

CE 311S: Final Exam

Thursday, April 27

3:30 – 5:30 PM

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. Please turn in this sheet with your exam.
- The number of points associated with each part of each problem is indicated.

Problem	Points	Possible
1		20
2		20
3		20
4		20
5		20
TOTAL		100

Problem 1. (20 points). You decide to use your CE 311K skills to improve the course registration system at UT by writing a new registration app. This app interfaces with the course schedule and registrar's systems to identify courses and professors that match your schedule preferences. Based on your experience at UT, on average students spend 2 hours per semester planning out their schedules. You convince the 64 students in the CE 311S class to try out your app. Within this sample of students, the mean time spent developing a schedule was 1.6 hours, with a standard deviation of 0.8 hours. As you are very nervous about your skills and terrified of rejection by Jay Hartzell, you will only show the administration your app if you are very sure that it saves students time on average; this corresponds to a significance of $\alpha = 0.01$.

- (a) (5) What are your null and alternative hypotheses?
- (b) (5) Without using any statistical jargon, what is a Type I and Type II error in this situation?
- (c) (5) What is the P value corresponding to your data?
- (d) (5) Based on the P value you calculated, do you show the administration your new app?

Problem 2. (20 points). After a particularly unfortunate registration experience, you conduct a survey to see how many other students struggle to get into all the classes they want to take. Five friends agree to take your survey, and they report the following data. Each data point shows how many classes they were unable to sign up for in the Fall semester, because they filled up before their registration time:

3 2 3 2 0

For parts (b) and (c), write down **one-sided** intervals with 95% confidence, based on the idea that not getting into classes you need will cause significant problems with graduating on time.

- (a) (5) What are the sample mean and sample standard deviation?
- (b) (5) Write a one-sided interval representing the number of classes you will be unable to sign up for the next time you register.
- (c) (5) Write a one-sided interval representing how many classes 90% of your classmates will be unable to sign up for next time.
- (d) (5) Write a two-sided interval on the population standard deviation.

Problem 3. (20 points). Over the next semester, you track how many times someone logs on to your app (x), and their GPA (y), to see if there is a relationship between these variables. You find that $\sum x_i = 33$, $\sum y_i = 15.6$, $\sum x_i^2 = 235$, $\sum y_i^2 = 48.9$, and $\sum x_i y_i = 103.4$, based on a sample size of $n = 5$.

- (a) (5) What is the best-fit linear regression line relating GPA to number of logins?
- (b) (5) What is the R^2 value?
- (c) (4) What is the t -statistic on your regression line (for the null hypothesis that there is no relationship between your app and GPA)?
- (d) (6) Use your answers to (a)–(c) to answer these three questions (explaining specifically why your findings lead to these answers): does there seem to be a positive or negative relationship between usage of your app and GPA? does this relationship seem to explain a lot of someone's GPA, or a little? are you confident that this relationship exists in reality, or is it just a coincidence from your sample?

Problem 4. (20 points). For each of the following random variables, indicate what kind of distribution best describes that random variable, and what its expected value is.

- (a) (5) You have identified 5 “first choice” classes you want to take next semester, along with some backups in case they are full. The probability you get into any course is 0.8, and independent of whether you can get into any other course. The random variable A is the number of “first choice” courses you successfully register for.
- (b) (5) Assume that all students in CAEE are in the same situation described in part (a); the random variable B is the mean number of “first choice” courses CAEE students successfully register for.
- (c) (5) Unfortunately the wifi in your apartment is unreliable, and on average it goes out twice every hour. The random variable C is the number of times the wifi goes out during the 30 minutes you need to register.
- (d) (5) After the third wifi outage, you will contact the management office to complain. The random variable D is the time until complain about the wifi.

Problem 5. (20 points). Finally, you ask your five friends how long the entire registration process took from start to finish, in minutes:

15 20 15 30 20

- (a) (10) What is the maximum likelihood estimate of λ , assuming that the registration time is described by an exponential distribution?
- (b) (10) Assuming your estimate of λ is correct, what is the median time it takes a student to register? What is the 90th percentile of the time it takes to register?