Homework 14 **Name:** _____
Elementary Statistics & Inference
STAT:1020, Bognar

Print this pdf file, show your work in the provided space, use scanning app to scan pages (in order) into a single pdf file, submit in Gradescope. Be sure to get entire page in each shot — keep pages flat when scanning. You can use an iPad/tablet too.

1. A gas station wants to understand the relationship between the gender of its customers and their choice of gasoline. The following two-way table summarizes gender (male/female) and gasoline (regular/midgrade/premium) for 100 randomly selected customers.

	Regular	Midgrade	Premium
Male	15	15	25
Female	25	15	5

They want to test H_0 : gender and gasoline are independent versus H_a : gender and gasoline are not independent at the $\alpha = 0.10$ significance level.

(a) Find the test statistic and critical value, plot the rejection region, and state your decision and final conclusion.

(b) Based upon your answer in (1a), is there a significant association between gender and gasoline? Why?

(c) Approximate the $p-$value for the test using the chi-square table.

(d) Use the χ^2-Probability Applet at

`http://www.stat.uiowa.edu/~mbognar/applets/chisq.html`

to precisely determine the $p-$value for the test.

(e) Based upon the $p-$value, is there a significant association between gender and gasoline? Why?

2. Consider the following two-way table which summarizes gender and job position (manager, non-manager) for 100 randomly selected employees at a large company.

	Male	Female
Manager	30	10
Non-Manager	30	30

A researcher wishes to test H_0 : no association between gender and position versus H_a : association between gender and position at the $\alpha = 0.01$ significance level.

(a) Find the test statistic and critical value, plot the rejection region, and state your decision and final conclusion.

(b) Approximate the $p-$value for the test using the chi-square table.

(c) Use the χ^2-Probability Applet at

`http://www.stat.uiowa.edu/~mbognar/applets/chisq.html`

to precisely determine the $p-$value for the test.

(d) Based upon the $p-$value, is there a significant association between gender and position? Why?

(e) At the $\alpha = 0.05$ significance level, is there a significant association between gender and position? Why?

3. In the game *Twister*, participants spin a spinner. The spinner can stop in a red, blue, yellow, or green section. The spinner is supposed to yield an equal probability for each color (i.e the probability for each color is supposed to be 1/4). Suppose 40 spins yielded

Spin:	Red	Blue	Yellow	Green
o_i :	6	11	10	13
e_i :	10	10	10	10

Test

$$H_0 : \text{the spinner is fair}$$
$$H_a : \text{the spinner is not fair}$$

at the $\alpha = 0.05$ significance level. Note that under H_0 (the spinner is fair), we expect the number of times the spinner lands in red to be $e_1 = 40 \times 1/4 = 10$. The other colors are the same, therefore $e_1 = \cdots = e_4 = 10$.

(a) Find the test statistic and critical value, plot the rejection region, and state your decision and final conclusion.

(b) Approximate the $p-$value for the test using the chi-square table.

(c) Use the χ^2-Probability Applet at

`http://www.stat.uiowa.edu/~mbognar/applets/chisq.html`

to precisely determine the $p-$value for the test.

(d) Based upon the $p-$value, is there evidence that the spinner is not fair? Why?

4. The manufacturer of M&M's claims the following color breakdown: 24% blue, 20% orange, 16% green, 14% yellow, 13% red, and 13% brown. A randomly selected bag of M&M's had 103 candies and yielded the following colors.

	blue	orange	green	yellow	red	brown
o_i :	25	22	19	17	7	13
e_i :	24.72	20.60				

Test

$$H_0 : \text{the manufacturers color breakdown is correct}$$
$$H_a : \text{the color breakdown is different than the manufacturers claim}$$

at the $\alpha = 0.05$ significance level. Under H_0 (i.e. under the manufacturers claimed color proportions), the number of blues that we expect is $e_1 = 103 \times 0.24 = 24.72$, the expected number of oranges is $103 \times 0.20 = 20.60$, etc.

(a) Determine the rest of the expected counts, $e_3, \ldots, e_6$.

(b) Find the test statistic and critical value, plot the rejection region, and state your decision and final conclusion.

(c) Approximate the $p-$value for the test using the chi-square table.

(d) Use the χ^2-Probability Applet at

`http://www.stat.uiowa.edu/~mbognar/applets/chisq.html`

to precisely determine the $p-$value for the test.

(e) Based upon the $p-$value, do we have evidence that the color breakdown significantly differs from the manufactures claim? Why?