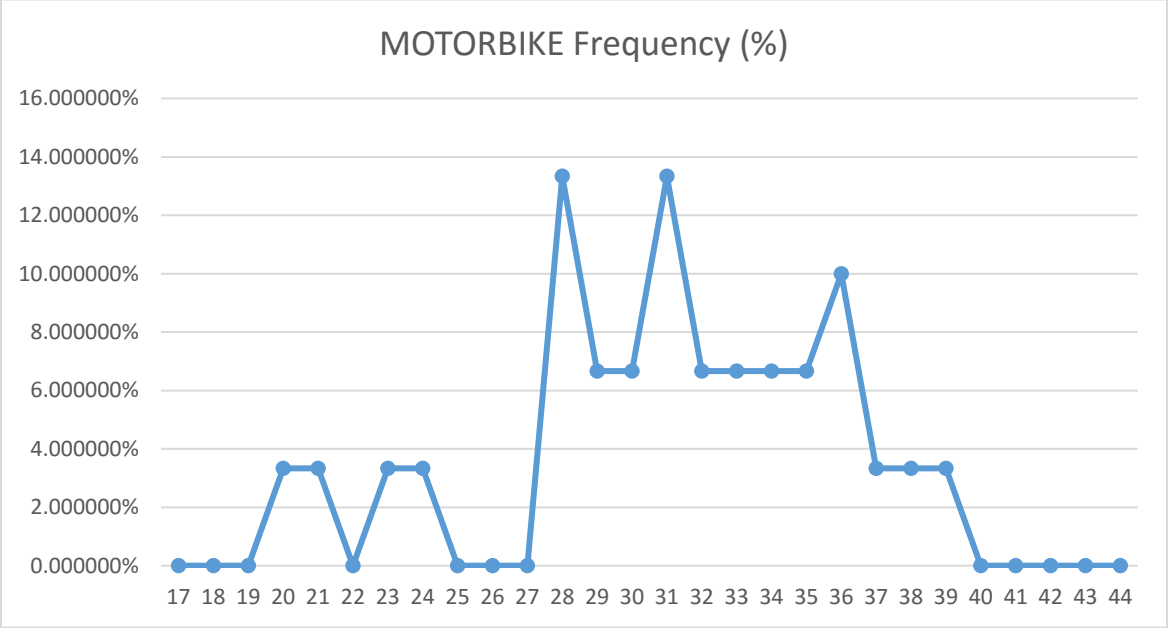
3. RESULTS

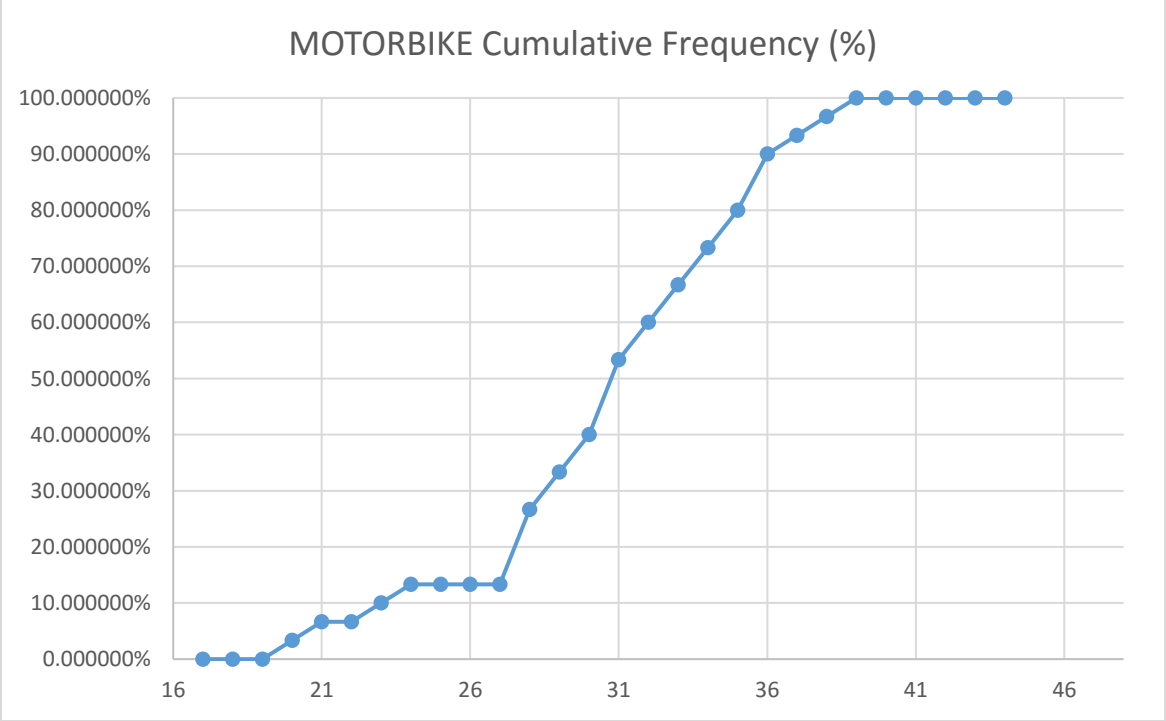
RESULTS			
MOTORBIKE		CAR	
Mid Speed	Frequency (%)	Mid Speed	Frequency (%)
17	0.000000%	17	0.000000%
18	0.000000%	18	0.000000%
19	0.000000%	19	0.000000%
20	3.333333%	20	3.333333%
21	3.333333%	21	3.333333%
22	0.000000%	22	0.000000%
23	3.333333%	23	0.000000%
24	3.333333%	24	6.666667%
25	0.000000%	25	3.333333%
26	0.000000%	26	6.666667%
27	0.000000%	27	0.000000%
28	13.333333%	28	3.333333%
29	6.666667%	29	10.000000%
30	6.666667%	30	10.000000%
31	13.333333%	31	13.333333%
32	6.666667%	32	6.666666%
33	6.666667%	33	0.000000%
34	6.666667%	34	3.333333%
35	6.666667%	35	3.333333%
36	10.000000%	36	0.000000%
37	3.333333%	37	6.666666%
38	3.333333%	38	3.333333%
39	3.333333%	39	0.000000%
40	0.000000%	40	10.000000%
41	0.000000%	41	3.333333%
42	0.000000%	42	3.333333%
43	0.000000%	43	0.000000%
44	0.000000%	44	0.000000%

RESULTS			
MOTORBIKE		CAR	
Mid Speed	Cumulative Frequency (%)	Mid Speed	Cumulative Frequency (%)
17	0.000000%	17	0.000000%
18	0.000000%	18	0.000000%
19	0.000000%	19	0.000000%
20	3.333330%	20	3.333333%
21	6.666667%	21	6.666666%
22	6.666667%	22	6.666666%
23	10.000000%	23	6.666666%
24	13.333333%	24	13.333333%
25	13.333333%	25	16.666667%
26	13.333333%	26	23.333333%
27	13.333333%	27	23.333333%
28	26.666667%	28	26.666667%
29	33.333333%	29	36.666667%
30	40.000000%	30	46.666667%
31	53.333333%	31	60.000000%
32	60.000000%	32	66.666667%
33	66.666667%	33	66.666667%
34	73.333333%	34	70.000000%
35	80.000000%	35	73.333333%
36	90.000000%	36	73.333333%
37	93.333333%	37	80.000000%
38	96.666667%	38	83.333333%
39	100.000000%	39	83.333333%
40	100.000000%	40	93.333333%
41	100.000000%	41	96.666667%
42	100.000000%	42	100.000000%
43	100.000000%	43	100.000000%
44	100.000000%	44	100.000000%

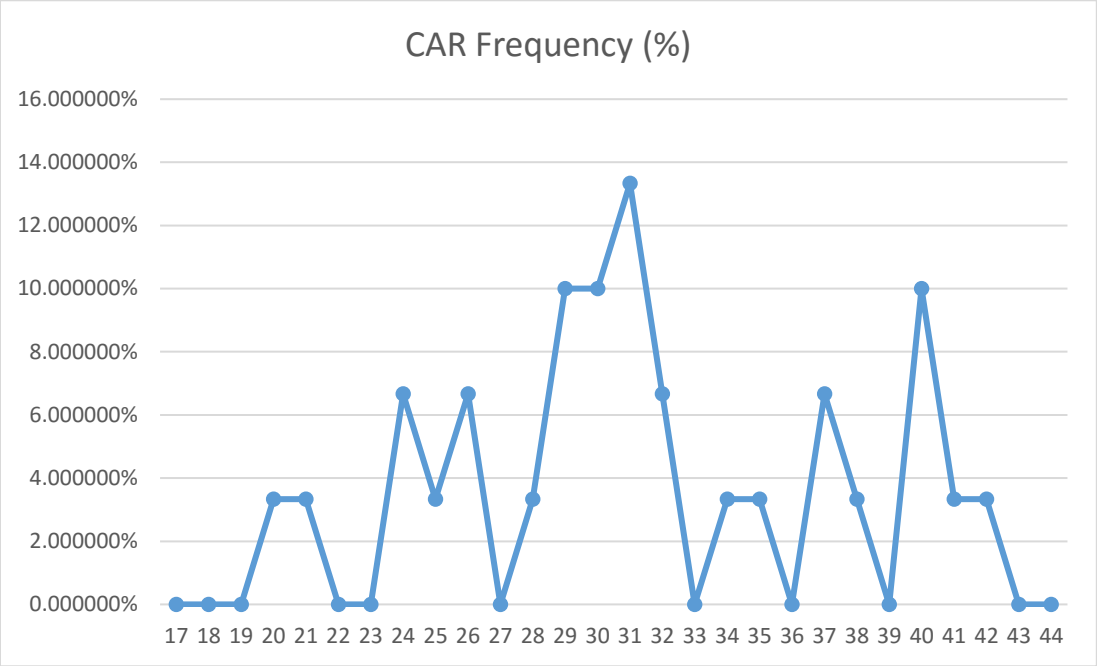
4. GRAPHICAL REPRESENTATION OF DATA

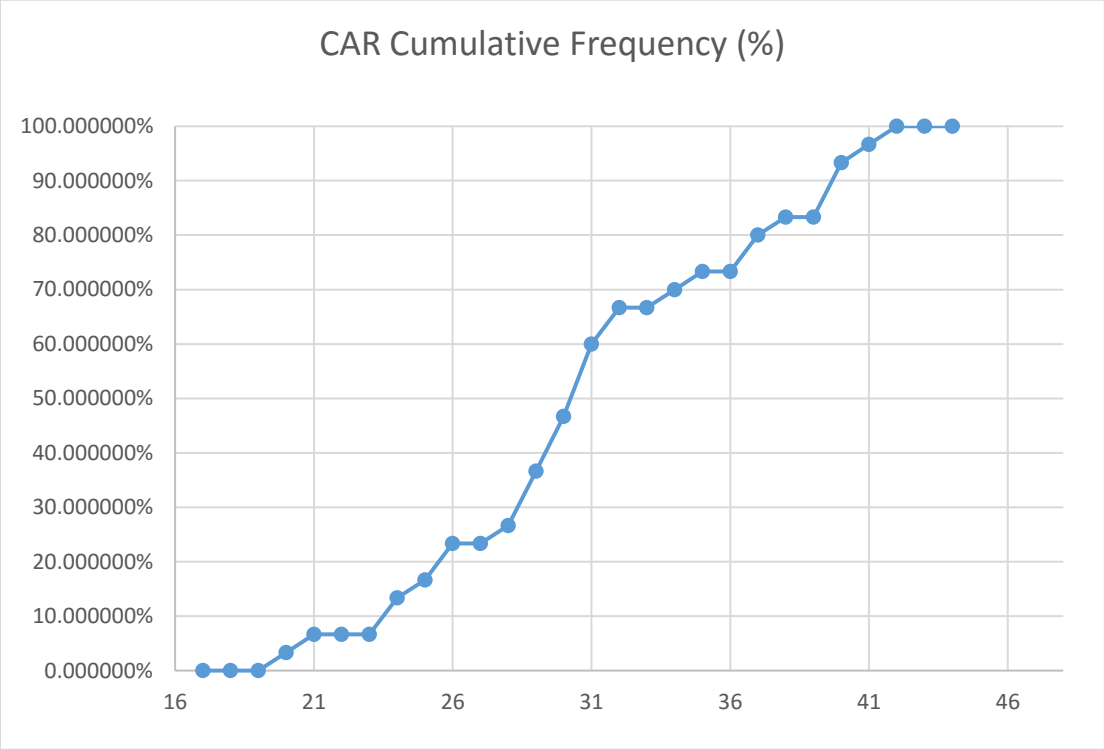
a) MOTORBIKES





b) CARS


CAR Frequency (%)
16.000000%
14.000000%
12.000000%
10.000000%
8.000000%
6.000000%
4.000000%
2.000000%
0.000000%
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44


CAR Cumulative Frequency (%)
100.000000%
90.000000%
80.000000%
70.000000%
60.000000%
50.000000%
40.000000%
30.000000%
20.000000%
10.000000%
0.000000%
16 21 26 31 36 41 46

II) After Speed Bump (closer to Law School):

1. OBSERVED DATA

Collected Raw Data			
MOTORBIKE		CAR	
Serial No.	Speed (KMPH)	Serial No.	Speed (KMPH)
1	33	1	34
2	32	2	42
3	22	3	36
4	29	4	35
5	38	5	26
6	36	6	38
7	30	7	36
8	27	8	22
9	38	9	39
10	34	10	34
11	31	11	34
12	39	12	38
13	33	13	30
14	35	14	25
15	24	15	28
16	23	16	30
17	34	17	27
18	37	18	33
19	41	19	22
20	35	20	20
21	38	21	21
22	33	22	26
23	26	23	34
24	25	24	20
25	31	25	39
26	33	26	34
27	33	27	34
28	41	28	31
29	32	29	26
30	24	30	22
Total Number of Readings	30	Total Number of Readings	30

2. CALCULATIONS ON COLLECTED DATA

a) MOTORBIKES

Data collection for Spot-Speed Study Experiment (MOTORBIKE)						
Serial No.	Higher Speed	Mid Speed	Lower Speed	Frequency	Frequency (%)	Cumulative Frequency (%)
1	16.5	17	17.5	0	0.000000%	0.000000%
2	17.5	18	18.5	0	0.000000%	0.000000%
3	18.5	19	19.5	0	0.000000%	0.000000%
4	19.5	20	20.5	0	0.000000%	0.000000%
5	20.5	21	21.5	0	0.000000%	0.000000%
6	21.5	22	22.5	1	3.333333%	3.333333%
7	22.5	23	23.5	1	3.333333%	6.666667%
8	23.5	24	24.5	2	6.666667%	13.333333%
9	24.5	25	25.5	1	3.333333%	16.666667%
10	25.5	26	26.5	1	3.333333%	20.000000%
11	26.5	27	27.5	1	3.333333%	23.333333%
12	27.5	28	28.5	0	0.000000%	23.333333%
13	28.5	29	29.5	1	3.333333%	26.666667%
14	29.5	30	30.5	1	3.333333%	30.000000%
15	30.5	31	31.5	2	6.666667%	36.666667%
16	31.5	32	32.5	2	6.666667%	43.333333%
17	32.5	33	33.5	5	16.666667%	60.000000%
18	33.5	34	34.5	2	6.666667%	66.666667%
19	34.5	35	35.5	2	6.666667%	73.333333%
20	35.5	36	36.5	1	3.333333%	76.666667%
21	36.5	37	37.5	1	3.333333%	80.000000%
22	37.5	38	38.5	3	10.000000%	90.000000%
23	38.5	39	39.5	1	3.333333%	93.333333%
24	39.5	40	40.5	0	0.000000%	93.333333%
25	40.5	41	41.5	2	6.666667%	100.000000%
26	41.5	42	42.5	0	0.000000%	100.000000%
27	42.5	43	43.5	0	0.000000%	100.000000%
28	43.5	44	44.5	0	0.000000%	100.000000%

b) CARS

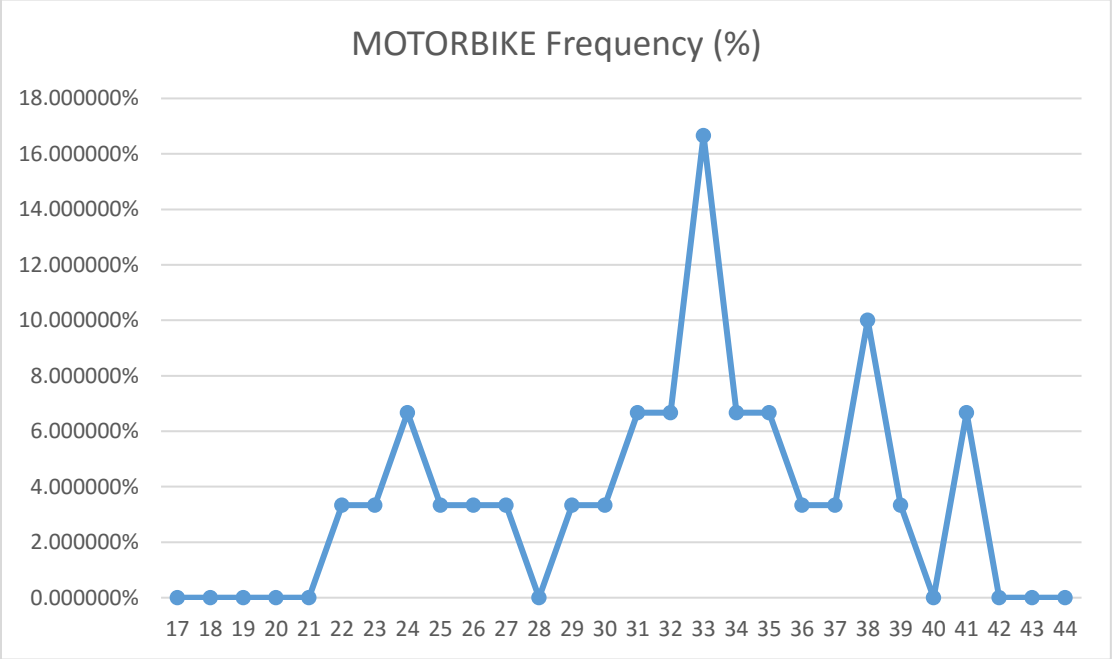
Data collection for Spot-Speed Study Experiment (CAR)						
Serial No.	Higher Speed	Mid Speed	Lower Speed	Frequency	Frequency (%)	Cumulative Frequency (%)
1	16.5	17	17.5	0	0.000000%	0.000000%
2	17.5	18	18.5	0	0.000000%	0.000000%
3	18.5	19	19.5	0	0.000000%	0.000000%
4	19.5	20	20.5	2	6.666667%	6.666667%
5	20.5	21	21.5	1	3.333333%	10.000000%
6	21.5	22	22.5	3	10.000000%	20.000000%
7	22.5	23	23.5	0	0.000000%	20.000000%
8	23.5	24	24.5	0	0.000000%	20.000000%
9	24.5	25	25.5	1	3.333333%	23.333333%
10	25.5	26	26.5	3	10.000000%	33.333333%
11	26.5	27	27.5	1	3.333333%	36.666667%
12	27.5	28	28.5	1	3.333333%	40.000000%
13	28.5	29	29.5	0	0.000000%	40.000000%
14	29.5	30	30.5	2	6.666667%	46.666667%
15	30.5	31	31.5	1	3.333333%	50.000000%
16	31.5	32	32.5	0	0.000000%	50.000000%
17	32.5	33	33.5	1	3.333333%	53.333333%
18	33.5	34	34.5	6	20.000000%	73.333333%
19	34.5	35	35.5	1	3.333333%	76.666667%
20	35.5	36	36.5	2	6.666667%	83.333333%
21	36.5	37	37.5	0	0.000000%	83.333333%
22	37.5	38	38.5	2	6.666667%	90.000000%
23	38.5	39	39.5	2	6.666667%	96.666667%
24	39.5	40	40.5	0	0.000000%	96.666667%
25	40.5	41	41.5	0	0.000000%	96.666667%
26	41.5	42	42.5	1	3.333333%	100.000000%
27	42.5	43	43.5	0	0.000000%	100.000000%
28	43.5	44	44.5	0	0.000000%	100.000000%

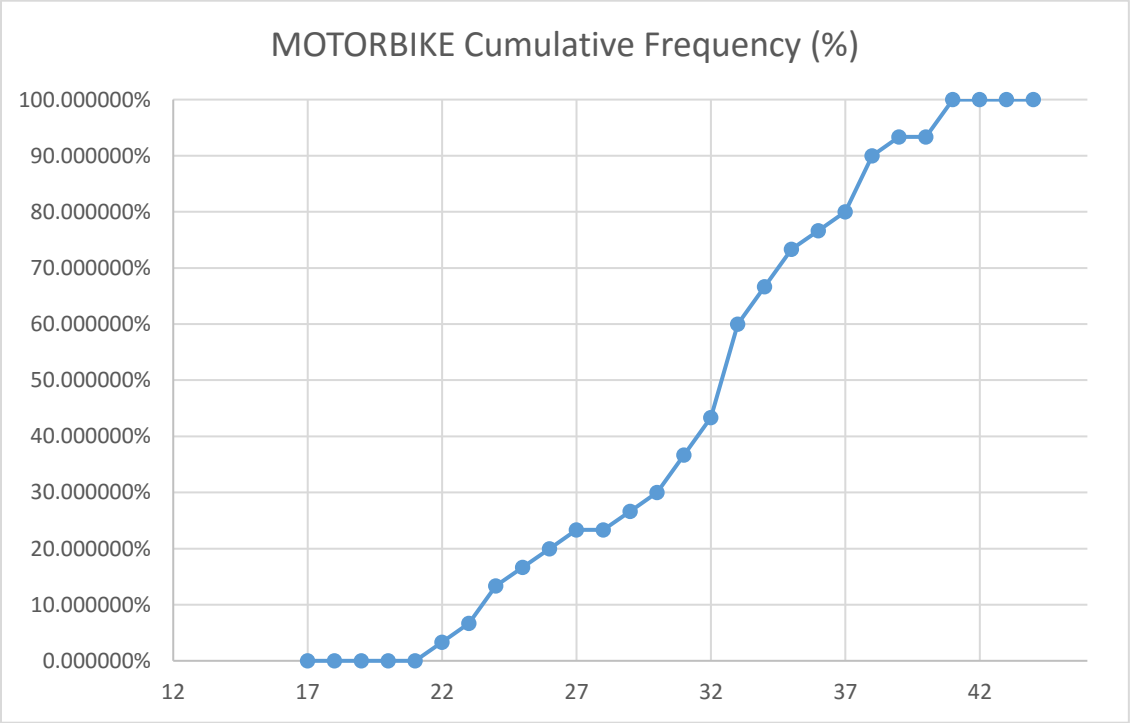
3. RESULTS

RESULTS					
MOTORBIKE			CAR		
Mid Speed	Frequency (%)	Cumulative Frequency (%)	Mid Speed	Frequency (%)	Cumulative Frequency (%)
17	0.000000%	0.000000%	17	0.000000%	0.000000%
18	0.000000%	0.000000%	18	0.000000%	0.000000%
19	0.000000%	0.000000%	19	0.000000%	0.000000%
20	0.000000%	0.000000%	20	6.666667%	6.666667%
21	0.000000%	0.000000%	21	3.333333%	10.000000%
22	3.333333%	3.333333%	22	10.000000%	20.000000%
23	3.333333%	6.666667%	23	0.000000%	20.000000%
24	6.666667%	13.333333%	24	0.000000%	20.000000%
25	3.333333%	16.666667%	25	3.333333%	23.333333%
26	3.333333%	20.000000%	26	10.000000%	33.333333%
27	3.333333%	23.333333%	27	3.333333%	36.666667%
28	0.000000%	23.333333%	28	3.333333%	40.000000%
29	3.333333%	26.666667%	29	0.000000%	40.000000%
30	3.333333%	30.000000%	30	6.666667%	46.666667%
31	6.666667%	36.666667%	31	3.333333%	50.000000%
32	6.666667%	43.333333%	32	0.000000%	50.000000%
33	16.666667%	60.000000%	33	3.333333%	53.333333%
34	6.666667%	66.666667%	34	20.000000%	73.333333%
35	6.666667%	73.333333%	35	3.333333%	76.666667%
36	3.333333%	76.666667%	36	6.666667%	83.333333%
37	3.333333%	80.000000%	37	0.000000%	83.333333%
38	10.000000%	90.000000%	38	6.666667%	90.000000%
39	3.333333%	93.333333%	39	6.666667%	96.666667%
40	0.000000%	93.333333%	40	0.000000%	96.666667%
41	6.666667%	100.000000%	41	0.000000%	96.666667%
42	0.000000%	100.000000%	42	3.333333%	100.000000%
43	0.000000%	100.000000%	43	0.000000%	100.000000%
44	0.000000%	100.000000%	44	0.000000%	100.000000%

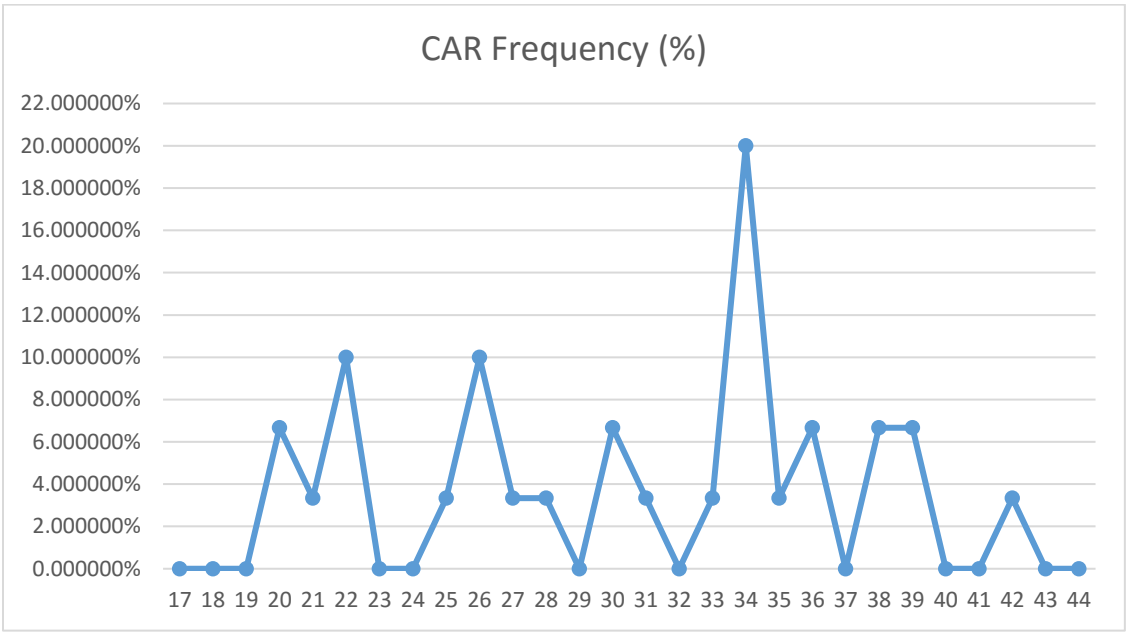
4. GRAPHICAL REPRESENTATION OF DATA

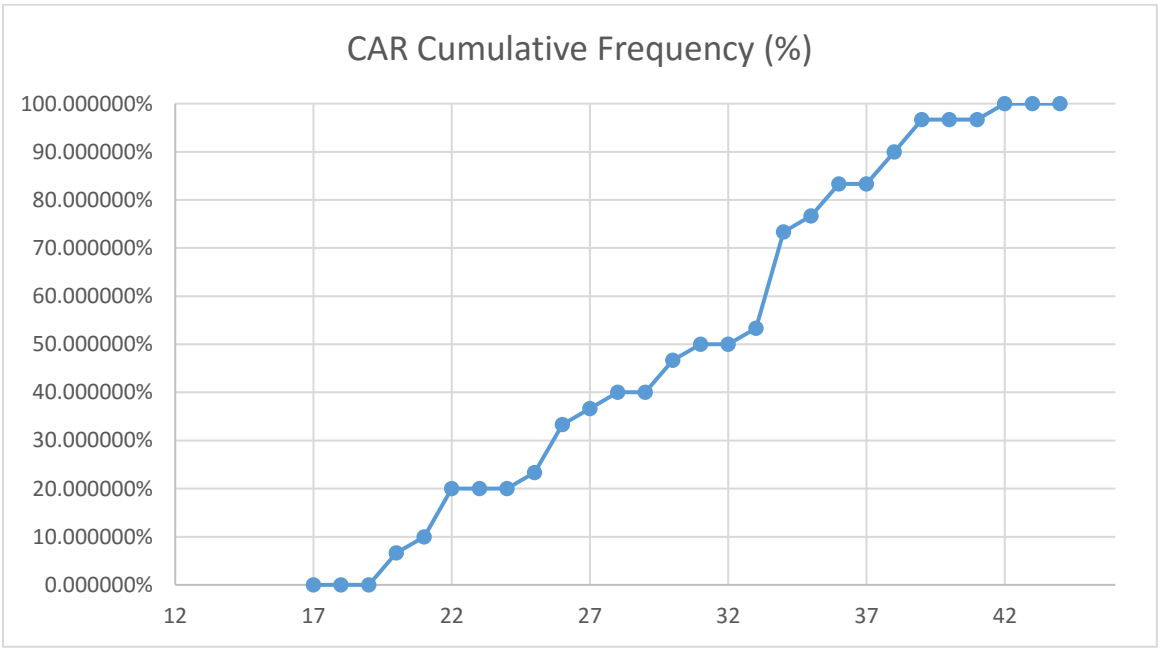
a) MOTORBIKES





b) CARS


CAR Frequency (%)
22.000000%
20.000000%
18.000000%
16.000000%
14.000000%
12.000000%
10.000000%
8.000000%
6.000000%
4.000000%
2.000000%
0.000000%
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44


CAR Cumulative Frequency (%)
100.000000%
90.000000%
80.000000%
70.000000%
60.000000%
50.000000%
40.000000%
30.000000%
20.000000%
10.000000%
0.000000%
12
17
22
27
32
37
42

V. STATISTICAL CALCULATIONS ON DATA

For further analysis of data, statistical measures are applied on the data.

The statistical indicators which would reflect a change in traffic flow are as follows:

1. Mean Speed – The average speed; calculated as the sum of all speeds divided by the number of speed observations.
2. Median Speed or 50^{th} Percentile Speed – The speed that equally divides the distribution of spot speeds; 50 percent of observed speeds are higher than the median; 50 percent of observed speeds are lower than the median.
3. 85^{th} Percentile Speed – The speed at or below which 85 percent of a sample of free flowing vehicles is traveling; this is typically used as a baseline for establishing the operating speed.
4. 15^{th} Percentile Speed – The speed at or below which 15 percent of a sample of free flowing vehicles is traveling.
5. 98^{th} Percentile Speed – The speed at or below which 98 percent of a sample of free flowing vehicles is traveling
6. Mode Speed – The number that occurs most frequently in a series of numbers.
7. Range – The difference between the smallest and the largest reading in a sample
8. Standard Deviation – The difference in travel speeds for vehicles on the road. Variance is the average of the squares of the difference to the mean for each observed speed. Standard Deviation is the square root of Variance.
9. Standard Error of Mean – The standard error of the mean (SEM) depicts the dispersion of sample means around the population mean.

$$\mathrm{SD}_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$ where, σ is the standard deviation & n is the size of the sample

A C-code has been developed to determine the mean, median, 85th, 98th percentile speed, variance, and standard deviation:

```
#include<stdio.h>
#include<math.h>
int n;
float speed_data[100];
int frequency[100];
float sum_of_speed=0,mean_speed,variance,standard_deviation;
int sum_freq=0;

void f_mean()
{
    int i;
    for(i=0;i<n;i++)
    {
        sum_of_speed+=speed_data[i]*frequency[i];
        sum_freq+=frequency[i];
    }
    mean_speed=sum_of_speed/sum_freq;
    printf("%4.2f\n",mean_speed);
}
void f_var()
{
    int i;
    float temp_var=0;
    for(i=0;i<n;i++)
    {
        temp_var+=(speed_data[i]-mean_speed)*(speed_data[i]-
mean_speed)*frequency[i];
    }
    variance=temp_var/sum_freq;
    standard_deviation=sqrt(variance);
    printf("%4.2f\n",variance);
}

void f_percentile()
{
    int i,j,k,temp_var=0;
    float m,percentile_50,percentile_85,percentile_98;
    for(i=0;i<n;i++)
    {
        if((temp_var+frequency[i])>=(sum_freq*0.5))
        {
            break;
        }
        temp_var+=frequency[i];
    }
    m=(speed_data[i]-speed_data[i-1])/(frequency[i]);
    percentile_50=speed_data[i-1] + m*(sum_freq*0.5-temp_var);
    printf("%4.2f\n",percentile_50);

    for(j=i+1;j<n;j++)
    {

        if(temp_var+frequency[j]>=(sum_freq*0.85))
        {
            break;
        }
        temp_var+=frequency[j];
    }
    m=(speed_data[j]-speed_data[j-1])/(frequency[j]);
    percentile_85=speed_data[j-1] + m*(0.85*sum_freq-temp_var);
```

```
    printf("%4.2f\n",percentile_85);

    for(k=j+1;k<n;k++)
    {

        if(temp_var+frequency[k]>=(sum_freq*0.98))
        {
            break;
        }
        temp_var+=frequency[k];
    }
    m=(speed_data[k]-speed_data[k-1])/(frequency[k]);
    percentile_98=speed_data[k-1] + m*(0.98*sum_freq-temp_var);
    printf("%4.2f\n",percentile_98);

}

int main()
{
    FILE *f,*s;
    f=fopen("f.txt","r");
    if(f==NULL)
    {
        printf("error\n");
        return;
    }
    s=fopen("s.txt","r");
    if(s==NULL)
    {
        printf("error\n");
        return;
    }

    printf("enter number of entries\n");
    scanf("%d",&n);

    int i;
    for(i=0;i<n;i++)
    {
        fscanf(s,"%f",&speed_data[i]);
        fscanf(f,"%d",&frequency[i]);
    }

    f_mean();
    f_var();
    f_percentile();
}
```

Calculations –

Statistical Measure	Before Speed Bump		After Speed Bump	
	Motorbike	Car	Motorbike	Car
Sample Size	30	30	30	30
Minimum Speed (KMPH)	20.0	20.0	22.0	20.0
Maximum Speed (KMPH)	39.0	42.0	41.0	42.0
Range (KMPH)	19.0	22.0	19.0	22.0
Mean Speed (KMPH)	31.07	31.43	32.23	30.53
Median Speed (KMPH)	31	31	33	33
85th Percentile Speed (KMPH)	36	40	38	38
15th Percentile Speed (KMPH)	28	24.75	25.35	22
98th Percentile Speed (KMPH)	38.42	41.5	41	40.8
Mode Speed (KMPH)	28 , 31	31.0	33.0	34
Standard Deviation (KMPH)	3.33	4.20	2.90	4.30

Some Observations –

1. The Range of the Sample Data decreases substantially after the speed bump. This is due to the fact that the minimum and maximum speeds have decreased for both Motorbikes and Cars.
2. There is statistically significant effect on the Mean, which is uniform across Motorbikes and Cars.
3. There is statistically significant effect on the Median, which is uniform across Motorbikes and Cars.
4. The 85^{th}, 15^{th}, 98^{th} Percentile Speeds are more or less the same 30 m from the speed bump.
5. The Standard Deviation decreases after the speed bump. This is in line with the fact that the range of the observed data decreases after the speed bump. This could mean that the speeds of the vehicles are normalized after they cross the speed bump and are given a chance to accelerate for about 30m.

VI. CONCLUSION AND RECOMMENDATION

Some Conclusions that can be drawn from the Spot Speed Study:

1. The posted Speed Limit is 30 km/hr, but almost half of the vehicles are violating it.
2. The 85^{th} Percentile Speed is 3-5 km/hr above the posted Speed Limit. So steps can be taken to reduce the speed, but aren't necessarily required.
3. We observed no Accident Prone Areas. This was mostly because during the time of conduction the vehicular traffic was very low.
4. There are 2 by-lanes which join the road near the Speed Bump. There are measures which are already taken to reduce the speeds of incoming vehicles from these by-lanes before they join the main road.
5. The role of the Speed Bump, therefore is to reduce the speed of vehicles on the main road so that they are aware of the adjoining traffic from the 2 by-lanes.
6. As such, the Speed Bump doesn't reduce the speed by much but is mostly used as a tactic to alert the driver of adjoining traffic.

Recommendations following the Spot Speed Study:

The roads where we carried out the Spot-Speed Study are very well-designed. The conclusions of this study are a confirmation of the above fact.

Therefore, there are no recommendations suggested by me following the study.