IV. Using the 5-step approach to hypothesis testing and the .01 level of significance, test whether the number of math courses taken and success in statistics are independent.

Statistics Grades and Math Background at State University			
Grade / Math courses taken	Less than B	Greater than or equal to B	Totals
Less than or equal to 2	15	5	20
Greater than 2	5	25	30
Totals	20	30	50

Contingency Table of Statistics Grades and Math Background						
Grade / Math courses taken	Less than B		Greater than or equal to B		Totals	
	f_o	f_e	f_o	f_e	f_o	f_e
Less than or equal to 2	15	8	5	12	20	20
Greater than 2	5	12	25	18	30	30
Totals	20	20	30	30	50	50

$$f_e = \frac{f_r \times f_c}{n} = \frac{20 \times 20}{50} = 8$$

$$f_e = \frac{f_r \times f_c}{n} = \frac{30 \times 20}{50} = 12$$

$$f_e = \frac{f_r \times f_c}{n} = \frac{20 \times 30}{50} = 12$$

$$f_e = \frac{f_r \times f_c}{n} = \frac{30 \times 30}{50} = 18$$

1. H_0 : math courses taken and statistics grades are independent.

   H_1 : math courses taken and statistics grades are not independent.
2. The significance level is .01.
3. Chi-square is the test statistic.
4. The decision rule:

   If χ^2 from the test statistic is beyond the critical value, reject the null hypothesis.
5. Apply the decision rule.

df = (r - 1) (c - 1) = (2 - 1) (2 - 1) = $\rightarrow \chi^2 = 6.64$

$$\chi^2 = \Sigma\left[\frac{(f_o - f_e)^2}{f_e}\right] = \Sigma\left[\frac{(15-8)^2}{8} + \frac{(5-12)^2}{12} + \frac{(5-12)^2}{12} + \frac{(25-18)^2}{18}\right]$$

$$= 6.13 + 4.08 + 4.08 + 2.72$$

$$= 17.01$$

Reject H_0 because 17.01 > 6.64. Math courses taken and statistics grades are not statistically independent at the .01 level of significance.