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CO3 - Apply Large Sample Test and Small sample test to analyze collected data.

Q1) A random sample of 50 items gives the mean 6.2 and standard deviation 10.24. Can it be regarded as drawn from a normal population with mean 5.4 at 5% LOS.

Ans

→ Here Null Hypothesis is : $(H_0) \Rightarrow \mu = 5.4$

→ Here Alternate Hypothesis is : $\mu \neq 5.4$
(Two-Tailed)

→ Level of significance : $\alpha = 0.05$.

→ Critical value of Z_α at 5% LOS is : = 1.96

→ Calculate Statistic $z = \frac{(x-\mu)}{\left(\frac{\sigma}{\sqrt{n}}\right)} = \frac{6.2-5.4}{\frac{10.24}{\sqrt{50}}} = 0.554$

Here we observe that $0.554 < 1.96$ so the null hypothesis is accepted. This is the final conclusion.

Q2) Diet A: 5 6 8 1 12 4 3 9 6 10

Diet B: 2 3 6 8 10 1 2 8

A group of 10 rats fed on diet A and another group of 8 rats feed on diet B. Does it show superiority of diet A over diet B?

Ans: $n_1 = 10$ (< 30 sample is small)

$n_2 = 8$

→ Null Hypothesis : $\sigma_1^2 = \sigma_2^2$

In null hypothesis variance is not significantly different

→ Alternate Hypothesis: $\sigma_1^2 \neq \sigma_2^2$

In alternate hypothesis variances are significantly different.

$\bar{X}_1 = \frac{\sum x_1}{N} = \frac{64}{10} = 6.4$ | $\bar{X}_2 = \frac{\sum x_2}{N} = \frac{40}{8} = 5.$

5	-1.4	1.96	2	-3	9
6	-0.4	0.16	3	-2	4
8	1.6	2.56	6	1	1
1	-5.4	29.16	8	3	9
12	5.6	31.36	1	-4	16
4	-2.4	5.76	10	5	25
3	-3.4	11.56	2	-3	9
9	2.6	6.76	8	3	9
6	0.4	0.16			
10	3.6	12.96			
64	0	102.4	40	0	82

$$S_1^2 = \frac{\Sigma(X_1-\bar{X}_1)^2}{n_1} \qquad S_2^2 = \frac{\Sigma(X_2-\bar{X}_2)^2}{n_2}$$

$$\boxed{n_1 \cdot S_1^2 = 102.4} \qquad \boxed{n_2 \cdot S_2^2 = \Sigma(X_2-\bar{X}_2)^2 = 82}$$

$$\sigma_1^2 = \frac{n_1 \cdot S_1^2}{n_1 - 1} = \frac{102.4}{10-1} = 11.3778$$

$$\sigma_2^2 = \frac{n_2 \cdot S_2^2}{n_2 - 1} = \frac{82}{8-1} = 11.7143$$

$$\therefore f_{cal} = \frac{\sigma_1^2}{\sigma_2^2} = \frac{11.7143}{11.3778} = 1.0296$$

LOS (5%)

Degree of freedom $V_1 = n_1 - 1 = 10 - 1 = 9$
$V_2 = n_2 - 1 = 8 - 1 = 7$

Value of F at $(9,7) = F(9,7,0.025) = 3.6767$

Value of F at $(7,9) = F(7,9,0.025) = 3.2927$

$$\therefore \frac{1}{F(9,7,0.025)} = \frac{1}{3.6767} = 0.2728$$

$\therefore$ Null Hypothesis is accepted as

$$\frac{1}{F(9,7,0.025)} < f_{cal} < F(7,9,0.025)$$

0 102.4

Q3) In an industry 200 workers employed for a specific job were classified according to their performance and training recieved to test independance of training recieved to test independance of training recieved & performance. The data are summarized as follows. Use χ^2-test for independence at 5% level of significance and write your conclusion.

Performance	Good	Not Good	Total
Trained	100	50	150
Untrained	20	30	50
Total	120	80	200.

Ans.

Ho (Null Hypothesis)
H_1 (Alternate Hypothesis)

Table for expected frequencies $= E_{ij} = \frac{A_i * B_j}{N}$

	Good	Not Good	Total
Trained	$\frac{150 \times 120}{200} = 90$	$\frac{150 \times 80}{200} = 60$	150
Untrained	$\frac{50 \times 120}{200} = 30$	$\frac{50 \times 80}{200} = 20$	50
Total	120	80	200

$$\chi^2 = \frac{\Sigma(O-E)^2}{E} = \frac{(100-90)^2}{90} + \frac{(50-60)^2}{60} + \frac{(20-30)^2}{30}$$

$$+ \frac{(30-20)^2}{20} = 11.1111.$$

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Degree of freedom = $(r-1)(c-1) = 1$.

$\therefore \chi^2 = 3.84$ at 5% LOS.

The result is significant at 5% LOS.

$\chi^2_{cal} > \chi^2_{tab}$ as $11.111 > 3.84$.