Spot Speed Study

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I. PROBLEM STATEMENT

With help of spot speed study (using laser gun) find the traffic on the road stretch between Rotary and Jnan Ghosh stadium and to Check whether people are travelling within speed limit or not

II. 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.

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.

III. 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.

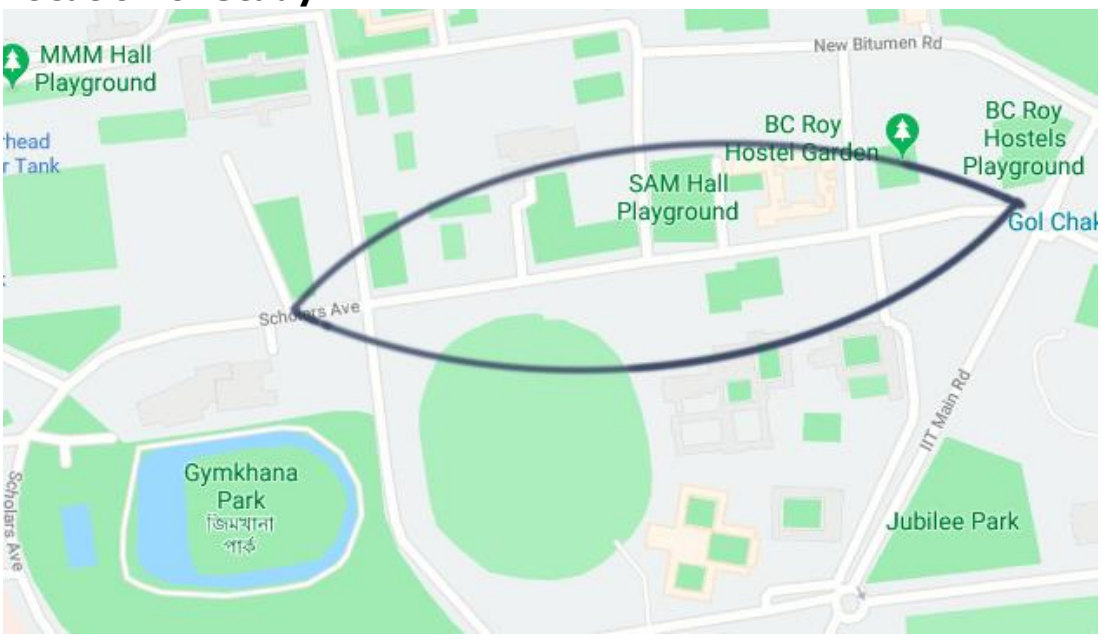
5. Reduce and Analyse Data –
    a. Tabulate the collected data.
    b. Identify key parameters associated with roadways speed, which may include:
        i. Mean Speed
        ii. Speed Variance or Standard Deviation
        iii. Median Speed (50^{th} percentile speed)
        iv. 15^{th}, 85^{th},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

IV. APPLICATIONS OF SPOT SPEED-

- Determining existing traffic operations evaluation of traffic control devices.
- Establishing roadway design elements.
- Assessing roadway safety questions.
- Monitoring traffic speed trends by systematic ongoing speed studies.
- Determining traffic signal timing, roadway capacity, evaluating the effectiveness of improvements, and installing speed zones.

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

Location of Study –



Description of Road:

Road stretch between Rotary (in front of B.C. Roy Hall) and Jnan Ghosh Stadium (before the speed bump in front of Ghokle Hall)

Laser gun for speed measurement

Photo of speed limit signal on the side of the road

Description of Condition at the time of survey:

Date of Survey:	Thursday, 16 August 2018
Start Time of Survey:	3:00 PM
End Time of Survey:	5:00 PM
Weather Conditions:	Cloudy, Rainy
Traffic Conditions:	Free Flow – Very Light to Light Vehicular Flow
Posted Speed Limit:	30 km/hr
Instrument Used:	Radar Speed Gun

VI. ANALYSIS OF RECORDED DATA

Both direction of vehicular flow was set ,B.C. Roy to Gyan Ghosh Stadium and Vice versa. 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

1) Motorbike Data

Serial no.	High speed	Mid speed	Lower speed	Frequency
1	19	20	21	1
2	21	22	23	0
3	23	24	25	3
4	25	26	27	1
5	27	28	29	6
6	29	30	31	7
7	31	32	33	11
8	33	34	35	9
9	35	36	37	9
10	37	38	39	9
11	39	40	41	7
12	41	42	43	5
13	43	44	45	0
14	45	46	47	2
15	47	48	49	1
16	49	50	51	0
17	51	52	53	0
18	53	54	55	1
19	55	56	57	0
20	57	58	59	0
21	59	60	61	0
Total				72

2) Cars Data

Serial no.	High speed	Mid speed	Lower speed	Frequency
1	19	20	21	0
2	21	22	23	1
3	23	24	25	1
4	25	26	27	3
5	27	28	29	4
6	29	30	31	6
7	31	32	33	6
8	33	34	35	11
9	35	36	37	4
10	37	38	39	7
11	39	40	41	6
12	41	42	43	6
13	43	44	45	2
14	45	46	47	2
15	47	48	49	1
16	49	50	51	0
17	51	52	53	0
18	53	54	55	0
19	55	56	57	0
20	57	58	59	0
21	59	60	61	0
Total				60

3) Result for Motorbikes

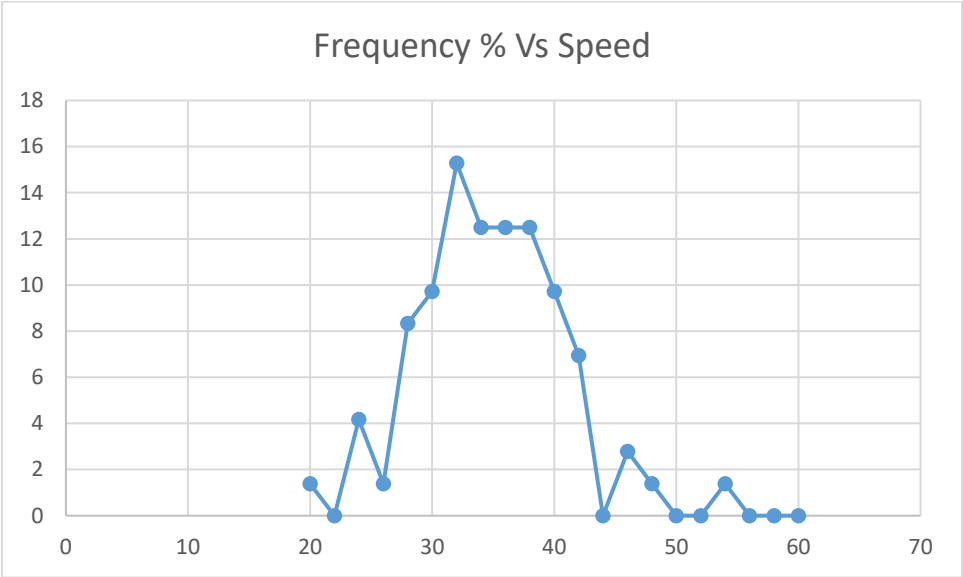
Serial no.	High speed	Mid speed	Lower speed	Frequency	Frequency %	Cumulative Frequency
1	19	20	21	1	1.388888889	1.388888889
2	21	22	23	0	0	1.388888889
3	23	24	25	3	4.166666667	5.555555556
4	25	26	27	1	1.388888889	6.944444444
5	27	28	29	6	8.333333333	15.27777778
6	29	30	31	7	9.722222222	25
7	31	32	33	11	15.27777778	40.27777778
8	33	34	35	9	12.5	52.77777778
9	35	36	37	9	12.5	65.27777778
10	37	38	39	9	12.5	77.77777778
11	39	40	41	7	9.722222222	87.5
12	41	42	43	5	6.944444444	94.44444444
13	43	44	45	0	0	94.44444444
14	45	46	47	2	2.777777778	97.22222222
15	47	48	49	1	1.388888889	98.61111111
16	49	50	51	0	0	98.61111111
17	51	52	53	0	0	98.61111111
18	53	54	55	1	1.388888889	100
19	55	56	57	0	0	100
20	57	58	59	0	0	100
21	59	60	61	0	0	100

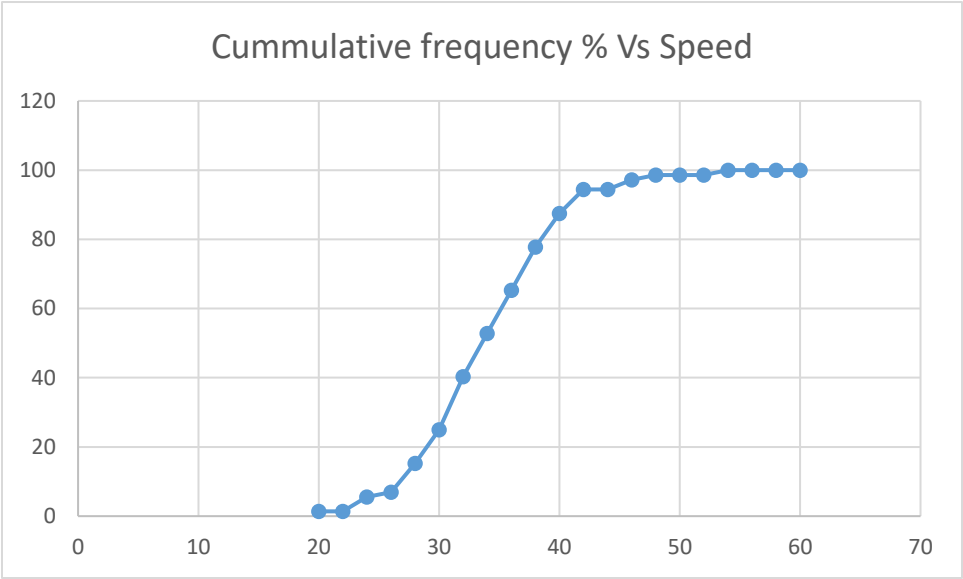
4) RESULT for Cars

Serial no.	High speed	Mid speed	Lower speed	Frequency	Frequency %	Cumulative Frequency
1	19	20	21	0	0	0
2	21	22	23	1	1.666666667	1.666666667
3	23	24	25	1	1.666666667	3.333333333
4	25	26	27	3	5	8.333333333
5	27	28	29	4	6.666666667	15
6	29	30	31	6	10	25
7	31	32	33	6	10	35
8	33	34	35	11	18.33333333	53.33333333
9	35	36	37	4	6.666666667	60
10	37	38	39	7	11.66666667	71.66666667
11	39	40	41	6	10	81.66666667
12	41	42	43	6	10	91.66666667
13	43	44	45	2	3.333333333	95
14	45	46	47	2	3.333333333	98.33333333
15	47	48	49	1	1.666666667	100
16	49	50	51	0	0	100
17	51	52	53	0	0	100
18	53	54	55	0	0	100
19	55	56	57	0	0	100
20	57	58	59	0	0	100
21	59	60	61	0	0	100

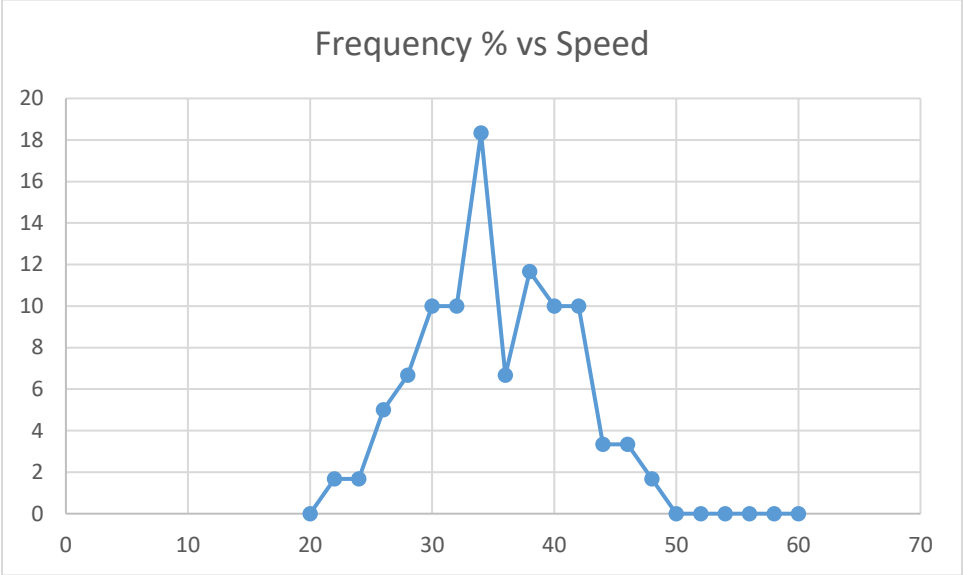
GRAPHICAL REPRESENTATION OF DATA

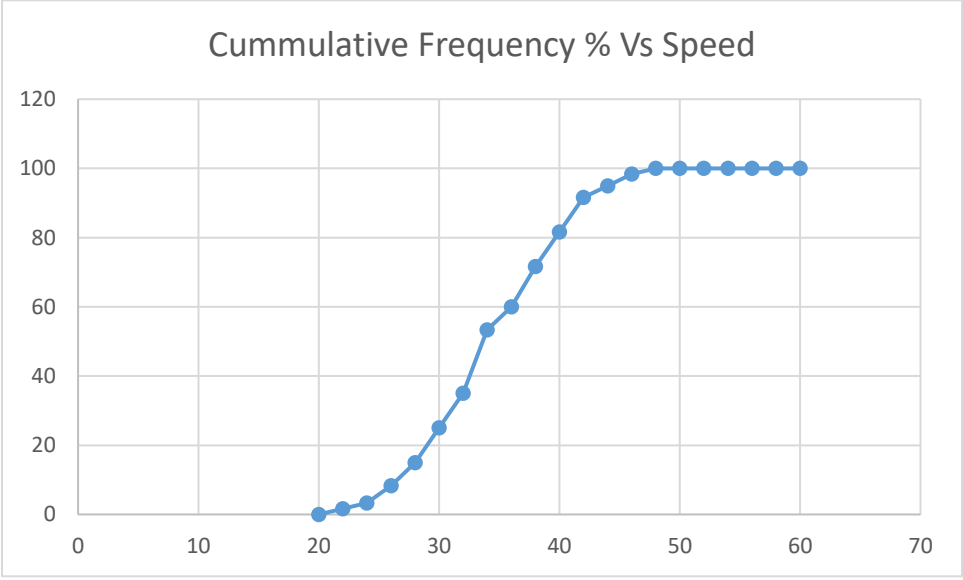
a. MOTORBIKES





b. CARS


Frequency % vs Speed
20
18
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70


Cummulative Frequency % Vs Speed
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70

VII. 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 50th 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. 85th 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. 15th Percentile Speed – The speed at or below which 15 percent of a sample of free-flowing vehicles is traveling.
5. 98th 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 Code in VBA MS Excel has been developed to determine the mean, mode, median, 15th, 85th, 98th percentile speed and standard deviation:

```
Sub dc ()

Dim i As Integer
Dim a As Double
Dim b As Double
Dim x As Double

'for calculating frequency % of motorbike
a = 0
For i = 11 To 31
     Cells(i, 7) = Cells(i, 6) / 0.72
Next

'for calculating cumulative frequency % of motorbike
a = 0
For i = 11 To 31
     a = a + Cells(i, 7)
    Cells(i, 8) = a
Next

'for calculating mean of motorbike
a = 0
For i = 11 To 31
  a = (Cells(i, 4) * Cells(i, 6)) + a
Next
Cells(10, 13) = a / Cells(32, 6)
x = Cells(10, 13)


'for calculating standard deviation of motorbike
a = 0
For i = 11 To 31
```

```
  a = ((Cells(i, 4) - x) * (Cells(i, 4) - x)) * (Cells(i, 6)) + a
Next
b = a / Cells(32, 6)
Cells(11, 13) = Sqr(b)

'for calculating median of motorbike
a = 0
For i = 11 To 31
  If Cells(i, 8) < 50 Then
  a = Cells(i + 1, 4)
  End If
Next
Cells(12, 13) = a

'for calculating Mode of motorbike
a = Cells(11, 7)
b = 0
For i = 12 To 31
   If Cells(i, 7) > a Then
      a = Cells(i, 7)
      b = Cells(i, 4)
   End If
Next
Cells(13, 13) = b

'for calculating 15% percentile speed of motorbike
a = 0
b = 0
For i = 11 To 31
  If Cells(i, 8) < 15 Then
  a = Cells(i, 4)
  b = i
  End If
Next
```

```
Cells(14, 13) = Cells(b + 1, 4) - (2) * (15 - Cells(b + 1, 8)) / (Cells(b, 8)
- Cells(b + 1, 8))


'for calculating 85% percentile speed of motorbike
a = 0
b = 0
For i = 11 To 31
  If Cells(i, 8) < 85 Then
  a = Cells(i, 4)
  b = i
  End If
Next
Cells(15, 13) = Cells(b + 1, 4) - (2) * (85 - Cells(b + 1, 8)) / (Cells(b, 8)
- Cells(b + 1, 8))


'for calculating 98% percentile speed of motorbike
a = 0
b = 0
For i = 11 To 31
  If Cells(i, 8) < 98 Then
  a = Cells(i, 4)
  b = i
  End If
Next
Cells(16, 13) = Cells(b + 1, 4) - (2) * (98 - Cells(b + 1, 8)) / (Cells(b, 8)
- Cells(b + 1, 8))



End Sub
```

Similar code is written for the car data.

Result–

Statistical Measure	Vehicle	
	Motorbike	Car
Sample Size	72	60
Minimum Speed (KMPH)	20.00	22.00
Maximum Speed (KMPH)	54.00	48.00
Range (KMPH)	34.00	26.00
Mean Speed (KMPH)	34.77	35.20
Median Speed (KMPH)	34.00	34.00
85th Percentile Speed (KMPH)	39.48	40.67
15th Percentile Speed (KMPH)	27.93	28.00
98th Percentile Speed (KMPH)	47.12	45.80
Mode Speed (KMPH)	32.00	34.00
Standard Deviation (KMPH)	05.92	05.83

Some Observations –

1. Most of the people are travelling at the speed higher than the speed limit.
2. For Motorcycles Only 25% of people are travelling in the speed limit of 30 km/hr.
3. For Cars also Only 25% of people are travelling in the speed limit of 30 km/hr.
4. Mean speed, median speed are almost same for the cars and motorbikes.
5. The 85^{th} percentile speed is much greater than the speed limit.

VIII. CONCLUSION AND RECOMMENDATION

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

1. The posted Speed Limit is 30 km/hr, but approx 75% of the vehicles are violating it.
2. The 85^{th} Percentile Speed is 9-10 km/hr above the posted Speed Limit. So steps can be taken to reduce the speed.
3. We observed no Accident Prone Areas. This was mostly because during the time of conduction the vehicular traffic was very low.
4. The role of the Speed Bump is to reduce the speed of vehicles on the main road but it is not working properly.
5. 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 we need one more speed bumps to control the speed of the vehicles. The conclusions of this study are a confirmation of the above fact that people are travelling at much higher speed than the limit.