حلول مسائل هندسة مرور   أ.د. زينب القيسي

Q1) what are the advantages and disadvantages of machine vision (video image detection) when compared with other forms of detection ?

sol.

advantages: it is non-intrusive as detectors need to be installed in the roadway (with inductive loops). Such as Autoscope (this type of system) detect traffic data at any location within camera's field of view.
Camera can replace many detector of inductive loop providing wide area detection system.

disadvantages: higher initial costs and the detection zone must be placed precisely for accurate detection.

Q2) Select and describe the method and equipment you will recommend for traffic volume counts for each of the road sections given below. Give reasons for your recommendations.

a) A private road leading to an industrial development.
b) A residential street.
c) A rural collector road.
d) A section of an interstate highway.

sol.

a) screen line counts
Involve dividing the study area into large sections by drawing imaginary lines (screen lines) across the study area. Counts are then taken at each place a road crosses this line. This data used to detect variations in traffic volumes and flow direction attributabe to changes in land-use patterns in the area.

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b) Cordon Counts

Involve similar to screen counts with the imaginary line completely surrounding an area, For example, CBD. Counts are taken at each place a road crosses the line, giving information about vehicle accumulation within the area. The information from cordon counts used to plan for parking facilities, evaluate traffic operational techniques, and long range infrastructure planning.

c) Intersection counts

counts for vehicular turning movements and classifications at intersection of study area, the data gathered is used to develop signal timing and phasing plans for signalization intersections and for geometric design improvements.

Q3) Speed data collected on an urban roadway yielded a standard deviation in speeds of ± 4.8 mile/hr.

a) If an engineer wishes to estimate the average speed on the roadway at 95% confidence level so that the estimate is within ± 2 mile/hr of the true average. How many spot speeds should be collected.

b) If the estimate of the average must be within ± 1 mile/hr what should be the sample size?

Sol.

a) $N = [(z\sigma)/d]^2 \Rightarrow z = 1.96$ for 95% confidence level

$N = [1.96(4.8)/2]^2 = 22.1 \simeq 23$ spot speeds

b) $N = [(1.96(4.8))/1]^2 = 88.5 \simeq 89$ spot speeds

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Q4) An engineer wishing to obtain the speed characteristics on a bypass around her city at a confidence level of 95% and an acceptable limit of ± 1.0 mile/hr collected a total of 130 spot speed samples and determined that the variance is 25 (mile/hr)^2. Has the engineer met with all of the requirements of study.

Sol.

$$N = [(Z\sigma)/d]^2$$

for error limil = ± 1 mile/hr

$\sigma = \sqrt{25} = 5$ mile/hr

$$N = [(1.96 \times 5)/(1)]^2 = 96.04 \simeq 97 < 130$$

∴ it ok.

Q5) An engineer wishing to determine whether there is a statistially significant difference between the average speed of passengers cars and that of large trucks on a section of highway, collected the data shown below. Determine whether the engineer canclude that the average speed of larger trucks is the same as that for passenger cars.

	Trucks	Passenger cars
Average speed (mile/hr)	62	59
Standard deviation of speed ± mile/hr	5.5	6.3
sample size	275	175

Sol

$$S_d = \sqrt{\frac{s_1^2}{n_1} + \frac{s_1^2}{n_2}}$$

$S_1 = 5.5$ $n_1 = 275$

$S_2 = 6.3$ $n_2 = 175$

$$S_d = \sqrt{\frac{5.52}{275} + \frac{6.3^2}{175}} = \sqrt{0.11 + 0.226} = \sqrt{0.3368}$$

$S_d = 0.5803$ $Z_{sd} = 1.96(0.5803) = 1.137$ ⇒

62 − 59 = 3

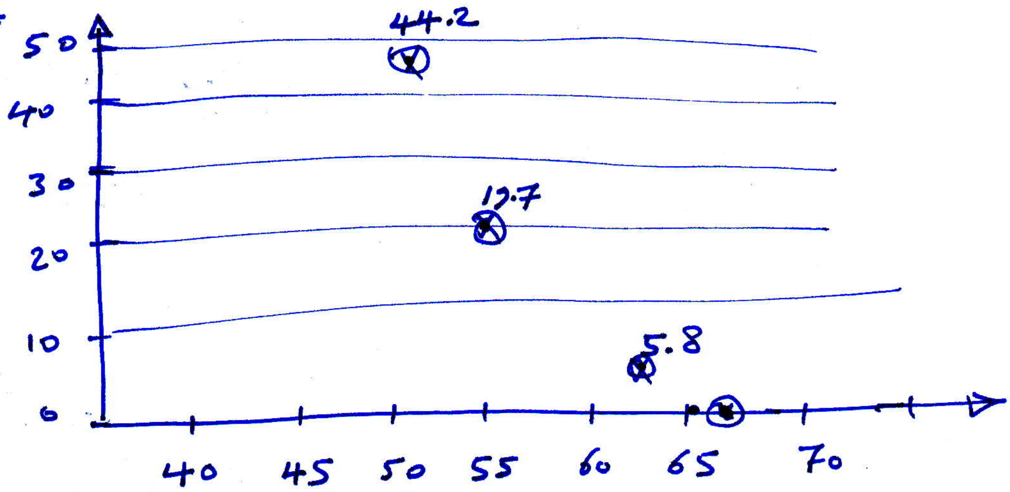
Since:

3 > 1.137

∴ the speeds are significantly different.

Q6) Assuming that the data shown in table (4-2) were collected on rural road in your state and consideration is being made to set the speed limit on the road. Speed limit of 50, 55, 60 and 65 mile/hr are being considered. plot the expected non-compliance percentages versus the associated speed limit on a graph and recommended the speed for the road. Give reasons for your selections.

Sol.



Q7) The accompanying data show spot speeds collected at a section of highway located in a residential area. Using the student's t-test, determine whether there was a statistically significant difference in the average speeds at 95% confidence level.

Before	After
40	23
35	33
38	25
37	36
33	37
30	34
28	23
35	28
35	24
40	31
33	24
35	20
⋮	⋮

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sol.

difference	(difference)^2
40 - 23 = 17	289
35 - 33 = 2	4
38 - 25 = 13	169
37 - 36 = 1	1
33 - 37 = -4	16
30 - 34 = -4	16
28 - 23 = 5	25
35 - 28 = 7	49
35 - 24 = 11	121
40 - 31 = 9	81
33 - 24 = 9	81
35 - 20 = 15	225
36 - 21 = 15	225
36 - 28 = 8	64
40 - 35 = 5	25
38 - 25 = 13	169
35 - 21 = 14	196
30 - 35 = -5	25
30 - 30 = 0	0
38 - 33 = 5	25
39 - 21 = 18	324
35 - 28 = 7	49
36 - 23 = 13	169
34 - 24 = 10	100
33 - 27 = 6	36
31 - 20 = 11	121
36 - 20 = 16	256
35 - 30 = 5	25
33 - 32 = 1	1
39 - 33 = 6	36

$\sum_{diff.} = 229$ $\qquad \sum_{(diff)^2} 2923$

Find

$$t = \frac{\Sigma diff / N}{\sqrt{\frac{\Sigma diff.^2 - \frac{(\Sigma diff.)^2}{N}}{(N-1)N}}}$$

$$t = \frac{229/30}{\sqrt{\frac{2923 - \frac{(229)^2}{30}}{(30-1)(30)}}}$$

$t = 6.57$

$N - 1 = 30 - 1 = 29$

Find p-value from t-table with degree of freedom 29, use 0.05 (95%)

$\Rightarrow$ t-table $\Rightarrow$ 1.699

the calculated t-value is greator > t-table at alpha of 0.05.

$\therefore$ there is no statistical difference between means.

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Q8) Using the data furnished in problem 4-7, draw the histogram frequency distribution and cumulative percentage distribution for each set of data and determine a) average speed, b) 85 percentile speed, c) 15 percentile speed, d) mode, e) median and f) pace.

sol.

a) average speed $= \frac{\sum u_i}{\sum f_i}$

befor average $= \frac{1053}{30} = 35.1$ mile/hr

after average $= \frac{824}{30} = 27.5$ mile/hr

b) 85% speed from cumulative distribution plots

befor = 38.4 mile/hr

after = 33.6 mile/hr

c) 15% speed from cumulative distribution plots

befor = 30.8 mile/hr

after = 20.5 mile/hr

d) mode from histograms

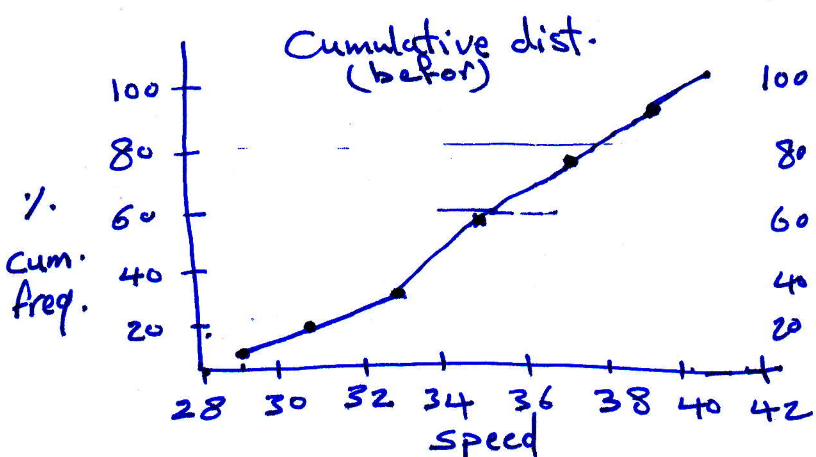
before = 35 mile/hr

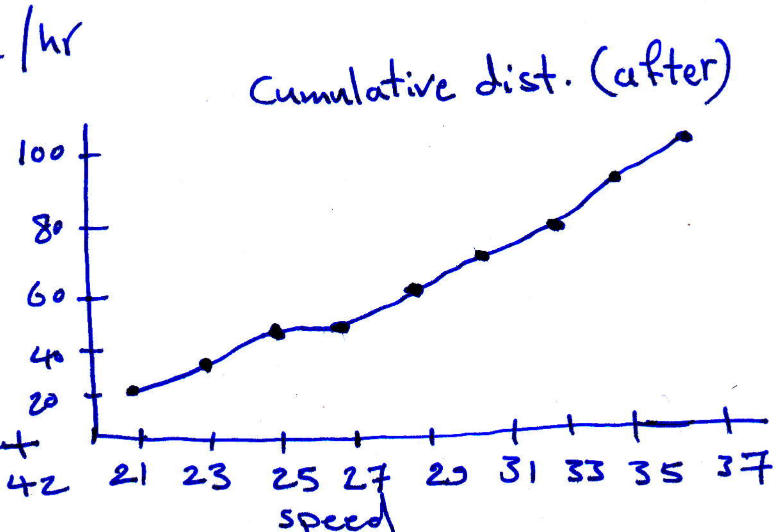
after = 21 mile/hr

f) pace from histograms

befor = 30-40 mile/hr

after = 21-31 mile/hr





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(Histogram Frequency Distribution)

Q9) Define the following and cite examples of how they are used.

- Average annual daily traffic (AADT)
- Average daily traffic (ADT)
- Vehicle-miles of Travel (VMT)
- Peak hour Volume (PHV)

Sol:

AADT: average 24hr traffic counts collected every day in the year. These counts are used to estimate highway user revenues, compute accident rates, and establish traffic volume trends.

ADT: average of 24 hr traffic counts collected over a number of days greater than one but less than a year. These counts are used for planning of highway activities, measuring current traffic demand, and evaluating existing traffic flow.

VMT: is a measure of travel usage along a section of road. It is the product of the volume (ADT) and the length of roadway in miles to which the volume is applicable. This measure is used mainly as a base for ~~collecting~~ allocating resources for maintenance and improvement of

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highways and to establish highway systems usage trends.

PHV: is the maximum number of vehicles that pass a point on a highway during a period of sixty consecutive minutes. This volume is used for functional classification of highways, geometric design of standrds selection, capacity analysis, development of operational programms, and development of parking regulations.

Q10) Describ the different traffic count programs carried in your state. What data are collected in each program?

Sol.

- Screen line counts
- Cordon counts
- intersection counts
- control counts

} الاجابة مشابهة لسؤال سابق بنفس الغرض

Q11) A traffic engineer, wishing to determine a representative value of the ADT on 250 highway links having similar volume characteristics, conducted a preliminary study from which the following estimates were made: mean volume = 45,750 veh/day standard deviation = 3750 veh/day. Determine the minum number of stations for which the engineer should obtain 24-hr volume counts for 95-5 precision level. Use an allowable range of error of 10%.

sol.

$$n = \left[t^2_{\alpha/2,N-1} (s^2/d^2)\right] / \left[1 + (1/N)(t^2_{\alpha/2,N-1})(s^2/d^2)\right]$$

$\alpha = 100 - 95 = 5$

(assume limit of acceptable error is 10% of mean volume)

$S = 3750$

$m = 45750 \Rightarrow d = (0.1)(45750) = 4575$

$V = N - 1 = 250 - 1 = 249$

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$(t_{\alpha/2, N-1}) = 1.96$

$$n = [(1.96)^2(3750^2/4575^2)] / [1 + (1/250)(1.96)^2(3750^2/4575^2)]$$

$n = 2.57$

use 3 count stations.

Q12) الإجابة مكررة
مع السؤال السابق

Q13) How are travel time and delay studies used? Describe one method for collecting travel time and delay data at a section of a highway. Explain how to obtain the following information from the data collected: a) travel time b) operational delay c) stopped time delay d) fixed delay and e) travel time delay.

sol.

Travel time and delay studies are used to aid the traffic engineer in identifying problem locations, which may require special attention in order to improve the overall flow of traffic on the route. Data from these studies may be used to determine the efficiency of a route with respect to its ability to carry traffic, identify bottle-neck locations with relatively high delays.

There are several methods for collecting travel time; floating car technique and moving vehicle technique.

Fixed delay would be measured as the time spent waiting for a traffic signal along the route to turn green.

Travel time delay is determined by subtracting the travel time for a vehicle to traverse the study section under uncongested conditions from actual travel time.

Stopped time delay: time vehicle stopped.

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Q14) Table 4.10 shows data obtained in a travel time study on a section of highway using the moving ~~st~~ vehicle technique. Estimate a) travel time b) volume in each direction

sol. Moving vehicle technique

$$V_N = \frac{(N_s + O_N + P_N)\,60}{T_s + T_N}$$

$T_s = 4.9$

$P_s = 1.0,\ T_N = 5.25$

$N_N = 104.2,\ N_s = 93.9,\ O_N = 1.6,\ O_s = 1.1,\ P_N = 1.1$

$V_N = (93.9 + 1.6 - 1.1)\,60/(5.25 + 4.9) = 558$ veh

$V_s = (104.2 + 1.1 - 1.0)\,60/(5.25 + 4.9) = 617$ veh

$T_N = T_N - [60(O_N - P_N)/V_N] = 5.2$ min.

$T_s = T_s - [60(O_s - P_s)/V_s] = 4.89$ min.

Q15) An engineer, wishing to determine the travel time and average speed along a section of an urban highway as part of an annual trend analysis on traffic operations, conducted a travel time study using the floating-car technique. He carried out 10 runs and obtained a standard deviation of ± 3 mile/hr in the speed obtained. If a 5% significance level is assumed, is the number of test runs adequate?

sol.

$$N = \left(\frac{t_\alpha\,(\sigma)}{d}\right)^2 = \left(\frac{1.833\,(3)}{3}\right)^2$$

$$= 3.36$$

therefore, 10 runs is adequate

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Q17) Select a parking lot on your compus. For several hours, conduct a study of the lot using the methods described in this chapter. From the data collection, determine the turnover ~~rate~~ and duration. Draw a parking accumulation curve for the lot.

sol.

To conduct a parking accumulation study of a parking lot, detailed data on space usage and vehicle turnover and duration must be collected.

- The No. of spaces
- license plate number of those vehicles and their entry and exit times

⇒ draw the parking accumulation curve to display (%) of spaces used (on the y-axis) as a function of time-of-day (on the x-axis). By noting the number of spaces that are occupied at discrete intervals (e.g. every hour), the data for drawing the accumulation curve are obtained.

Q18) Data collected at a parking lot indicate that a total of 300 cars between 8 a.m. and 6 p.m. 10% of these cars are parked for an average of 2hr, 30% for an average of 10 hr. Determine the space-hours of demand at the lot.

sol.

$$D = (0.1)(300)(2) + (0.3)(300)(4) + (0.6)(300)(10)$$
$$= 2220 \text{ space-hours.}$$

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Q19) If 10% of the parking bays are vacant on average (between 8.a.m. and 6 p.m.) at the parking lot of (Problem 18), determine the number of parking bays in the parking lot. Assume an efficiency factor of 0.85.

Sol.

$2220 + (2220)(0.1) = 2442$ space-hours (assuming 10% vacancy)

$(0.85)(10)(N) = 2442$

$N = 288$ spaces

Q20) The owner of the parking lot of (problem 19 and 18) is planning an expansion of her lot to provide adequate demand for the following 5 years. If she has estimated that parking demand for all categories will increase by 5% a year, determine the number of additional parking bays that will be required.

Sol.

Find space-hours of demand in 5 years

$(1+0.05)^5(2442) = 3,117$ Space-hours

Additional space-hours $= 3117 - 2442$

$= 675$

Find the number of spaces

$(0.85)(10)(N) = 675$

$N = 79.4 \simeq 80$ spaces