

# $\chi^2$ test for Independence

## 3x3 Table

Ex: Does "test failure" reduce academic aspirations and thereby contribute to the decision to drop out of school? A survey of 283 students randomly selected from schools with low graduation rates. The contingency table below reports results to the question "Do tests required for graduation discourage students from staying in school"? Does there appear to be a relation

between the schools' location and the students' responses.

(Use  $\alpha = .05$ )

		School Location			Row Totals
		Urban	Suburb	Rural	
Response	Yes	57 (57.86)	27 (31.48)	47 (41.66)	131
	No	23 (22.53)	16 (12.25)	12 (16.22)	51
	Unsure	45 (44.61)	25 (24.27)	31 (32.12)	101
	Col totals	125	68	90	283

$H_0$ : School location and student response are indep.

$H_1$ : School location and student response are dependent

$$\alpha = 0.05$$

For  $r \times c$  tables, the test statistic is not the same as for  $2 \times 2$  tables.

Test statistic (for  $r \times c$  tables):

$$\chi^2* = \sum \frac{(\theta - E)^2}{E}$$

where  $\theta$  represents the observed cell frequencies; and

the expected cell frequencies ( $E$ ) are computed as usual

$$E = \frac{\text{row total} * \text{col total}}{n}$$

For our example

$$\chi^2 * = \frac{(57 - 57.86)^2}{57.86} + \frac{(27 - 31.48)^2}{31.48}$$

$$+ \dots + \frac{(31 - 32.12)^2}{32.12}$$

$$= .013 + .638 + .684 + .010 + 1.148$$

$$+ 1.098 + .003 + .022 + .039$$

$$= 3.655$$

Critical Value: Table C

$$\begin{aligned}df &= (r-1)(c-1) \\ &= (3-1)(3-1) = 4\end{aligned}$$

$$\alpha = .05$$

$$\chi^2 = 9.49$$

Reject  $H_0$  if  $\chi^2^* > \chi^2$

Since  $3.655 \not> 9.49$

do not reject  $H_0$ .

We conclude that the evidence is not sufficient to show a significant association between school location and response.

Assumptions:

Some as for  $2 \times 2$  table