## CHI SQUARE TEST FOR INDEPENDENCE OF ATTRIBUTES:

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

where $O_i \rightarrow$ Observed frequency

$E_i \rightarrow$ Expected frequency

$$E_i = \frac{(\text{row total})(\text{column total})}{\text{whole total}}, \quad \begin{matrix} i = 1 \text{ to } \\ j = 1 \text{ to } \end{matrix}$$

Degrees of freedom, $\nu = (3-1)(2-1)$.

1) On the basis of information noted below, find out whether the new treatment is comparatively superior to the conventional one.

| | Favourable | Not Favourable | Total |
|---|---|---|---|
| New | 60 | 30 | 90 |
| Conventional | 40 | 70 | 110 |
| Total | 100 | 100 | 200 |

Soln:

To find $E_i$:

| | |
|---|---|
| $\frac{90 \times 100}{200} = 45$ | $\frac{90 \times 100}{200} = 45$ |
| $\frac{110 \times 100}{200} = 55$ | $\frac{110 \times 100}{200} = 55$ |

| $O_i$ | $E_i$ | $O_i - E_i$ | $(O_i - E_i)^2/E_i$ |
|---|---|---|---|
| 60 | 45 | 15 | 5 |
| 30 | 45 | -15 | 5 |
| 40 | 55 | -15 | 4.09 |
| 70 | 55 | 15 | 4.09 |
| | | $\sum \frac{(O_i - E_i)^2}{E_i}$ : | 18.18 |

step 1: Formulating $H_0$ & $H_1$:

$H_0$: There is no difference between new & conventional treatment.

$H_1$: There is difference between new & conventional treatment.

step 2: Los at $\alpha = 5\%$.

step 3: Test statistics, $\chi^2 = \frac{\sum (O_i - E_i)^2}{E_i}$

$= 18.18$

step 4: Degrees of freedom, $\nu = ((s-1) * (t-1))$

$\nu = (2-1 * 2-1)$

$= 1 * 1$

$= 1$

$\therefore$ Tab value, $\chi^2_\alpha = 3.841$

step 5: Conclusion:

$\chi^2 = 18.18 > 3.841 = \chi^2_\alpha$

$\therefore$ $H_0$ is rejected at 5% Los

Ans: There is difference between new & conventional treatment.

2) Two researchers A and B adopted different techniques while rating the students level. Can you say that the techniques adopted by them are significant?

| Researchers: | Below avg. | Avg. | Above Avg. | Genius | Total |
|---|---|---|---|---|---|
| A | 40 | 33 | 25 | 2 | 100 |
| B | 86 | 60 | 44 | 10 | 200 |
| Total | 126 | 93 | 69 | 12 | 300 |

Soln:

To find $E_i$

$\frac{100 \times 126}{300} = 42$ $\quad \frac{100 \times 93}{300} = 31$ $\quad \frac{100 \times 69}{300} = 23$ $\quad \frac{100 \times 12}{300} = 4$

$\frac{200 \times 126}{300} = 84$ $\quad \frac{200 \times 93}{300} = 62$ $\quad \frac{200 \times 69}{300} = 46$ $\quad \frac{200 \times 12}{300} = 8$

| $O_i$ | $E_i$ | $O_i - E_i$ | $(O_i - E_i)^2 / E_i$ |
|---|---|---|---|
| 40 | 42 | -2 | 0.0952 |
| 33 | 31 | 2 | 0.129 |
| 25 | 23 | 2 | 0.173 |
| 2 | 4 | -2 | 1 |
| 86 | 84 | 2 | 0.047 |
| 60 | 62 | -2 | 0.064 |
| 44 | 46 | -2 | 0.086 |
| 10 | 8 | 2 | 0.5 |

$\sum \frac{(O_i - E_i)^2}{E_i} = 2.094$

Step 1 : Formulating $H_0$ and $H_1$ :

$H_0$ : There is no difference between the two researchers.

$H_1$ : There is difference between the two researchers

Step 2 : LOS at $\alpha = 5\%$.

Step 3 : Test statistics, $\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$

$= 2.097$.

Step 4 : Degrees of freedom, $v = ((4-1) * (2-1))$

$= (3 * 1)$

$= 3$

$\therefore$ Tab value is $\chi^2_\alpha = 7.115$

Step 5 : Conclusion.

$\chi^2 = 2.097 < 7.115 = \chi^2_\alpha$

$\therefore$ $H_0$ is acceptid at 5% LOS

(a) There is no difference between the two researchers.