Test #1

STAT 880

Spring 2021

This is an “open book, open note” test. You may use the course textbooks, course notes, your own notes, R programs, Sage code/output in Jupyter Notebook documents, data from the course website, any R programs and Sage code/output in Jupyter Notebook documents that you created prior to the test, projects, and help within R or Sage. You cannot communicate with your classmates or anyone outside of our class to complete the test. Also, you cannot use the Internet other than to download the test, turn in the test, or to communicate with me. E-mail to me (bilder@unl.edu) your completed test prior to 2PM. You will receive an e-mail response from me to confirm receipt. Do not move on from taking the test until you receive this confirmation.

Complete the problems below. Make sure to fully explain all answers and show your work to receive full credit. Use R or Sage for all calculations and plots.

1. (21 total points) Which brand of paper towels is more absorbent? Some graduate students a few years ago decided to investigate this on their own by performing an experiment. Below is how the experiment was performed:
	* 1. A large glass is filled with 32 ounces of water.
		2. A paper towel is submerged into the water for 20 seconds.
		3. After the paper towel is removed, the amount of water remaining in the glass is recorded.
		4. The difference between the beginning amount of water (32 ounces) and the ending amount of water is found, and this represents the amount of water absorbed by the paper towel.

A number of paper towels from two brands (“A” and “B”) were used in the experiment. The data from the experiment is available in the set1.csv file located where you downloaded this test. Below is an example of how to read in the data.

> # Set the appropriate file location on your computer

> paper.towel <- read.csv(file = "set1.csv")

> head(paper.towel)

 type response

1 A 3.665608

2 A 3.313991

3 A 3.936691

4 A 3.997216

5 A 4.508679

6 A 4.734902

* 1. (8 points) Construct a box and dot plot of the data so that one can compare the two paper towel brands. Make sure the dot plot overlays the box plot and use a yellow color inside the boxes.
	2. (6 points) Were there any “unusual” observed absorbency values? Explain.

* 1. (7 points) Is there any preliminary evidence that one paper towel brand absorbs more water than the other? Explain.
1. (39 total points) The waiting time, in hours, between successive speeders spotted by a police radar unit is a continuous random variable X with CDF of



Note that x = 1/5 is the equivalent to 12 minutes. Answer the questions below and be VERY careful about the units that X is measured in.

* 1. (6 points) Find the probability of waiting less than 12 minutes (12/60 = 1/5 hours) before successive speeders using the CDF.
	2. (7 points) Find the PDF.
	3. (8 points) Plot the PDF and show how the probability of waiting less than 12 minutes (12/60 = 1/5 hours) before successive speeders is represented.
	4. (10 points) Find the standard deviation of the waiting time and interpret it in the context of the problem.
	5. (8 points) Find the waiting time such that 50% are less than this value (i.e., find the median). Interpret this value in the context of the problem.
1. (20 total points) Two electronic components of a system work together for the success of the total system. Let X and Y be random variables for the life in hours of the two components. The joint PDF of X and Y is



* 1. (12 points) What is the probability that at least one of the components will exceed 2 hours of life?
	2. (8 points) Find average number of hours for the X component. Interpret it in the context of the problem
1. (20 total points) Answer the questions below.
	1. (7 points) Explain why P(A|B) = P(A∩B)/P(B) for two events A and B. You may use a two row and two column contingency table to help with your explanation if needed.
	2. (7 points) Suppose F(x) is a CDF of a random variable X. What are F(-∞) and F(∞)? Why?

* 1. (6 points) Suppose a medical professional informs you that you have tested positive for an infectious disease. Why would knowing the positive predictive value for the test be important for you know?