ASSIGNMENT -2

ASHOKA

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Q. In a random sample of 200 people in a city, 108 like to purchase imported watches and the remaining like to purchase local watches. Can we conclude that both the imported and local watches are popular in the City?

Ans.
$$P = \frac{n_1p_1 + n_2p_2}{n_1+n_2}$$

$$Q = 1-P$$

$$z = \frac{p_1 - p_2}{PQ\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}$$

$n_1 = 200$

$n_2 = 200$

$p_1 = \frac{108}{200}$, $p_2 = \frac{92}{200}$

$$P = \frac{\cancel{200}\times\frac{108}{\cancel{200}} + \cancel{200}\times\frac{92}{\cancel{200}}}{200+200} = \frac{\cancel{200}}{\cancel{400}}\ \frac{1}{2} = 0.5$$

$$\boxed{P = 0.5}$$

$Q = 1-P$

$Q = 1-0.5$

$$\boxed{Q = 0.5}$$

$$z = \frac{\frac{108}{200} - \frac{92}{200}}{0.5\times0.5\left(\frac{1}{\frac{108}{200}} + \frac{1}{92/200}\right)} \Rightarrow \frac{16/200}{0.25\left(\frac{1}{\cancel{108}_{\cancel{54}\,27}}\times\cancel{200}^{\cancel{100}\,50} + \frac{1}{\cancel{92}_{46}}\times\cancel{200}^{100}\right)}$$

$$\Rightarrow \frac{0.08}{0.25\left(\frac{1}{27}\times 50 + \frac{1}{\cancel{46}_{23}}\times\cancel{100}^{50}\right)} \Rightarrow \frac{0.08}{0.25\left(\frac{1}{27}\times50 + \frac{1}{23}\times50\right)}$$

$$\Rightarrow \frac{0.08}{0.25(1.85+2.17)} \Rightarrow \frac{0.08}{0.25(4.02)} \Rightarrow \frac{0.08}{1.005}\ \boxed{z = 0.07}$$

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Q2. Explain the concept of confidence interval with suitable example.

Ans. A confidence interval is the mean of your estimate plus and minus the variation in that estimate. this is the range of values you except your estimate to fall between if you redo your test, within a certain level of confidence.

Confidence, in statistics, is another way to describe probability,

for eg.

If you construct a confidence interval with a 95% confidence level, you are confident that 95 out of 100 times the estimate will fall between the upper and lower values specified by the confidence interval.

Your desired confidence level is usually one minus the alpha (α) value you used in your statistical test:

$$\text{Confidence level} = 1 - a$$

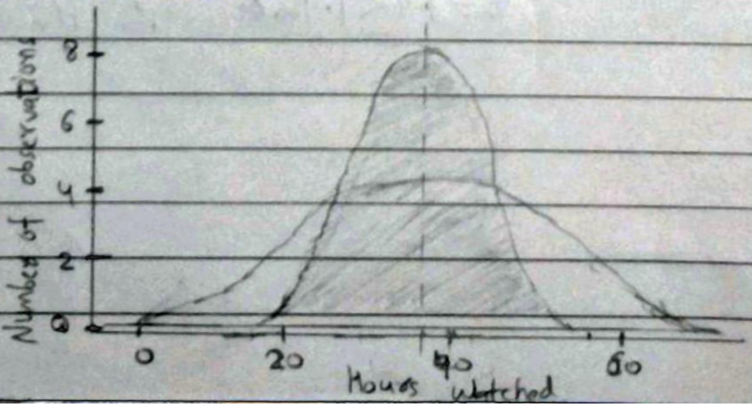
So, if you use an alpha value of $p < 0.05$ for statistical significance, then your confidence level would be $1 - 0.05 = 0.95$ or 95%.

Example: You survey 100 Brits and 100 Americans about their television-watching habits, and find that both groups watch an average of 35 hours of television per week.

However, the British people surveyed had a wide variation in the no. of hours watched, while the Americans all watched similar amounts.

Even though both groups have the same point estimate, the British estimate will have a wider confidence interval than the American estimate because there is more variation in the data.

Average hours of TV watched per week, G.B vs USA



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Q3. Two types of new cars produced in India are tested for petrol mileage. One group consisting of 36 cars averaged 14 Kms per litre. While the other group consisting of 72 cars averaged 12.5 Kms per litre.

(a) What test statistic is appropriate, if $\sigma_1^2 = 1.5$ and $\sigma_2^2 = 2.0$?

(b) Test, whether there exists a significant difference in the petrol consumption of these two types of cars. (Use alpha = 0.01)

Ans.

	Mean	Size
Sample 1	14	36
Sample 2	12.5	72

$\bar{x}_1 = 14$ $\quad \sigma_1^2 = 1.5$ $\quad n_1 = 36$

$\bar{x}_2 = 12.5$ $\quad \sigma_2^2 = 2.0$ $\quad n_2 = 72$

$$z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \Rightarrow z = \frac{14 - 12.5}{\sqrt{\frac{1.5}{36} + \frac{2.0}{72}}}$$

$$= \frac{1.5}{\sqrt{\frac{3.0}{72} + \frac{2.0}{72}}} = \frac{1.5}{\frac{1}{6}\sqrt{\frac{5}{2}}}$$

$$= 1.5 \times \frac{6\sqrt{2}}{\sqrt{5}}$$

$$= \frac{3}{2} \times \frac{\overset{3}{\cancel{6}}\sqrt{2}}{\sqrt{5}}$$

$$= \frac{9\sqrt{2}}{\sqrt{5}} > 1.966$$

$\therefore H_0$ is Rejected.

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Q4. A machine produced 16 defective articles in a batch of 500. After over hauling it produced 3 defectives in a batch of 100. Has the machine improved?

Ans. H_0 : Machine has not improved

$p_1 = p_2$

H_1 : Machine has improved

$p_1 > p_2$

$n_1 = 500$ $\quad p_1 = \frac{16}{500}$, $p_2 = \frac{3}{10}$, $P = \frac{16}{600}$, $Q = \frac{581}{600}$

$n_2 = 100$

$$z = \frac{p_1 - p_2}{\sqrt{PQ\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \Rightarrow \frac{\frac{16}{500} - \frac{15}{500}}{\sqrt{\frac{16}{500} \times \frac{581}{600}\left[\frac{1}{500} + \frac{1}{100}\right]}}$$

$$\Rightarrow \frac{\frac{16}{500} - \frac{15}{500}}{\sqrt{\frac{16}{600} \times \frac{581}{600} \times \left(\frac{600}{500}\right)}}$$

$$\Rightarrow \frac{1}{500} \times \frac{600 \times 10^2\sqrt{6}}{\sqrt{19 \times 581 \times 5}} = \frac{12\sqrt{6}}{\sqrt{19 \times 581 \times 5}} = \frac{12\sqrt{6}}{55,195}$$

$$\Rightarrow \frac{28.8}{55,195}$$

$\therefore z \ngtr 1.685$

$\boxed{\text{Ans}}$

Q5. Fit a straight line to the following data:

x :	0	1	2	3	4
y :	1	1.8	3.3	4.5	6.3

Let the straight line is $y = a + bx$ —— (1)

Ans. Normal equations are, $\Sigma y = na + b\,\Sigma x$ —— (2)

$\Sigma xy = a\,\Sigma x + b\,\Sigma x^2$ —— (3)

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x	y	xy	x^2
0	1	0	0
1	1.8	1.8	1
2	3.3	6.6	4
3	4.5	13.5	9
4	6.3	25.2	16
$\Sigma x=10$	$\Sigma y=16.9$	$\Sigma xy=47.1$	$\Sigma x^2=30$

Here $n=5$,

$\Sigma x=10$, $\Sigma y=16.9$, $\Sigma xy=47.1$, $\Sigma x^2=30$

Putting these values in normal equations, we get

$$16.9 = 5a + 10b$$

$$47.1 = 10a + 30b$$

On solving these two equations, we get

$a = 0.72$, $b = 1.33$

So, line $\Rightarrow$ $\boxed{y = 0.72 + 1.33x}$

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