DPP-5 Maths-4 Unit-V

Topic- Chi-Square Test

Q-1 - What is $X^2$ Test?

A die is thrown 90 times with the following results:

| Face: | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Frequency: | 10 | 12 | 16 | 14 | 18 | 20 |

Use $X^2$- Test to test whether these data are consistent with hypothesis that die is unbiased.

Sol- Chi Square Test-

- Chi-square test is the test of significance.
- It was first of all used by Karl Pearson in year 1900.
- Chi-square is a useful measure of comparing experimentally obtained result with those expected theoretically and based on the hypothesis.

| $O_i$ | $E_i$ | $O_i - E_i$ | $(O_i - E_i)^2$ |
|---|---|---|---|
| 10 | 15 | -5 | 25 |
| 12 | 15 | -3 | 9 |
| 16 | 15 | 1 | 1 |
| 14 | 15 | -1 | 1 |
| 18 | 15 | 3 | 9 |
| 20 | 15 | 5 | 25 |
| $\Sigma O_i = 90$ | | | $\Sigma (O_i - E_i)^2 = 70$ |

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Null Hypothesis ($H_0$)

Die is unbiased.

Calculation of $\chi^2$, under $H_0$

$$E_i = \frac{\Sigma O_i}{n} = \frac{90}{6} = 15$$

$$\chi^2 = \frac{\Sigma (O_i - E_i)^2}{E_i}$$

$$= \frac{70}{15}$$

$$\boxed{\chi^2 = 4.67}$$

Degree of freedom = $n-1$
$= 5$

Level of significance ($\alpha$) = 5% = 0.05

For $\chi^2$ test table

$$\boxed{\chi^2_{0.05} = 11.070}$$

Conclusion - $\because \chi^2 < \chi^2_{0.05}$

$\therefore H_0$ is accepted

Hence, die is unbiased.

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Q-2- The demand of a particular spare part in a factory was found to vary from day to day. In a sample study, the following information was obtained

| Days: | Mon | Tue | Wed | Thurs | Fri | Sat |
|---|---|---|---|---|---|---|
| No. of parts | 1124 | 1125 | 1110 | 1120 | 1126 | 1115 |

Test the hypothesis that the number of part demanded doesn't depend on the day of week.

Sol- Null Hypothesis

$H_0$: Number of part demanded doesn't depend on the day of week.

| $O_i$ | $E_i$ | $O_i - E_i$ | $(O_i - E_i)^2$ |
|---|---|---|---|
| 1124 | 1120 | 4 | 16 |
| 1125 | 1120 | 5 | 25 |
| 1110 | 1120 | -10 | 100 |
| 1120 | 1120 | 0 | 0 |
| 1126 | 1120 | 6 | 36 |
| 1115 | 1120 | -5 | 25 |

$\Sigma (O_i - E_i)^2 = 202$

$\Sigma O_i = 6720$

$$E_i = \frac{\Sigma O_i}{n} = \frac{6720}{6} = 1120$$

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$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

$$= \frac{202}{1120}$$

$$\boxed{\chi^2 = 0.18}$$

Degree of freedom = $n - 1 = 5$

Level of significance ($\alpha$) = 5%
= 0.05

From $\chi^2$ test table

$$\boxed{\chi^2_{0.05} = 11.07}$$

$\therefore$ $\chi^2 < \chi^2_{0.05}$

$\therefore$ $H_0$ is accepted.

Hence, Number of part demanded doesn't depend on day of week.

Q- The theory predicts the propotion of bears in the four groups, $G_1$, $G_2$, $G_3$, $G_4$ should be in the ratio 9:3:3:1. In an experiment with 1600 bears the number in the four groups were 882, 313, 287 and 118. Does the experimental result support the theory?

Sol- Null Hypothesis ($H_0$) = The experimental result support the Support theory.

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$E_1 = \frac{9}{16} \times 1600 = 900$

$E_2 = \frac{3}{16} \times 1600 = 300$

$E_3 = \frac{3}{16} \times 1600 = 300$

$E_4 = \frac{1}{16} \times 1600 = 100$

| $O_i$ | $E_i$ | $O_i - E_i$ | $(O_i - E_i)^2$ | $(O_i - E_i)^2 / E_i$ |
|---|---|---|---|---|
| 882 | 900 | 18 | 324 | 0.36 |
| 313 | 300 | 13 | 169 | 0.5633 |
| 287 | 300 | -13 | 169 | 0.5633 |
| 118 | 100 | 18 | 324 | 3.24 |

$\sum \left[ \frac{(O_i - E_i)^2}{E_i} \right] = 4.726$

$$\chi^2 = \sum \left[ \frac{(O_i - E_i)^2}{E_i} \right] = 4.726$$

Degree of freedom = $n - 1 = 3$

Level of significance $(\alpha) = 5\% = 0.05$

$$\boxed{\chi^2_{0.05} = 7.815}$$

Conclusion = $\because \chi^2 < \chi^2_{0.05}$

$\therefore H_0$ is accepted

Hence, Experimental Result support the theoritical result.

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