Problems Section 4C (Updated Version)

(#1-10) Go to lock5stat.com, click on "StatKey". Under "Theoretical Distributions", click on "Normal". If it is a one tailed test, type the significance level into the top proportion box in that tail. The bottom box of the tail will show the critical value. If it is a two-tailed test, type half of the significance level into each of the top proportion boxes. The two bottom boxes will be the critical values. Then complete the table answers.

	Tail of Test	Significance Level	StatKey Critical Value or Values	Z-test stat	Does the Z-test statistic fall in a tail determined by a critical value? (In Tail or Not in tail)	Do the two sample proportions significantly disagree with each other?	Does the sample proportion difference significantly disagree with Ho?
1.	Left	0.05		−1.835			
2.	Right	0.1		+0.974			
3.	Two	0.01		−1.226			
4.	Left	0.05		−3.177			
5.	Right	0.1		+2.244			
6.	Two	0.05		+1.448			
7.	Left	0.01		−0.883			
8.	Right	0.1		+1.117			
9.	Two	0.05		+2.139			
10.	Left	0.1		−0.199			

(#11-20) Go to lock5stat.com, click on "StatKey". Under "Theoretical Distributions", click on "Normal". If it is a one tailed test, type the test statistic into the bottom box in that tail. The top box of the tail will show the P-value proportion. If it is a two-tailed test, type positive test statistics into the lower right box. Type negative test statistics into the lower left box. Add the two top proportion boxes in the tails to get the P-value. Then complete the table answers.

	Tail of Test	Z-test stat	StatKey P-value Proportion	P-value %	Significance Level Proportion	Significance Level %	P-value Lower or Higher Than Sig. Level?	If H_0 is true, could the sample proportion difference or more extreme occur by sampling variability or is that unlikely?	Reject H_0 or Fail to reject H_0?
11.	Left	−1.835			0.05				
12.	Right	+0.974			0.1				
13.	Two	−1.226			0.01				
14.	Left	−3.177			0.05				
15.	Right	+2.244			0.1				
16.	Two	+1.448			0.05				
17.	Left	−0.883			0.01				
18.	Right	+1.117			0.1				
19.	Two	+2.139			0.05				
20.	Left	−0.199			0.1				

21. Explain the difference between random samples and random assignment.

22. List the assumptions that we need to check for a two-population proportion hypothesis test.

23. List the assumptions that we need to check for a two-population proportion hypothesis test that is using experimental design.

(#24-27) Directions: Use the following Statcato printouts to answer the questions.

24. The United States has the highest teen pregnancy rate in the industrialized world. In 2008, a random sample of 1014 teenage girls found that 32.1% (0.321) of them were pregnant before the age of 20. In 2012, a random sample of 1025 teenage girls was taken and 32.6% (0.326) of them were found to be pregnant before the age of 20. Let population proportion 1 represent teen girls in 2012 and population proportion 2 represent teen girls 2008. Use a 5% significance level and the following printout to test the claim that the population percentage of teen pregnancies in the U.S. was significantly higher in 2012 than it was in 2008.

	Pregnant	Total	Sample Proportion
Sample 1 (2012 teens)	334	1025	0.326
Sample 2 (2008 teens)	326	1014	0.321

Significance Level	Critical Value	Z Test Statistic	P-value
0.05	+1.645	+0.210	0.4168

a) Write the null and alternative hypothesis. Is this a left-tailed, right-tailed, or two-tailed test?

b) Check all of the conditions (assumptions) for this two-population proportion Z-test. Explain your answers. Does the problem pass all of the conditions?

c) Write a sentence to explain the Z-test statistic in context.

d) Use the test statistic and the critical value(s) to determine if the test statistic falls in a tail of the distribution.

e) Do the two sample proportions significantly disagree with each other or not? Explain how you know.

f) Does the sample proportion difference significantly disagree with the null hypothesis. Explain how you know.

g) Convert the P-value and significance level into percentages

h) Is the P-value lower than the significance level (low P-value) or higher than the significance level (high P-value)

i) If H_0 is true, could the sample proportion difference or more extreme occur by sampling variability or is that unlikely? *Explain how you know.*

j) Should we reject the null hypothesis (significant evidence) or fail to reject the null hypothesis (not significant evidence)? Explain how you know.

k) Write the formal conclusion for the hypothesis test.

l) Explain the what happened in the test in plain language.

25. While many Americans favor the legalization of marijuana, opponents of legalization argue that marijuana may be a gateway drug. They believe that if a person uses marijuana, then they are more likely to use other more dangerous illegal drugs. A random sample data was collected to test this claim. The people in the data were not related to each other. Use the table below and a 1% significance level to test the claim that non-marijuana users have a lower percentage of other drug use than marijuana users do.

	Use Other Drugs	Total	Sample Proportion
Sample 1 (Do not use Marijuana)	26	219	0.119
Sample 2 (Use Marijuana)	87	213	0.408

Significance Level	Critical Value	Z Test Statistic	P-value
0.01	−2.327	−6.850	0

a) Write the null and alternative hypothesis. Is this a left-tailed, right-tailed, or two-tailed test?

b) Check all of the conditions (assumptions) for this two-population proportion Z-test. Explain your answers. Does the problem pass all of the conditions?

c) Write a sentence to explain the Z-test statistic in context.

d) Use the test statistic and the critical value(s) to determine if the test statistic falls in a tail of the distribution.

e) Do the two sample proportions significantly disagree with each other or not? Explain how you know.

f) Does the sample proportion difference significantly disagree with the null hypothesis. Explain how you know.

g) Convert the P-value and significance level into percentages

h) Is the P-value lower than the significance level (low P-value) or higher than the significance level (high P-value)

i) If H_0 is true, could the sample proportion difference or more extreme occur by sampling variability or is that unlikely? *Explain how you know.*

j) Should we reject the null hypothesis (significant evidence) or fail to reject the null hypothesis (not significant evidence)? Explain how you know.

k) Write the formal conclusion for the hypothesis test.

l) Explain the what happened in the test in plain language.

26. Use a 5% significance level and the following printout to test this claim that the percentages of women and men that abstain from drinking alcohol is the same. We took a random sample of 250 women and found that that 137 of them never drink alcohol. We took a random sample of 190 men and found that 66 of them never drink alcohol. None of the men or women were related to each other. We designated the proportion of women that never drink alcohol as population 1 and the men that never drink alcohol as population 2.

	Abstain from Alcohol	Total	Sample Proportion
Sample 1 (Women)	137	250	0.548
Sample 1 (Men)	66	190	0.347

Significance Level	Critical Value	Z Test Statistic	P-value
0.05	−1.96 & +1.96	+4.182	0

a) Write the null and alternative hypothesis. Is this a left-tailed, right-tailed, or two-tailed test?

b) Check all of the conditions (assumptions) for this two-population proportion Z-test. Explain your answers. Does the problem pass all of the conditions?

c) Write a sentence to explain the Z-test statistic in context.

d) Use the test statistic and the critical value(s) to determine if the test statistic falls in a tail of the distribution.

e) Do the two sample proportions significantly disagree with each other or not? Explain how you know.

f) Does the sample proportion difference significantly disagree with the null hypothesis. Explain how you know.

g) Convert the P-value and significance level into percentages

h) Is the P-value lower than the significance level (low P-value) or higher than the significance level (high P-value)

i) If H_0 is true, could the sample proportion difference or more extreme occur by sampling variability or is that unlikely? *Explain how you know.*

j) Should we reject the null hypothesis (significant evidence) or fail to reject the null hypothesis (not significant evidence)? Explain how you know.

k) Write the formal conclusion for the hypothesis test.

l) Explain the what happened in the test in plain language.

27. A health magazine claims that marriage status is one of the most telling factors for a person's happiness. Use a 10% significance level and the Statcato printout below to test the claim that the percent of married people that are unhappy is significantly lower than the percent of single or divorced people that are unhappy. The following sample data was collected randomly. None of the people were related to each other. Population 1 represented unhappy married adults and population 2 represented unhappy single or divorced adults.

	Number of Events	Number of trials	Proportion
Sample 1	74	200	0.37
Sample 2	97	200	0.485

Significance Level	Critical Value	Test Statistic Z	p-Value
0.10	-1.282	-2.325	0.0100

a) Write the null and alternative hypothesis. Is this a left-tailed, right-tailed, or two-tailed test?

b) Check all of the conditions (assumptions) for this two-population proportion Z-test. Explain your answers. Does the problem pass all of the conditions?

c) Write a sentence to explain the Z-test statistic in context.

d) Use the test statistic and the critical value(s) to determine if the test statistic falls in a tail of the distribution.

e) Do the two sample proportions significantly disagree with each other or not? Explain how you know.

f) Does the sample proportion difference significantly disagree with the null hypothesis. Explain how you know.

g) Convert the P-value and significance level into percentages

h) Is the P-value lower than the significance level (low P-value) or higher than the significance level (high P-value)

i) If H_0 is true, could the sample proportion difference or more extreme occur by sampling variability or is that unlikely? *Explain how you know.*

j) Should we reject the null hypothesis (significant evidence) or fail to reject the null hypothesis (not significant evidence)? Explain how you know.

k) Write the formal conclusion for the hypothesis test.

l) Explain the what happened in the test in plain language.

(#28-30) Directions: Use the given sample statistics and StatKey at www.lock5stat.com to answer the questions and perform the hypothesis test.

28. A body mass index of 20-25 indicates that a person is of healthy weight for their height and body type. A random sample of 745 men found that 273 of them had a healthy BMI. A random sample of 760 women found that 198 of the women had a healthy BMI. Let population 1 be the proportion of men with a healthy BMI and population 2 be the proportion of women with a healthy BMI. Use a 1% significance level and StatKey to test the claim that the percent of men with a healthy BMI is significantly higher than the percent of women with a healthy BMI.

	Healthy BMI	Total	Proportion
Sample 1 (Men)	273	745	0.366
Sample 2 (Women)	198	760	0.261

a) Write the null and alternative hypothesis.

b) Is this a right tailed, left tailed, or two tailed test? Explain how you know.

d) Check all of the conditions for two population proportion Z-test. Does the data pass all of the conditions?

e) The sample proportion difference is +0.105 and the standard error is 0.024. Calculate the Z-test statistic

with formula $Z = \frac{Sample\ Proportion\ Difference}{Standard\ Error}$

Go to the "Normal" distribution in the Theoretical Distributions menu in StatKey (www.lock5stat.com). Click on the appropriate tail and put in the significance level into the top proportion box in that tail. The bottom box now shows the critical value where the tails begins.

f) What is the critical value?

g) Does the Z-test statistic fall in a tail of the distribution starting at the critical value?

h) Do the sample proportions significantly disagree with each other? Explain how you know.

Go to the "Normal" distribution in the Theoretical Distributions menu in StatKey (www.lock5stat.com). Click on the appropriate tail or tails. Put the Z-test stat in the bottom box of the tail. The top box in the tail will now be the P-value.

i) What is the P-value proportion?

j) Convert the P-value into a percentage. Is the P-value lower or higher than the significance level?

k) Could the sample proportion difference or more extreme have occurred by sampling variability (random chance) or is that unlikely? Explain how you know.

l) Should we reject the null hypothesis (significant evidence) or fail to reject the null hypothesis (not significant evidence)? Explain your answer.

m) Write the formal conclusion for the hypothesis test.

n) Explain what happened in the test in plain language.

29. A tattoo magazine claimed that the percent of men and women that have at least one tattoo are the same. Use a 10% significance level and the following Statcato printout to test this claim. A random sample of 857 men found that 146 of them had at least one tattoo. A random sample of 794 women found that 137 of them had at least one tattoo. Population 1 was the proportion of men with at least one tattoo and population 2 was the proportion of women with at least one tattoo.

	Number of Events	Number of trials	Proportion
Sample 1	146	857	0.170
Sample 2	137	794	0.173

a) Write the null and alternative hypothesis.

b) Is this a right tailed, left tailed, or two tailed test? Explain how you know.

d) Check all of the conditions for two population proportion Z-test. Does the data pass all of the conditions?

e) The sample proportion difference is -0.003 and the standard error is 0.0254. Calculate the Z-test statistic

with formula $Z = \frac{Sample\ Proportion\ Difference}{Standard\ Error}$

Go to the "Normal" distribution in the Theoretical Distributions menu in StatKey (www.lock5stat.com). Click on the appropriate tail or tails and put in 0.025 (half of the significance level) in one of the top proportion boxes in either the right or left tail. The other tail will adjust. The bottom boxes now show the critical values where the right and left tails begins.

f) What are the critical values?

g) Does the Z-test statistic fall in a tail of the distribution starting at one of the critical values?

h) Do the sample proportions significantly disagree with each other? Explain how you know.

Go to the "Normal" distribution in the Theoretical Distributions menu in StatKey (www.lock5stat.com). Click on the appropriate tail or tails. If the Z-test stat is positive, but the Z-test stat in the bottom right box. If the Z-test stat is negative, put the Z-test stat in the bottom left box. The other tail will adjust. Add the proportions in the two right and left tailed boxes to calculate the P-value.

i) What is the P-value proportion?

j) Convert the P-value into a percentage. Is the P-value lower or higher than the significance level?

k) Could the sample proportion difference or more extreme have occurred by sampling variability (random chance) or is that unlikely? Explain how you know.

l) Should we reject the null hypothesis (significant evidence) or fail to reject the null hypothesis (not significant evidence)? Explain your answer.

m) Write the formal conclusion for the hypothesis test.

n) Explain what happened in the test in plain language.

30. A study was done to see if women that smoke cigarettes have a lower chance of getting pregnant. Two random samples of women trying to get pregnant were compared. A random sample of 135 women that smoke (population 1) found that 38 were able to get pregnant in the allotted amount of time. A random sample of 543 women that do not smoke (population 2) found that 206 were able to get pregnant in the allotted amount of time. Use StatKey and a 5% significance level to test the claim that the population percent of smoking women that were able to get pregnant is lower than the population percent of non-smoking women.

	Able to get Pregnant	Total	Proportion
Sample 1 (Women that smoke)	38	135	0.281
Sample 2 (Women that do not smoke)	206	543	0.379

a) Write the null and alternative hypothesis.

b) Is this a right tailed, left tailed, or two tailed test? Explain how you know.

d) Check all of the conditions for two population proportion Z-test. Does the data pass all of the conditions?

e) The sample proportion difference is -0.098 and the standard error is 0.04616. Calculate the Z-test statistic

with formula $Z = \frac{Sample\ Proportion\ Difference}{Standard\ Error}$

Go to the "Normal" distribution in the Theoretical Distributions menu in StatKey (www.lock5stat.com). Click on the appropriate tail and put in the significance level into the top proportion box in that tail. The bottom box now shows the critical value where the tails begins.

f) What is the critical value?

g) Does the Z-test statistic fall in a tail of the distribution starting at the critical value?

h) Do the sample proportions significantly disagree with each other? Explain how you know.

Go to the "Normal" distribution in the Theoretical Distributions menu in StatKey (www.lock5stat.com). Click on the appropriate tail or tails. Put the Z-test stat in the bottom box of the tail. The top box in the tail will now be the P-value.

i) What is the P-value proportion?

j) Convert the P-value into a percentage. Is the P-value lower or higher than the significance level?

k) Could the sample proportion difference or more extreme have occurred by sampling variability (random chance) or is that unlikely? Explain how you know.

l) Should we reject the null hypothesis (significant evidence) or fail to reject the null hypothesis (not significant evidence)? Explain your answer.

m) Write the formal conclusion for the hypothesis test.

n) Explain what happened in the test in plain language.

Social Justice Questions

31. An experiment was done on labor market discrimination. The statisticians created fictitious resumes to help-wanted adds in Boston and Chicago newspapers with both male and female sounding names. Each resume was randomly assigned either a very black sounding name or a very white sounding male or female name. Other confounding variables like experience, age, type of job, where the person lives, etc. were controlled. The data met the assumptions for a two-proportion hypothesis test. The following table summarizes the findings of multiple two-population proportion hypothesis tests including P-values.

Table 1
Mean Call-Back Rates By Racial Soundingness of Names [a]

	Call-Back Rate for White Names	*Call-Back Rate for African American Names*	*Ratio*	*Difference (p-value)*
Sample:				
All sent resumes	**10.06%** [2445]	**6.70%** [2445]	**1.50**	**3.35%** (.0000)
Chicago	**8.61%** [1359]	**5.81%** [1359]	**1.48**	**2.80%** (.0024)
Boston	**11.88%** [1086]	**7.83%** [1086]	**1.52**	**4.05%** (.0008)
Females	**10.33%** [1868]	**6.87%** [1893]	**1.50**	**3.46%** (.0001)
Females in administrative jobs	**10.93%** [1363]	**6.81%** [1364]	**1.60**	**4.12%** (.0001)
Females in sales jobs	**8.71%** [505]	**6.99%** [529]	**1.25**	**1.72%** (.1520)
Males	**9.19%** [577]	**6.16%** [552]	**1.49**	**3.03%** (.0283)

[a] Notes:

1. The table reports, for the entire sample and different subsamples of sent resumes, the call-back rates for applicants with a White sounding name (column 1) and an African American sounding name (column 2), as well as the ratio (column 3) and difference (column 4) of these call-back rates. In brackets in each cell is the number of resumes sent in that cell.
2. Column 4 also reports the p-value for a test of proportion testing the null hypothesis that the call-back rates are equal across racial groups.

a) Let's look at all the resumes (male and female) from Chicago. When comparing callbacks for resumes with white sounding names to resumes with black sounding names, the P-value was 0.0024 (0.24%). Assuming the significance level was 5%, would this P-value indicate that there was a significant difference? The experiment controlled confounding variables. So does the experiment show that there is racial discrimination in the labor market in Chicago?

b) Let's look at all the resumes (male and female) from Boston. When comparing callbacks for resumes with white sounding names to resumes with black sounding names, the P-value was 0.0008 (0.08%). Assuming the significance level was 5%, would this P-value indicate that there was a significant difference? The experiment controlled confounding variables. So does the experiment show that there is racial discrimination in the labor market in Boston?

c) Let's look at all the resumes from males applying for jobs in Boston and Chicago. When comparing callbacks for resumes with white sounding names to resumes with black sounding names, the P-value was 0.0283 (2.83%). Assuming the significance level was 5%, would this P-value indicate that there was a significant difference? The experiment controlled confounding variables. So does the experiment show that there is racial discrimination in the labor market in Boston and Chicago for males attempting to get jobs?

d) Let's look at all the resumes from females applying for administrative jobs in Boston and Chicago. When comparing callbacks for resumes with white sounding names to resumes with black sounding names, the P-value was 0.0001 (0.01%). Assuming the significance level was 5%, would this P-value indicate that there was a significant difference? The experiment controlled confounding variables. So does the experiment show that there is racial discrimination in the labor market in Boston and Chicago for females attempting to get administrative jobs?

e) Let's look at all the resumes from females applying for sales jobs in Boston and Chicago. When comparing callbacks for resumes with white sounding names to resumes with black sounding names, the P-value was 0.1520 (15.2%). Assuming the significance level was 5%, would this P-value indicate that there was a significant difference? The experiment controlled confounding variables. So does the experiment show that there is racial discrimination in the labor market in Boston and Chicago for females attempting to get sales jobs?
