Use JMP to answer the following questions. Instructions for how to find the relevant JMP output are included in Chapter 12 of your Lecture Guide.

1. The following data on gender and highest earned degree were collected for individuals with a college degree in the United States. A researcher wonders if there is an association between gender and highest degree earned. Conduct a χ^2 test of independence at the $\alpha = 0.05$ level to investigate the researcher's hypothesis.

	Bachelor's	**Master's**	**Professional**	**Doctorate**	**Total**
Women	644	230	32	18	924
Men	506	154	40	26	726
Total	1150	384	72	44	1650

(a) State the appropriate **hypotheses** in this context.

H_0: Gender and highest degree earned are independent (not associated)
H_1: Gender and highest degree earned are dependent (associated)

(b) What is the **expected count** for women with a master's degree?

$$E = \frac{\text{Row Total} \times \text{Column Total}}{\text{Total Sample Size}} = \frac{924 \times 384}{1650} = 215.04$$

(c) Are the **conditions** for the chi-square test of independence of gender and highest degree earned met?

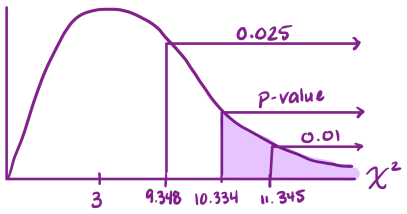
Yes, because all expected counts are greater than 5.

(d) Calculate the chi-square **test statistic**.

$$E = \frac{(506-506)^2}{506} + \cdots + \frac{(32-40.32)^2}{40.32} = 10.334 \text{ (from output)}$$

(e) Find the **approximate p-value** using the chi-square table. Include a sketch.

$df = (r-1)(c-1) = (2-1)(4-1) = (1)(3) = 3$ $\quad$ $0.01 < \text{p-value} < 0.025$



(f) What is the **exact p-value** from your JMP output?

p-value = 0.0159

(g) State your **conclusion** in context.

Reject H_0 because the p-value is smaller than $\alpha = 0.05$. At the 5% level, there is sufficient evidence that gender and highest degree earned are dependent.

2. The following data were compiled on medals won by different countries in several years of the Olympics.

	Bronze	Silver	Gold
China	26	28	26
Great Britain	17	23	27
Russia	19	18	19
United States	38	37	46
Other	260	211	189

Investigate whether there is an association between country and type of medal won. Use a significance level of $\alpha = 0.05$.

(a) State the appropriate **hypotheses** in this context.

H_0: Country and medal type are independent (not associated)
H_1: Country and medal type are dependent (associated)

(b) What is the **expected count** for gold medals from the United States?

$$E = \frac{\text{Row Total} \times \text{Column Total}}{\text{Total Sample Size}} = \frac{121 \times 307}{984} = 37.751$$

(c) Are the **conditions** for the chi-square test of independence of gender and highest degree earned met?

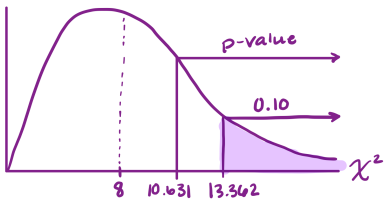
Yes, because all expected counts are greater than 5.

(d) Calculate the chi-square **test statistic**.

$$E = \frac{(26 - 29.2683)^2}{29.2683} + \cdots + \frac{(37 - 38.9807)^2}{38.9807} = 10.631 \text{ (from output)}$$

(e) Find the **approximate p-value** using the chi-square table. Include a sketch.

$df = (r-1)(c-1) = (5-1)(3-1) = (4)(2) = 8$ p-value > 0.10



(f) What is the **exact p-value** from your JMP output?

p-value = 0.2235

(g) State your **conclusion** in context.

Do not reject H_0 because the p-value is larger than $\alpha = 0.05$. At the 5% level, there is insufficient evidence that country and medal type in the Olympics are dependent.

For reference, your JMP output for #2 should be as follows.

Contingency Analysis of Medal By Country

Freq: Count

Contingency Table

Country	Count / Expected	Bronze	Gold	Silver	Total
		Medal			
China	Count	26	26	28	80
	Expected	29.2683	24.9593	25.7724	
Great Britain	Count	17	27	23	67
	Expected	24.5122	20.9035	21.5843	
Other	Count	260	189	211	660
	Expected	241.463	205.915	212.622	
Russia	Count	19	19	18	56
	Expected	20.4878	17.4715	18.0407	
US	Count	38	46	37	121
	Expected	44.2683	37.751	38.9807	
Total		360	307	317	984

Tests

N	DF	-LogLike	RSquare (U)
984	8	5.3490579	0.0050

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	10.698	0.2194
Pearson	10.631	0.2235