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PROBABILITY AND STATISTICS

ASSIGNMENT - 1

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Q1. A company has three establishments A, B and C in three cities. Analysis of the daily wages paid to the employees in the three establishments is given below:

Establishments:	A	B	C
Number of employees:	20	25	40
Average daily wages:	305	300	340
Standard Deviation:	50	40	45

Find the average and standard deviation of the wages of all the 85 employees the company.

Ans. Mean of Monthly wages (A) = $\frac{\text{Total Wages}}{\text{No. of Workers (employees)}}$

Total Wages (A) = Mean (A) * No. of Employees (A)

Total Wages (A) = 305 * 20 = 6100

Total Wages (B) = 300 * 25
= 7500

Total Wages (C) = 340 * 40
= 13600

Standard deviation for A = $\sqrt{50}$

Standard deviation for B = $\sqrt{40}$

Standard deviation for C = $\sqrt{45}$

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Q2. The median and Mode of the following marks are known to be 33.5 and 34 respectively. However, three frequencies are missing. Determine their values.

Marks:	0-10	10-20	20-30	30-40	40-50	50-60	60-70	Total
No. of students:	4	16	?	?	?	6	4	230

Ans. Median = 33.5, Mode = 34

Total sum of frequencies = 230

$4 + 16 + 60 + x + y + z + 4 = 230$

$\Rightarrow 84 + x + y + z = 230$

$\Rightarrow x + y + z = 146 \quad -①$

Daily wages	Frequencies	C.F
0-10	4	4
10-20	16	20
20-30	60	80
30-40	x	80+x
40-50	y	80+x+y
50-60	z	80+x+y+z
60-70	4	84+x+y+z

$$\text{Median} = l + \left(\frac{N/2 - C.f}{F}\right) \times h$$

$$\Rightarrow 33.5 = 30 + \left(\frac{\frac{230}{2} - 80}{x}\right) \times 10$$

$$\Rightarrow \frac{33.5 - 30}{10} = \frac{115 - 80}{x}$$

$$\Rightarrow \frac{3.5}{10} = \frac{35}{x}$$

$$x = \frac{35 \times 10}{3.5} \times 10$$

$$\boxed{x = 100}$$

$$\text{Mode} = l + \left(\frac{f_1 + f_0}{2f_1 - f_0 - f_2}\right) \times h$$

$$\Rightarrow 34 = 30 + \left(\frac{x - 60}{2x - 60 - y}\right) \times 10$$

$$\Rightarrow 34 - 30 = \left(\frac{100 - 60}{200 - 60 - y}\right) \times 10$$

$$\Rightarrow \frac{4}{10} = \frac{40}{140 - y}$$

$$\Rightarrow 560 - 4y = 400$$

$$\Rightarrow 4y = 560 - 400$$

$$\Rightarrow y = \frac{160}{4} = 40$$

$$\boxed{y = 40}$$

$\because x + y + z = 146$

$\Rightarrow 100 + z + 40 = 146$

$\Rightarrow z = 146 - 140$ $\quad \boxed{z = 6}$

Here, $x = 100$, $y = 40$, $z = 6$

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Q2. The mean of marks in Statistics of 100 students of a class was 72. The mean of marks of boys was 75, while their number was 70. Find out the mean marks of girls in the class.

Ans. $\underset{100}{\frac{x_1 + x_2 + \dots + x_{100}}{}} = 72$

$\underset{70}{\frac{x_1 + x_2 + \dots + x_{70}}{}} = 75$

$x_1 + x_2 + \dots + x_{70} = 75 \times 70$

$= 5250$

$\underset{100}{\frac{(x_1 + x_2 + \dots + x_{70}) + (x_{71} + \dots + x_{100})}{}} = 72$

$\Rightarrow 5250 + x_{71} + \dots + x_{100} = 7200$

$\Rightarrow x_{71} + \dots + x_{100} = 7200 - 5250$

$\Rightarrow x_{71} + \dots + x_{100} = 1950$

$\therefore x_{71} + x_{72} + \dots + x_{100} = 1950$

$\underset{30}{\frac{x_{71} + x_{72} + \dots + x_{100}}{}} = \frac{1950}{30}$ Mean

Mean of the marks of girls $= \frac{1950}{30}$

$= 65$

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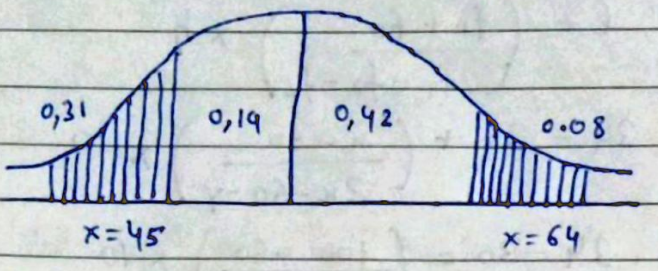
Q4. In a normal distribution 31% of the items are under 45 and 8% of the items are over 64. Find the mean and S.D. of the distribution.

Ans.



$$z = \frac{x - \bar{x}}{\sigma}$$

Value of z, corresponding to 0.50 - 0.31 = 0.19 area, is equal to -0.5

$$\Rightarrow -0.5 = \frac{45 - \bar{x}}{\sigma} \Rightarrow -0.5\sigma = 45 - \bar{x}$$

$$\Rightarrow \bar{x} - 0.5\sigma = 45$$

Value of z, corresponding to 0.5 - 0.08 = 0.42 area, is equal to +1.41

$$\Rightarrow 1.41 = \frac{64 - \bar{x}}{\sigma}$$

$$\Rightarrow 1.41\sigma = 64 - \bar{x}$$

$$\Rightarrow \bar{x} + 1.41\sigma = 64$$

Solving the system of equations

$$\begin{cases} \bar{x} - 0.5\sigma = 45 \\ \bar{x} + 1.41\sigma = 64 \end{cases} \Rightarrow -1.91\sigma = -19$$

$$\Rightarrow \boxed{\sigma = 10} \text{ (approx)}$$

Substituting the value of σ in the first equation.

$$\bar{x} - 0.5 \cdot 10 = 45$$

$$\boxed{\bar{x} = 50}$$

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Q5. The heights of persons with No. of persons is given, Heights (in cm) 58, 59, 60, 61, 62, 63, 64, 65 and No. of persons: 10, 18, 30, 42, 35, 28, 16, 8.
Find Karl Pearson's coefficient of correlation.

Ans.

x	y	$x-M_x$	$(x-M_x)^2$	$y-M_y$	$(y-M_y)^2$	$(x-M_x)(y-M_y)$
58	10	-3.5	12.25	-13.375	178.891	46.812
59	18	-2.5	6.25	-5.375	28.891	13.438
60	30	-1.5	2.25	+6.625	43.891	-9.938
61	42	-0.5	0.25	18.625	396.891	-9.312
62	35	0.5	0.25	11.625	135.141	5.812
63	28	1.5	2.25	4.625	21.391	6.938
64	16	2.5	6.25	-7.375	54.391	-18.438
65	8	3.5	12.25	-15.375	236.391	-53.812
$\Sigma x = 492$	$\Sigma y = 187$				$\Sigma = 1045.87$	$\text{Sum} = 18.5$

x Values

$\Sigma x_1 = 492$

$\text{Mean} = \frac{\Sigma x_1}{x_1}$

$= \frac{492}{7} = 61.5$

$\Sigma (x-M_x)^2 = 42$

y values

$\Sigma y_1 = 187$

$\text{Mean} = 23.375$

$\Sigma (y-M_y)^2 = 1045.87$

$r = \Sigma xy / \sqrt{\Sigma x^2} \times \sqrt{\Sigma y^2}$

$\Rightarrow r = 18.5 / \sqrt{(42)(1045.87)} = 0.0883$

Thus, the value of correlation coefficient $= -0.0883$