

CE 311S: Exam 1

Friday, March 5

9:00 – 9:50 AM

Name _____

Instructions:

- **SHOW ALL WORK** unless instructed otherwise. No shown work means no partial credit!
- If you require additional space, you may use the back of each sheet and/or staple additional pages to the end of the exam.
- If you need to make any additional assumptions, state them clearly.
- You may use a calculator and one regular-sized sheet of notes. No additional resources are permitted.
- The number of points associated with each part of each problem is indicated.

Problem	Points	Possible
1		20
2		25
3		30
4		25
TOTAL		100

Please copy the following statement (based on UT's honor code and the ASCE code of ethics) in your own handwriting, and sign it. For the purposes of this statement, academic dishonesty includes (but is not limited to) sharing with or receiving information from others about the exam, by any mode of communication.

“As a student of The University of Texas at Austin and as a civil engineer, I certify that I have not and will not participate in any acts of academic dishonesty related to this exam. If I witness any acts of academic dishonesty, I will report them to the instructor.”

Your handwritten copy of the statement:

Signature _____

Problem 1. (20 points). You are anxious to receive a Covid vaccine, so you can meet up again with your friends. Unfortunately, current wait times are long. You ask a number of your friends who are studying public health to provide their best estimate of how many days it would take until you receive the vaccine:

48 94 84 48 28 94

- (a) (5) What is the mean amount from the sample?
- (b) (5) What is the median?
- (c) (5) What is the mode?
- (d) (5) What is the standard deviation?

Problem 2. (25 points). You decide that those wait times are too long, so you reach out to your shady brother-in-law, a biochem dropout from A&M who is working on his own underground vaccine. He offers to give you a sample of the vaccine if you help him with his “clinical trials,” which you readily agree to. You gather a large number of participants, who are randomly assigned either the Moderna vaccine (20% probability), the Pfizer vaccine (30% probability), or his new vaccine (50% probability).

After several months, you notice that 20% of the participants in the trial contracted Covid-19. Among the ones who came down with Covid, 10% had been given the Moderna vaccine, compared to 20% Pfizer and 70% your brother-in-law’s new vaccine. Among those who did not have Covid, 40% had been given Moderna, 40% Pfizer, and 20% the new vaccine.

What is the probability that someone given your brother-in-law’s new vaccine contracts Covid-19?

Problem 3. (30 points). You have 20 volunteers for your next clinical trial; 8 of them are UT students and the rest are not. You randomly choose 5 of the volunteers to participate in your study, to see if they contract Covid when exposed to contagious people in their daily life after receiving your brother-in-law's "vaccine." Assume that each person encounters an average of 1 Covid-positive person per week, and you observe them for the next 4 weeks. Assume that any participant who encounters at least 2 Covid-positive people during these 4 weeks will contract Covid-19 themselves.

- (a) (10) What is the probability that at least two of the 5 people in your study are UT students?
- (b) (20) What are the expected value and standard deviation of the number of people in the sample who will contract Covid-19? What is the probability that none of them do?

Problem 4. (25 points). After all this, you finally decide to get a real vaccine, driving the 500 miles from Austin to Amarillo where it is easier to get an appointment. You can drive this distance in one day — but your route passes through Killeen, Abilene, and Lubbock, and you have friends in each city. Assume that when you pass through each of these three cities, there is a 50% probability that you will stop for an extra day to visit your friends.

- (a) (5) Let X be the number of days it takes to reach Amarillo (one day plus an extra day for each friend you visit). Write the PMF for X .
- (b) (10) What are the mean and standard deviation of X ?
- (c) (10) Let Y be your rate of travel, in miles per day (for example, if $X = 2$, then $Y = 500/2 = 250$ miles per day). What are the mean and standard deviation of Y ?