

- II. This is Darin's page 42 study of customer age and making a sale. Test at the .05 level of significance whether customer age and making a sale are independent.

Customer Age and Making A Sale			
Customer Age	Less than or equal to 20	Over 20	Totals
Making A Sale			
No	16	8	24
Yes	24	12	36
Totals	40	20	60

Contingency Table of Customer Age and Making A Sale						
Customer Age	Less than or equal to 20		Over 20		Totals	
Making A Sale						
	$f_o$	$f_e$	$f_o$	$f_e$	$f_o$	$f_e$
No	16	16	8	8	24	24
Yes	24	24	12	12	36	36
Totals	40	40	20	20	60	60

Working left to right:

$$f_e = \frac{f_r \times f_c}{n} = \frac{24 \times 40}{60} = 16$$

$$f_e = \frac{f_r \times f_c}{n} = \frac{24 \times 20}{60} = 8$$

Alternate formula

$$f_e = \frac{f_r}{n} \times f_c = \frac{24}{60} \times 40 = 16$$

$$f_e = \frac{f_r}{n} \times f_c = \frac{24}{60} \times 20 = 8$$

- $H_0$  : customer age and making a sale are independent (not related).  
 $H_1$  : customer age and making a sale are dependent (related).
- The significance level will be .05.
- Chi-square is the test statistic.
- The decision rule:  
If  $\chi^2$  from the test statistic is beyond the critical value, reject the null hypothesis.
- Apply the decision rule.

$$df = (r - 1)(c - 1) = (2 - 1)(2 - 1) = 1 \rightarrow \chi^2 = 3.84$$

$$\chi^2 = \sum \left[ \frac{(f_o - f_e)^2}{f_e} \right] = \sum \left[ \frac{(16 - 16)^2}{16} + \frac{(8 - 8)^2}{8} + \frac{(24 - 24)^2}{24} + \frac{(12 - 12)^2}{12} \right] = 0 + 0 + 0 + 0 = 0$$

Accept  $H_0$  because  $0 < 3.84$ . Customer age and making a sale are statistically independent at the .05 level of significance.

**Note:** These variables are independent because both types of buyers do not make a purchase 40% of the time and do make a purchase 60% of the time.