Name: _____ Section: 04 05 06

Read and Sign the Following Statement:
I understand that give or receiving help on this exam is a violation of academic regulations and is punishable by a grade of **F** in this course. This includes looking at other students' exams and/or allowing other students, actively or passively, to see answers on my exam. This also includes revealing, actively or passively, any information about the exam to any member of Professor Schroth-Glanz's STAT 218 class who has not yet taken the exam. The use of cell phones is strictly prohibited. **I pledge not to do any of these things.**

Signed: _____

Instructions.

1. Read and sign the honesty pledge at the top of this page. Your exam will not be graded unless the honesty pledge is signed!!
2. Attempt all questions and write legibly.
3. Show ALL the steps of your work clearly.
4. You have 50 minutes to complete this exam, so budget your time wisely.

Q1.[17] Are urban Torresian Crows in Australia more likely to feed off of human produced food than their own natural food produced from their habitat? Researchers in Australia observed 287 individual crows across 15 sites. For the purposes of this exam, you may treat this sample of crows as if it were selected randomly. The researchers wanted to investigate whether crow diet was associated with the time of day. In other words, did the time of day affect the type of food begin consumed. Below is a table of their results:

		Time of Day	
		Morning	Afternoon
Food Type	Human	49	53
	Natural	114	71

a) Which of the following would be appropriate hypotheses for this investigation into crows eating habits throughout the day? Circle **all** that apply. (Note: *morn* stands for morning and *aft* stands for afternoon.)

(i) $H_0 : \mu_{morn} = \mu_{aft}$
$H_A : \mu_{morn} > \mu_{aft}$

(ii) $H_0 : \pi_{morn} = \pi_{aft}$
$H_A : \pi_{morn} \neq \pi_{aft}$

(iii) $H_0 : \mu_{morn} = \mu_{aft}$
$H_A : \mu_{morn} \neq \mu_{aft}$

(iv) $H_0 : \pi_{morn} = \pi_{aft}$
$H_A : \pi_{morn} > \pi_{aft}$

(v) $H_0 : \mu_{morn} - \mu_{aft} = 0$
$H_A : \mu_{morn} - \mu_{aft} > 0$

(vi) $H_0 : \pi_{morn} - \pi_{aft} = 0$
$H_A : \pi_{morn} - \pi_{aft} > 0$

(vii) $H_0 : \pi_{morn} - \pi_{aft} = 0$
$H_A : \pi_{morn} - \pi_{aft} < 0$

(viii) $H_0 : \mu_{morn} - \mu_{aft} = 0$
$H_A : \mu_{morn} - \mu_{aft} \neq 0$

b) Which of the following would be the correct statistic for the given test? Circle one.

(i) 49/163

(ii) 114/163

(iii) (49/163) - (53/124) = 0.301 - 0.427 = -0.127

(iv) (49/114) - (53/71) = 0.429 - 0.747 = -0.317

c) A Chi-Squared Goodness-of-Fit Test would be more appropriate to implement here than the Chi-Squared Test for Independence. Circle one. **TRUE** **FALSE**

d) Suppose your chi-squared test-statistic turned out to be 4.943 thus giving a p-value of 0.026. Provide a rough sketch of what the null distribution of chi-squared statistics would look like indicating a shaded area for the p-value. You should be specific and clearly show where the shaded area will start.

e) What was/were the main purposes(s) of the use of *randomness* **in the actual study**? Circle one.

(i) To allow the researchers to generalize the results to a larger population.

(ii) To allow the researchers to draw a cause-and-effect conclusion from the study.

(iii) To simulate values of the statistic under the null hypothesis.

(iv) To replicate the study and increase the accuracy of the results.

(v) To get a larger sample size.

(vi) None of the above.

f) Suppose I were to run the appropriate simulation for this situation. What would be the main purpose(s) of the use of *randomness* **in this simulation**? Circle one.

(i) To allow the researchers to generalize the results to a larger population.

(ii) To allow the researchers to draw a cause-and-effect conclusion from the study.

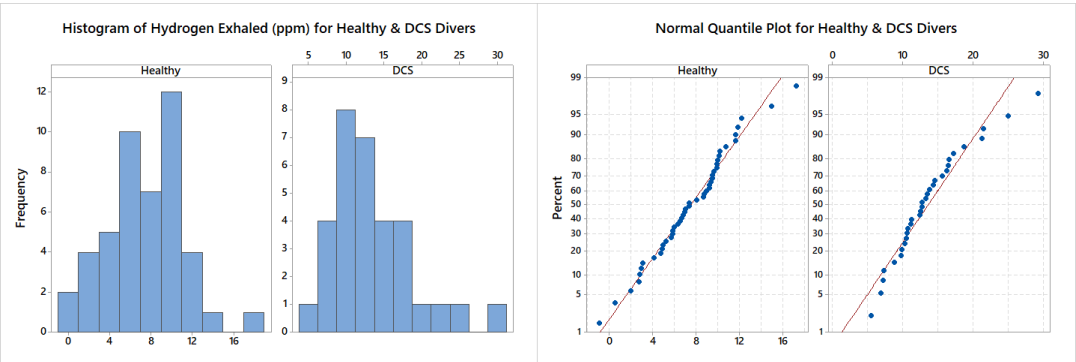
(iii) To simulate values of the statistic under the null hypothesis.

(iv) To replicate the study and increase the accuracy of the results.

(v) To get a larger sample size.

(vi) None of the above.

Q2.[32] Does gut fermentation promote decompression sickness in divers? Since hydrogen is a known by-product of gut fermentation, researchers wanted to study the effects of diving type on exhaled hydrogen quantities thinking that there will typically be larger quantities of hydrogen exhaled for divers experiencing decompression sickness. In one part of this study, researchers compared the amount of exhaled hydrogen (H_2) in the breath of 46 healthy divers (post-dive) to 32 divers being treated for post-dive decompression sickness (DCS). Here is a description of the sample:



Statistics

Variable	N	Mean	StDev
Healthy	46	7.530	3.607
DCS	32	13.593	5.290

a) Is this an observational or experimental study? Circle one.

Observational Study **Experimental study**

b) What is the response variable? What kind of variable is it (categorical or quantitative)?

*****For the following questions, please use the order: DCS - Healthy*****

c) State the null and alternative hypotheses **in symbols**.

H_0 : _____ H_A : _____

Suppose the researcher decided to answer the research question by conducting a hands-on simulation.

d) How many cards would you need to conduct the simulation? _____

e) How will the cards be differentiated? Briefly explain.

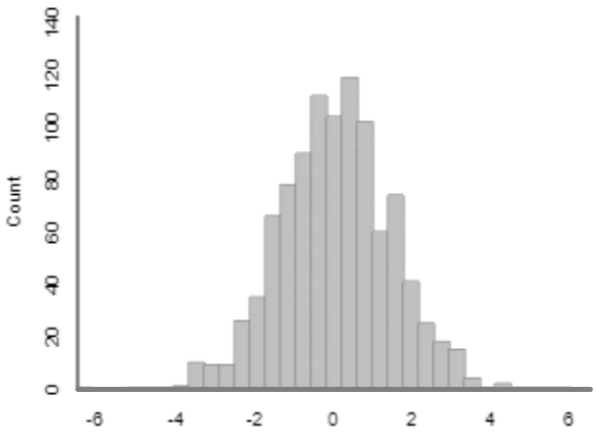
f) Fill in the blanks below:

After you shuffle the cards, you should divide the cards into (*how many*)_____ piles. There are (*how many*) _____ cards in the first pile and (*how many*)_____ in the second pile.
The piles represent (*briefly describe below*)

g) What is the simulated statistic you should compute after the cards are divided in piles? Show this with symbols and keep in mind the order that was specified.

The researchers carried out a simulation with 1000 simulated samples using the order (DCS-Healthy) and obtained the null distribution below.

h) In the distribution below, **clearly shade the area** that you would use to calculate the p-value. Make sure to identify (1) where you start the calculation of the p-value and (2) the direction(s) used. (Note: you will need to calculate your statistic from the study in order to do this. Keep in mind the order that was specified.)



i) Which of the following is the most likely value for the p-value?

(i) p-value = 0.00 (ii) p-value = 0.03 (iii) p-value = 0.20 (iv) p-value = 1.00

j) Which of the following would be the best overall conclusion in context of the problem?

(i) With such a small p-value, we do not have significant evidence to reject the null hypothesis that the average amount of hydrogen exhaled is the same for healthy divers as it is for divers with decompression sickness. We are therefore unable to conclude that hydrogen, as a by-product of gut fermentation, is helping to promote decompression sickness, on average.

(ii) With such a large p-value, we do not have significant evidence to reject the null hypothesis that the average amount of hydrogen exhaled is the same for healthy divers as it is for divers with decompression sickness. We are therefore unable to conclude that hydrogen, as a by-product of gut fermentation, is helping to promote decompression sickness, on average.

(iii) With such a small p-value, we have significant evidence to reject the null hypothesis that the average amount of hydrogen exhaled is the same for healthy divers as it is for divers with decompression sickness. We are therefore unable to conclude that hydrogen, as a by-product of gut fermentation, is helping to promote decompression sickness, on average.

(iv) With such a small p-value, we do not have significant evidence to reject the null hypothesis that the average amount of hydrogen exhaled is the same for healthy divers as it is for divers with decompression sickness. We can therefore conclude that hydrogen, as a by-product of gut fermentation, is helping to promote decompression sickness, on average.

(v) With such a small p-value, we have significant evidence to reject the null hypothesis that the average amount of hydrogen exhaled is the same for healthy divers as it is for divers with decompression sickness. We can therefore conclude that hydrogen, as a by-product of gut fermentation, is helping to promote decompression sickness, on average.

(vi) With such a large p-value, we have significant evidence to reject the null hypothesis that the hydrogen exhaled is the same for healthy divers as it is for divers with decompression sickness. We can therefore conclude that hydrogen, as a by-product of gut fermentation, is helping to promote decompression sickness, on average.

k) In a different version of this study, the researcher obtained a p-value of 0.13 and a 95% confidence interval for the parameter of interest to be (3.9, 8.22). Circle which of the following makes the following statement a true statement.

"In this different version of this study, the two results from the hypothesis test and the confidence interval.....

(i) seem to agree with one another at the 5% significance level. Thirteen percent of the time we would obtain a statistic, like the one we saw, somewhere in the interval 3.9% to 8.22%."

(ii) seem to agree with one another at the 5% significance level. With a p-value of 0.13, we have evidence to reject the null hypothesis, thus indicating that 0 should be in our confidence interval (since we are considering a difference of values)."

(iii) are conflicting at the 5% significance level. There's a 95% chance that a statistic of 0.13 would end up in the interval (3.9, 8.22)."

(iv) are conflicting at the 5% significance level. With a p-value of 0.13 we do not have evidence to reject the null hypothesis, which would mean that our confidence interval would contain 0 (since we are looking a difference of values)."

Q3.[8] Sea turtle nests usually suffer a high mortality on important nesting grounds. The amount of clay can be high on some nesting beaches and could affect egg incubation. In one laboratory experiment, researchers incubated 60 eggs in hopes of determining if silt/clay inhibit hatching. Forty eggs were covered with a thin layer of silt/clay and the other 20 served as controls. After a period of time, researchers took a record of how many of the eggs hatched.

a) Based on the data from the study, the researchers computed a 95% confidence interval for the parameter of interest to be (0.062, 0.5133). The order used was "Control - Treatment." The following is a reader's interpretation of the interval:

I am 95% confident that the average number of eggs hatched for the treatment group with the silt/clay application is between 0.062 to 0.5133 times higher than the average number of eggs hatched with the control group.

Identify the **three** unique mistakes committed and fix them. Be brief but clear in your description.

Mistake 1: _____

Fix: _____

Mistake 2: _____

Fix: _____

Mistake 3: _____

Fix: _____

b) The p-value is about 0.03. Select the choice below which best fills in the blanks in the following:

It would [blank 1] surprising to obtain the observed sample results, or more extreme results, if there is really [blank 2] between the the amount of clay present in sea turtle nests and the likelihood of mortality for such creatures.

(i) (blank 1) be, (blank 2) no association

(ii) (blank 1) not be, (blank 2) no association

(iii) (blank 1) be, (blank 2) an association

(iv) (blank 1) not be, (blank 2) an association

Q4.[6] Can pleasant aromas help students learn better? A group of researchers believe that the presences of a floral scent can improve a person's learning ability in certain situations. In their experiment, 20 people worked through a set of paper mazes while wearing a floral-scented mask and an unscented mask. Individuals were randomly assigned to the order of which mask they would wear first. The length of time it took subjects to complete the maze for each trial was then recorded. Researchers were glad to see that the data supported their belief that the floral scented mask would improve learning and thus take subjects the least amount of time to complete the maze.

a)Which of the following is the most appropriate **R** code needed to run this analysis? Circle one.

(i) `t.test(Time ~ Smell_Type, alternative = "greater", data = maze)`

(ii) `t.test(Time ~ Smell_Type, alternative = "greater", paired = TRUE, data = maze)`

(iii) `t.test(Time ~ Smell_Type, alternative = "two.sided", data = maze)`

b)Which of the following is the most appropriate **R** output from the appropriate analysis? Circle one.

(i)

```
        Welch Two Sample t-test

data:  Time by Smell_Type
t = 3.1959, df = 31.214, p-value = 0.003183
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 0.2171679 0.9826077
sample estimates:
   mean in group Floral mean in group Unscented
              2.393902                1.794014
```

(ii)

```
        Welch Two Sample t-test

data:  Time by Smell_Type
t = 3.1959, df = 31.214, p-value = 0.001592
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
 0.2816981       Inf
sample estimates:
   mean in group Floral mean in group Unscented
              2.393902                1.794014
```

(iii)

```
        Paired t-test

data:  Time by Smell_Type
t = 3.6978, df = 19, p-value = 0.0007636
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
 0.3193759       Inf
sample estimates:
mean of the differences
              0.5998878
```

END OF EXAM