CE 311S: Exam 2

Thursday, April 9

8:00 – 9:15 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		30
2		15
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."

Signature ____________________

Problem 1. (30 points). You decide to take an internship this summer. Unfortunately, you decide to intern with your shady brother-in-law's company, Engineer Nick's.[1] Engineer Nick's is a low-budget consulting firm which offers civil engineering services at steeply discounted prices.

Over the summer, you are assigned to produce concrete blocks for strength testing along with several other interns. During the next 32 days, you count how many interns show up for work (including you) and the number of blocks you are able to produce each day, producing the following table of probabilities between the two values:

While the first two planks in your platform fail to get much traction, the third gains a considerable amount of support. Indeed, you conduct a survey of 12 students who reveal the total amount they have spent on transcript-related fees:

Number of months		Number of interns		
		1	2	3
Blocks produced	0	1/32	3/32	0/32
	2	3/32	5/32	4/32
	3	0/32	7/32	5/32
	4	0/32	?	3/32

(a) (5) What is the missing value in the table?

(b) (5) The company expects daily production of at least one block per intern who showed up. What is the probability that this goal is achieved?

(c) (10) What is the correlation coefficient between the number of interns who show up and the number of blocks produced?

(d) (10) Each intern is paid \$72 per day worked, and each produced block leads to a net gain of \$144. What is the expected daily profit for the company? (Assume profit is "net gain" minus wages paid to interns.)

[1] Motto: "You've tried the best, now try the rest!"

Problem 2. (15 points). Engineer Nick's sources steel rods for rebar from your even shadier sister-in-law's company, Fabricator Nicole. In the last shipment of 1000 rods, each rod was supposed to have a length of 5 meters. When you measure them, you find that the rods actually have a mean length of 5.1 meters, with a standard deviation of 0.2 meters, following a normal distribution. Longer rods are annoying, but salvageable (you can cut them to the right length), but rods which are too shirt are unusable.

(a) (5) Approximately how many rods are 5 meters or longer?

(b) (5) What is the 90th percentile length for these rods?

(c) (5) You complain that too many of the rods are unusable. A new shipment is ordered, and you are promised that the standard deviation will be reduced, so that 98% of the new batch of rods will satisfy the minimum length of 5 meters. If this promise is upheld exactly, what was the standard deviation in the new batch?

Problem 3. (30 points). Over the summer, you notice that the profit X from any given project seems to be uniformly distributed between \$0.5 million and \$1.5 million. However, due to low quality work, Engineer Nick's often has to go back and do repairs on its past projects, without charging the client. The cost of these repairs Y is also uniformly distributed between 0 and \$1 million. Assume these values are independent.

(a) (10) What are the mean and standard deviation of the amount of repairs?

(b) (5) Write the joint PDF for X and Y.

(c) (10) What is the probability that the company has to spend more on repairs than it makes in profit on a given project?

(d) (5) What is the correlation coefficient between X and Y?

Problem 4. (25 points). Engineer Nick's is often the victim of litigation. Lawsuits come in at random intervals, and can be modeled by a Poisson process with a mean of 2 per month.

(a) (5) What is the expected time until the next lawsuit comes in?

(b) (5) What is the median time until the next lawsuit comes in?

(c) (5) What is the probability that there are no lawsuits during the 3 months you work during the summer?

(d) (5) After the next two lawsuits, the firm will have to close. Write down the PDF for the time until this happens.

(e) (5) What are the mean and standard deviation of the time before the firm closes?