

**CE 311S: Exam 1**  
Friday, February 25  
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. 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		25
2		40
3		35
<b>TOTAL</b>		100

**Problem 1.** (25 points). You and your friends decide to form a band to compete in the Cockrell School of Engineering's upcoming "Battle of the Bands." In the past you dabbled with the theremin<sup>1</sup> and want to make this the starring instrument in your band. You search online for used theremins, and find the following prices:

98 74 95 85 45 95

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

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<sup>1</sup>An ætherial-sounding electronic instrument controlled by waving your hands around two antennae without actually touching it; one hand controls pitch and the other volume.

**Problem 2.** (40 points). Since your friends can't decide on the name of the band (except that it should reflect your passion for civil, architectural, and environmental engineering), or even the genre of music you want to perform, you create a list of possibilities that you will randomly choose from. The start of your band's name is chosen from the first column below, the end of the name from the second column, and the genre of music from the third:

Start of name	End of name	Genre
Radical	Retaining Walls	Hip-hop
Steel Bridge	Wastewater	Smooth jazz
DJ	Reinforced Concrete	Metal
Lil	Monorail	K-pop
Poisson's	Contract	
	Tower	

For example, one possibility is that you name your band "Poisson's Retaining Walls" and you perform K-pop.

After you are done, you forget to take the lists of names and genres with you. Unfortunately, two rival groups of students come across these lists — they also want to compete, and they also pick their names and genre in the exact same process that you did (independent of each other and you).

- (a) (5) What is the probability that all three bands (you and your two rivals) perform hip-hop?
- (b) (5) What is the probability that at least one of the three bands performs either smooth jazz or metal?
- (c) (5) What is the probability that exactly one of the three bands performs K-pop?
- (d) (5) How many possible names can your band have?
- (e) (5) What is the probability that at least one of the three bands ends up with the exact same name as another?
- (f) (5) Given that at least two of the three bands have "Poisson's" in its name, what is the probability that all three do?
- (g) (5) What is the probability that your band's name consists of more than two words?
- (h) (5) Let  $X$  be the number of the three bands with "Monorail" in its name. What are  $E[X]$  and  $V[X]$ ?

(This page intentionally left blank; you can write answers here if they do not fit on another page.)

**Problem 3.** (35 points). In the end, you decide to form a theramin-led metal band named “Steel Bridge Monorail,” and get ready for the competition later in the semester (8 weeks from now).

- (a) (7) On average, you come up with ideas for 2 songs per week. What are the mean and standard deviation of the number of songs you come up with before the competition? What is the probability you come up with at least 3 songs?
- (b) (7) It turns out that you come up with 6 songs by the time of the competition; however there is only a 50% probability that any given song you write is actually good. What is the probability that 3 of your 6 songs are good? What is the probability you have at least one good song?
- (c) (7) In your specific case, 2 of your 6 songs happen to be good (but you don’t know which ones). You randomly select three songs to perform for the judges; let  $Y$  denote the number of these three songs which are good. Write down the PMF of  $Y$ , and calculate its expected value.
- (d) (7) There are four judges at the competition; each judge makes their decision independently of each other, and has a 0.1 probability of ranking your band in 1st place, a 0.2 probability for 2nd place, a 0.3 probability for 3rd place, and a 0.4 probability of ranking you outside of the top three. What are the mean and standard deviation of the number of judges who rank you among the top three bands?
- (e) (7) When you play through a song, the probability of making a mistake somewhere is 70%. In a recording session, you will keep recording takes until you get three good ones (no mistakes). What is the probability that you record exactly five takes to get three good ones? What are the mean and variance of the number of takes you will record?