Formula for computing χ^2 statistic -

$$\chi^2 = \Sigma\left[\frac{(O_{ij} - E_{ij})^2}{E_{ij}}\right]$$

Where,

χ^2 = Chi-square value

O_{ij} = Observed frequencies

E_{ij} = Expected frequencies

It is common to write

χ^2 as $\chi^2 = \Sigma\left[\frac{(O-E)^2}{E}\right]$

The **Expected frequencies** can be obtained by using the formula:

$$E_{ij} = \frac{R_i \times C_j}{N}$$

Where,

R_i = Row Total

C_j = Column Total

N = Grand Total that is Total frequency

SOLVED EXAMPLES

Ex.1: Following data is obtained from a sample of 200 people of which 80 were men and 120 were women.

	Right-handed	Left- handed
Men	40	40
Women	35	85

Table 4.26

Find the value of χ^2 statistic.

Solution:

Let us find the row and column totals and total frequency from the given 2 × 2 contingency table.

	Right Handed	Left Handed	Total
Men	40	40	80
Women	35	85	120
Total	75	125	200

Table 4.27

Expected frequencies are given by

$$E_{ij} = \frac{R_i \times C_j}{N}$$

Therefore,

$$E_{11} = \frac{R_1 \times C_1}{N} = \frac{80 \times 75}{200} = 30,$$

$$E_{12} = \frac{R_1 \times C_2}{N} = \frac{80 \times 125}{200} = 50$$

$$E_{21} = \frac{R_2 \times C_1}{N} = \frac{120 \times 75}{200} = 45,$$

$$E_{22} = \frac{R_2 \times C_2}{N} = \frac{120 \times 125}{200} = 75$$

Write the table of expected frequencies

We have,

$$\chi^2 = \Sigma\left[\frac{(O_{ij} - E_{ij})^2}{E_{ij}}\right]$$

$$= \frac{(40-30)^2}{30} + \frac{(40-50)^2}{50} + \frac{(35-45)^2}{45} + \frac{(85-75)^2}{75}$$

$$= \frac{100}{30} + \frac{100}{50} + \frac{100}{45} + \frac{100}{75}$$

$$= 3.33 + 2.22 + 2.00 + 1.33$$

$$\chi^2 = 8.88$$

Ex.2: A sample of boys and girls were asked to choose one colour from three options – pink, blue and orange to paint their room with the following results.

	Pink	Blue	Orange
Boys	27	63	10
Girls	41	45	14