Math 107 Exam 2

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February 20, 2015

Instructions:

- This exam is closed book and closed notes.
- No copying, cheating, collaborations, computers, or cell phones (or similar devices) are allowed.
- You may use a scientific or graphing calculator.
- Show your work.
- Write complete and coherent answers.
- Incorrect answers unaccompanied by supporting reasoning will receive no partial credit.
- Please write as clearly and neatly as possible. If I cannot read your answers, I cannot give you any credit.
- If you want any work done on scratch paper to be graded, mention where to look (make this obvious by using big letters with a box around them) on the page with the question.

After you have completed the exam, please *reaffirm the Lawrence University Honor Code* in the space provided below, then print and sign your name.

Reaffirmation:

Name: _____

Signature: _____

Formulas:

$$\overline{x} = \frac{\sum x_i}{n}$$

$$s_x = \sqrt{\frac{\sum (x_i - \overline{x})^2}{n-1}}$$

$$z = \frac{x - \overline{x}}{s}$$

$$\text{range} = \max - \min$$

$$\text{IQR} = Q_3 - Q_1$$

$$Q_1 - 1.5 \times \text{IQR}$$

$$Q_3 + 1.5 \times \text{IQR}$$

$$r = \frac{1}{n-1} \sum \left(\frac{x_i - \overline{x}}{s_x} \right) \left(\frac{y_i - \overline{y}}{s_y} \right)$$

$$\text{statistic} \pm 2 \cdot \text{SE}$$

1. (2 pts) Statistical inference is the process of drawing conclusions about the entire population based on information in a sample.

   A. TRUE

   B. FALSE

2. (4 pts)Suppose that you perform a hypothesis test and, based on the p-value, decide to reject the null hypothesis at the $\alpha = 0.05$ significance level. Now, suppose that your colleague decides to conduct the same test on the same data but using a different significance level. For each of the following significance levels, indicate whether your colleague will reject the null hypothesis, fail to reject the null hypothesis, or whether there is not enough information to say.

(a)	$\alpha = 0.065$	REJECT	FAIL TO REJECT	NOT ENOUGH INFO
(b)	$\alpha = 0.01$	REJECT	FAIL TO REJECT	NOT ENOUGH INFO

3. (2 pts) Let p denote the population proportion of interest and suppose a 95% confidence interval for p is calculated to be (0.63, 0.73) and a 99% confidence interval for p is calculated to be (0.61, 0.75). Also, suppose that we want to test the following hypotheses

   $$H_0 : \ p = 0.74 \quad \text{vs.} \quad H_a : \ p \neq 0.74$$

   What can you say about the corresponding p-value?

   A. The corresponding p-value will be smaller than 0.05, but larger than 0.01.

   B. The corresponding p-value will be larger than 0.05.

   C. The corresponding p-value will be smaller than 0.01.

   D. I can't say anything about the corresponding p-value until I run the test.

4. (2 pts) Which confidence level will yield the widest confidence interval?

   A. 85% B. 90% C. 95% D. 99%

5. (2 pts) Briefly explain what the standard error represents.

6. (3 pts) Explain what it means to be 98% confident in a confidence interval.

7. November 6, 2012 was election day. Many of the major television networks aired coverage of the incoming election results during the primetime hours. The table below displays summary statistics for the amount of time (in minutes) spent watching election coverage for a random sample of 25 U.S. adults.

n	$\overline{x}$	s	min	max
25	80.44	43.9	2	168

(a) (2 pts) Identify the population of interest.

(b) (2 pts) Identify the parameter of interest.

(c) (5 pts) Describe how to use the data to construct a bootstrap distribution. What value should be recorded for each of the bootstrap samples?

(d) (2 pts) Where should the bootstrap distribution be centered?

(e) (2 pts) Describe how you would estimate the standard error from the bootstrap distribution.

(f) (3 pts) The standard error is estimated to be 8.769 (based on 5,000 bootstrap samples). Find a 95% confidence interval for the mean amount of time (in minutes) U.S. adults spent watching election coverage on election night. Round the margin of error to two decimal places.

(g) (5 pts) Interpret your 95% confidence interval in the context of the problem.

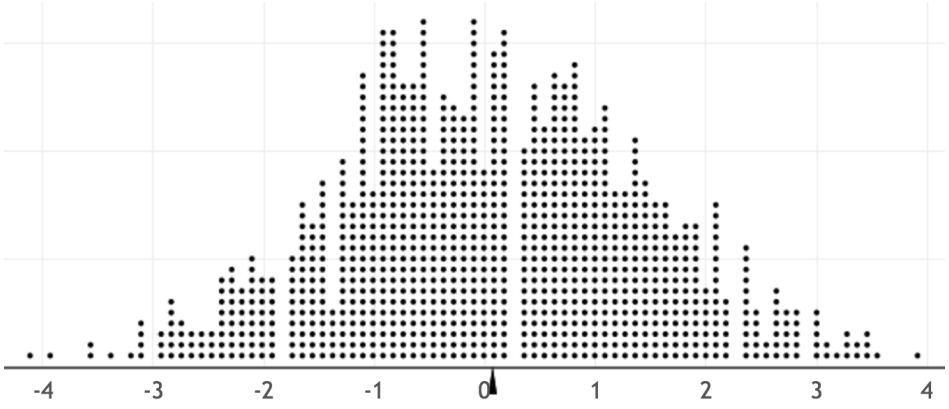
8. Does consuming beer attract mosquitoes? A study done in Burkino Faso, Africa, about the spread of malaria investigated the connection between beer consumption and mosquito attraction. In the experiment, 25 volunteers consumed a liter of beer while 18 volunteers consumed a liter of water. The volunteers were assigned to the two groups randomly. Mosquitoes were released and caught in traps as they approached the volunteers using a Y tube-olfactometer. The researchers counted the number of mosquitoes caught in the trap for each volunteer, which are presented below. Summary statistics for each group are also provided.

Beer	27	19	20	20	23	17	21	24	31	$\overline{x}_b = 23.6$ $s_b = 4.1$
	26	28	20	27	19	25	31	24	28	
	24	29	21	21	18	27	20			
Water	21	19	13	22	15	22	15	22	20	$\overline{x}_w = 19.2$ $s_w = 3.7$
	12	24	24	21	19	18	16	23	20	

(a) (5 pts) State the null and alternative hypotheses, defining any parameters used.

(b) (3 pts) What would a type I error mean in this context?

(c) (3 pts) The randomization distribution (based on 1,000 samples) for the difference in sample means between the treatment groups ($\overline{x}_b - \overline{x}_w$) is displayed below. What does a single dot represent? Be specific.



(d) (5 pts) Use the above randomization distribution to estimate the p-value for this sample. Explain how you calculated your estimate.

(e) (3 pts) Do you consider the observed result to be statistically significant? Briefly justify your answer.

(f) (3 pts) Based on your answer to part (e), state a conclusion in the context of the problem.