College Prep Stats
11.3 Extra Practice

1. Achievement and School Location Is achieving a basic skill level in a subject related to the location of the school? The results of a random sample of students by the location of school and the number of those students achieving basic skill levels in three subjects is shown in the contingency table. At α = 0.05, test the hypothesis that the variables are independent. (Adapted from HUD State of the Cities Report)

	Subject		
Location of school	**Reading**	**Math**	**Science**
Urban	43	42	38
Suburban	63	66	65

MATRIX[B] ■ ×3

41.129	41.905	39.965
64.871	66.095	63.035

Requirements Check: 1) Random Sample 2) Observed Frequencies are all given 3) All Expected Frequencies are > 5

a) State the null hypothesis and the alternative hypothesis.

H_0 : *Location of school is independent of subject.* (original claim)

H_1 : *Location of school and subject are dependent.*

b) Calculate the test statistic.

$$\chi^2 = \sum \frac{(O-E)^2}{E} = 0.2973$$

c) Determine the *p*-value.

P-Value = 0.8619 > 0.05, Fail to reject H_0

d) What is the conclusion?

There is not sufficient evidence to warrant rejection of the claim that location of school is independent of subject.

2. Attitudes about Safety The results of a random sample of students by type of school and their attitudes on safety steps taken by the school staff are shown in the contingency table. At α = 0.01, can you conclude that attitudes about the safety steps taken by the school staff are related to the type of school? (Adapted from Horatio Alger Association)

	School staff has	
Type of school	**Taken all steps necessary for student safety**	**Taken some steps toward student safety**
Public	40	51
Private	64	34

MATRIX[B] 2 ×2

50.074	40.926
53.926	44.074

Requirements Check: 1) Random Sample 2) Observed Frequencies are all given 3) All Expected Frequencies are > 5

a) State the null hypothesis and the alternative hypothesis.

H_0 : *School staff attitude about the safety steps is independent of the type of school.*

H_1 : *School staff attitude about the safety steps and the type of school are dependent.* (original claim)

b) Calculate the test statistic.

$$\chi^2 = \sum \frac{(O-E)^2}{E} = 8.6911$$

c) Determine the *p*-value.

P-Value = 0.0032 < 0.01, Reject H_0

d) What is the conclusion?

The sample data support the claim that school staff attitude about the safety steps and the type of school are related /dependent.

3. Trying to Quit Smoking The contingency table shows the number of times a random sample of former smokers tried to quit smoking before they were habit-free and gender. At α = 0.05, can you conclude that the number of times they tried to quit before they were habit-free is related to gender? (Adapted from Porter Novelli Health Styles for the American Lung Association)

	Number of times tried to quit before habit-free		
Gender	**1**	**2–3**	**4 or more**
Male	271	257	149
Female	146	139	80

MATRIX[B] 2 ×3

270.93	257.29	148.78
146.07	138.71	80.216

Requirements Check: 1) Random Sample 2) Observed Frequencies are all given 3) All Expected Frequencies are > 5

a) State the null hypothesis and the alternative hypothesis.

H_0 : *The number of times the smoker tried to quit is independent of gender.*

H_1 : *The number of times the smoker tried to quit and gender are dependent.* (original claim)

b) Calculate the test statistic.

$$\chi^2 = \sum \frac{(O-E)^2}{E} = 0.0019$$

c) Determine the *p*-value.

P-Value = 0.9991 > 0.05, Fail to reject H_0

d) What is the conclusion?

There is not sufficient evidence to support the claim that the number of times the smoker tried to quit is related to gender.

4. Reviewing a Movie The contingency table shows how a random sample of adults rated a newly released movie and gender. At α = 0.05, can you conclude that the adults' ratings are related to gender?

	Rating			
Gender	**Excellent**	**Good**	**Fair**	**Poor**
Male	97	42	26	5
Female	101	33	25	11

MATRIX[B] 2 ×4

99	37.5	25.5	8
99	37.5	25.5	8

Requirements Check: 1) Random Sample 2) Observed Frequencies are all given 3) All Expected Frequencies are > 5

a) State the null hypothesis and the alternative hypothesis.

H_0 : *The adult's ratings is independent of gender.*
H_1 : *The adult's ratings and gender are dependent.* (original claim)

b) Calculate the test statistic.

$\chi^2 = \sum \frac{(O-E)^2}{E} = 3.4304$

c) Determine the *p*-value.

P-Value = 0.3299 > 0.05, Fail to reject H_0

d) What is the conclusion?

There is not sufficient evidence to support the claim that the adult's rating is related to gender.

5. Musculoskeletal Injury The results of a random sample of children with pain from musculoskeletal injuries treated with acetaminophen, ibuprofen, or codeine are shown in the contingency table. At α = 0.01, can you conclude that the treatment is related to the result? (Adapted from American Academy of Pediatrics)

	Treatment		
Result	**Acetaminophen**	**Ibuprofen**	**Codeine**
Significant improvement	58	81	61
Slight improvement	42	19	39

MATRIX[B] 2 ×3
[66.667 66.667 66.667
33.333 33.333 33.333]

Requirements Check: 1) Random Sample 2) Observed Frequencies are all given 3) All Expected Frequencies are > 5

a) State the null hypothesis and the alternative hypothesis.
H_0 : *The treatment is independent of the result.*
H_1 : *The treatment and result are dependent.* (original claim)

b) Calculate the test statistic.

$\chi^2 = \sum \frac{(O-E)^2}{E} = 14.07$

c) Determine the *p*-value.

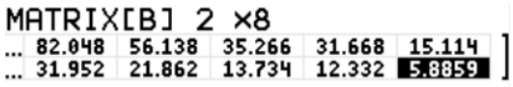
P-Value = 0.00088 < 0.01, Reject H_0

d) What is the conclusion?

The sample data support the claim that the treatment is related to the result.

6. Motor Vehicle Crash Deaths The contingency table shows the results of a random sample of motor vehicle crash deaths by age and gender. At α = 0.05, perform a homogeneity of proportions test on the claim that the proportions of motor vehicle crash deaths involving males or females are the same for each age group. (Adapted from Insurance Institute for Highway Safety)

	Age							
Gender	**16–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65–74**	**75–84**	**85 and older**
Male	123	97	82	82	56	31	26	14
Female	46	28	28	32	22	18	18	7



Requirements Check: 1) Random Sample 2) Observed Frequencies are all given 3) All Expected Frequencies are > 5

a) State the null hypothesis and the alternative hypothesis.

H_0 : *The proportions of motor vehicle crash deaths involving males or females are the same for each age group.* (original claim)

H_1 : *At least one of the proportions is different from others.*

b) Calculate the test statistic.

$$\chi^2 = \sum \frac{(O-E)^2}{E} = 8.1335$$

c) Determine the *p*-value.

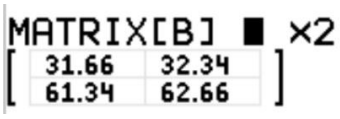
P-Value = 0.3210 > 0.05, Fail to reject H_0

d) What is the conclusion?

There is not sufficient evidence to warrant rejection of the claim that the proportions of motor vehicle crash deaths involving males or females are the same for each age group.

7. Obsessive-Compulsive Disorder The contingency table shows the results of a random sample of patients with obsessive-compulsive disorder after being treated with a drug or with a placebo. At α = 0.05, perform a homogeneity of proportions test on the claim that the proportions of the results for drug and placebo treatments are the same. (Adapted from The Journal of the American Medical Association)

	Treatment	
Result	**Drug**	**Placebo**
Improvement	39	25
No change	54	70



Requirements Check: 1) Random Sample 2) Observed Frequencies are all given 3) All Expected Frequencies are > 5

a) State the null hypothesis and the alternative hypothesis.

H_0 : *The proportions of the results for drug and placebo treatments are the same.* (original claim)

H_1 : *At least one of the proportions is different from others.*

b) Calculate the test statistic.

$$\chi^2 = \sum \frac{(O-E)^2}{E} = 5.1063$$

c) Determine the *p*-value.

P-Value = 0.0238 < 0.05, Reject H_0

d) What is the conclusion?

There is sufficient evidence to warrant rejection of the claim that the proportions of result for drug and placebo treatments are the same.