Assignment of Social Statistics

Question-1: The frequency distribution of profit per share of 45 companies are given below:

Profit per share in taka	0-10	10-20	20-30	30-40	40-50	50-60
Number of companies	4	10	16	8	5	2

Compute mean, median and modal profit of the companies.

Solution:

The table for calculation of mean,

Profit per share in tk	Number of companies (f)	Mid(x)	F_x
0-10	4	5	20
10-20	10	15	150
20-30	16	25	400
30-40	8	35	280
40-50	5	45	225
50-60	2	55	110
	N=45		f_x=1185

$\therefore$ Mean $\bar{x} = \frac{\sum f_x}{\sum N} = \frac{1185}{45}$ =26.33

Ans: 26.33 (APP)

Median:

Table for calculation of medain,

Profit per share in tk	Number of companies (f)	Cumulative frequency
0-10	4	4
10-20	10	14
20-30	16	30
30-40	8	38
40-50	5	43
50-60	2	45
	N=45	

We know, Median $M_c = L + \frac{\frac{N}{2} - F_c}{f_m} \times C$

Where,

L=Lower limit of the medain class.

Fc=Pre median class

F_m= Frequency of the median class

C=Width of the median class

N=Total number of observations

Here, Location of the median=size of $\frac{n}{2}$ th observation=size of $\frac{45}{2}$ th observation =size of 22.5^{th} observation, which lies in the class 20-30.

So, median lies in the class 20-30.

Therefore, L=20, F_c=14, f_m =16, C=10, N=45

∴ Median $M_c = 20 + \frac{22.5-14}{16} \times 10 = 20 + 5.31 = 25.31$

Ans: Median $M_c = 25.31$

Mode:

Table for calculation of modal profit in the companies,

Profit per share in tk	Number of companies
0-10	4
10-20	10
20-30	16
30-40	8
40-50	5
50-60	2
	N=45

We know, Mode, $M_0 = L + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times C$

Here,

Modal= The maximum frequency 16 lines in the class 20-30

L= 20

Δ_1=16-10=6

Δ_2= 16-8= 8

C=10

$\therefore$ Mode $M_0 = 20 + \frac{6}{6+8} \times 10 = 20 + 4.28 = 24.28$

Ans: Mode, M_0 =24.28 (App)

<u>Question-2:</u> A researcher wants to find out if there is any relationship between the age of husbands and the age of wives. He took a random sample of 10 couples and are given below:

Age of husband (x)	22	23	23	24	26	27	27	28	30	30
Age of wives (y)	18	20	21	20	21	22	23	24	25	26

a) Determine the regression equation of the ages of wives on the age of husbands.

b) If husband's age is 40, compute the probable age of wife.

Solution:

a) regression equation of y on x

Here, x= age of husband

y= age of wives

age of husband(x)	age of wife(y)	xy	x	y
22	18	396	484	324
23	20	460	529	400
23	21	483	529	441
24	20	480	576	400
26	21	546	676	441
27	22	594	729	484
27	23	621	729	529
28	24	672	784	576
30	25	750	900	625
30	26	780	900	676
$\sum x$=260	$\sum y$=220	$\sum xy$=5782	$\sum x^2$=6836	$\sum y^2$=4896

a).Let the regression equation of y on x is $y=a_1+b_1x$

hence, $b_1=\frac{\sum xy-\frac{\sum x\sum y}{N}}{\sum x^2-\frac{(\sum x)^2}{N}} = \frac{5782-\frac{260\times220}{10}}{6836-\frac{260^2}{10}} = \frac{5782-5720}{6836-6760} = 0.816$

$a_1 = \bar{y}-\bar{b_1}\bar{x} = \frac{\sum y}{N}-b_1\frac{\sum x}{N} = \frac{220}{10} -0.816\times \frac{260}{10} =0.784$

so the estimated regression equation of the ages of wifes on the age of husbands

y^n=0.784 + 0.816x

b) If husbands age is 40, the probable of wife will be:

$y=a_1+b_1x = 0.784+ 0.816\times40 = 33.424$ year

<u>Questiion-3:</u> A box contains items of which are defectives. An item is selected at random from this box. Find the probability that, the selected item is i) non-defective, ii) defective, iii) defective or non-defective, iv) defective and non-defective. Comment on the nature of the events.

Solution:

Here, 12 equally likely outcomes in the box. That is n(s)=12

i) Let A be the event that the selected item is non defective.Then n(A)=12-2=10

and the probability of A is $P(A)=\frac{Number\ of\ non\ defective\ items}{Total\ number\ of\ item}=\frac{n(A)}{n(S)}=\frac{10}{12}=\frac{5}{6}$

Here the event A is an uncertain event.

ii) Let B be the event that the selected item is defective. Then n(B)=2

$P(B)=\frac{Number\ of\ defective\ items}{Total\ number\ of\ item}=\frac{n(B)}{n(S)}=\frac{2}{12}=\frac{1}{6}$

Here the event B is also an uncertain event.

iii) Let C be the event that the selected item is defective or non-defective. Then n(C)=12 and the probability of C is-

$P(C)=\frac{Number\ of\ defective\ or\ non\ defective\ items}{Total\ number\ of\ item}=\frac{n(C)}{n(S)}=\frac{12}{12}=1$

Here the event C is an sure event.

iv) Let D be the event that the selected item is defective and non-defective. Then n(D)=0 and the probability of D is-

$P(D)=\frac{Number\ of\ defective\ and\ non\ defective\ items}{Total\ number\ of\ item}=\frac{n(D)}{n(S)}=\frac{0}{12}=0$

Here the event C is an impossible event.

Question-4: A gas station repair shop claims that the average time it takes to do a lubrication job and oil change is maximum 30 minutes. The consumer protection department wants to test the claim. A sample of six cars was sent to the station for oil change and lubrication. The job took an average of 34 minutes with a standard deviation of 4 minutes. Do you think that the job took an average of time more than 30 minutes? (Use a=0.05)

Solution:

Assumptions:

i)The sample is randomly random.

ii)The sample is drawn from a normal population.

Hypothesis: It is a one tailed test because average of time more than 30 minutes in alternative hypothesis.

$H_0 : \mu \leq 30$

$H_1 : \mu > 30$

Test Statistics: Since sample size is small and population variance is unknown, statistic will be used.

$T=\frac{\bar{x}-\mu_0}{\frac{s}{\sqrt{n}}} \sim t_n - 1$ under H_0

Decision Rule: Reject H_0 if $t_{cal} > t_{n-1},a$

calculation:

Hence , $\bar{x}$=30 , $\mu_0 = 30$, S=4, n=6

$T=\frac{\bar{x}-\mu_0}{\frac{s}{\sqrt{n}}} = \frac{34-3}{\frac{4}{\sqrt{6}}} = 2.45$

Given, a=5%=0.005 and d_f=n-1=6-1=5

So, form t table,$t_{n-1},a=t_5$, 0.005=2.02

Statical Decision:

Since t_{cal}=2.45> $t_{n-1}.a$=2.02. So we reject the null hypothesis (H_0) at 5% level of significance.

Conclusion: So, the job took an average of time more than 30 minutes. That means the claim of the shop is not considered to be correct.

<u>Question-5:</u> The probability that a Sociology graduate gets a bank job is Four Statistics graduate applied for bank jobs. What is the probability that,

i)Exactly 2 will get the job.

ii)All will get the job and

iii)At least 3 will get the job.

Solution:

Let's define Statistics graduates get jobs as success and does not get a job as failure.Let x be a number of Statistics graduates get the bank job, then x is a binomial variate with p=0.6 and q=0.4

That is x~(4, 0.6)

Then the probability function of x is

f(x, 4.06)= $\binom{4}{x}(0.6)^x(0.4)^{4-x}$, x=1,2,3,4

i)P[x=2]= $\binom{4}{2}(0.6)^2(0.4)^{4-2}$=0.3456

ii)P[x=4]= $\binom{4}{4}(0.6)^4(0.4)^{4-4}$=0.1296

iii)P[x≥ 3]= $P[x = 3] + P[x = 4] = 0.4752$