

Chi-Square Test As a Test of Independence

$$\text{Expected frequency} = \frac{\text{Row total} \times \text{Column total}}{\text{Grand total}}$$

Example → The I.Q. and economic condition of homes of 1000 students of an engineering college, Delhi were noted as given in the table

I.Q.	High	Low	Total
Frequency			
Rich	100	300	400
Poor	350	250	600
Total	450	550	1000

Find out whether there is any association between economic condition at home and I.Q. of the students.

Given for 1 d.f. χ^2 at the level of significance 0.05 is 3.84

Solution →

Null Hypothesis H_0 : There is no association between economic condition at home & I.Q.

Alternative Hypothesis H_1 :

There is an association between economic condition at home & I.Q.

Expected frequency $E = \frac{\text{Row total} \times \text{Column total}}{\text{Grand total}}$

Economic cond. I.Q.	High	Low	Total
Rich	$\frac{400 \times 450}{1000} = 180$	$\frac{400 \times 550}{1000} = 220$	400
Poor	$\frac{600 \times 450}{1000} = 270$	$\frac{600 \times 550}{1000} = 330$	600
Total	450	550	1000

calculation of χ^2 (chi square)

observed value (O)	Expected value (E)	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
100	180	-80	6400	35.5
350	270	80	6400	23.7
300	220	80	6400	29.1
250	330	-80	6400	19.4
			total	107.7

Degree of freedom = $(R-1)(C-1)$
 $= (2-1)(2-1) = 1$
 R = Rows
 C = Columns

χ^2 at the level of significance 0.5 & 1 degree of freedom
 $= 3.84$ (given in question)

Cal value of $\chi^2 = 107.7$
 Tabulated value of $\chi^2 = 3.84$
 $107.7 > 3.84$

Hence the Null hypothesis is rejected & alternative hypothesis is accepted.
 i.e., there is an association between economic condition at home & I.Q.