

ECE 314 Quiz 2

Name:

NetID:

1. (-1 point if you don't answer this problem) Write your name initials on the paper to indicate your agreement to the following statement:

I know that:

- I may consult one page of notes. Otherwise it is closed book, no calculators, tablets, etc.
- The time limit of this quiz is 20 minutes writing + 5 minutes uploading to Gradescope.

2. (30 points) There are four ways to describe a Bernoulli process in lab 3:

- $X = (X_1, X_2, \dots)$: the results of the trials, a sequence of ones and zeros.
- $L = (L_1, L_2, \dots)$: L_i is the number of trials after the $(i - 1)$ th 1 up to and including the i th 1.
- $S = (S_1, S_2, \dots)$: S_i is the time the i th one occurs.
- $C = (C_1, C_2, \dots)$: C_i is the number of ones up to and including time i .

Let p denote the parameter of the Bernoulli process, so that $P\{X_k = 1\} = p$ for each k .

- (a) Which of the random variables above have a binomial probability distribution? For each such random variable, explain what the parameters n and p are.
- (b) Which of the random variables above have a geometric probability distribution? For each such random variable, explain what the parameter p is.

3. (20 points) Consider an online exam for ECE 313 in which 200 students take the exam, and suppose each student has a problem with scanning and uploading the exam with probability 0.04. Let X be the number of students that have a problem with scanning and uploading and let Z be the number of registered students that don't have that problem.

- (a) Which random variable, X or Z , has approximately a Poisson probability distribution?
- (b) What is the value of the associated parameter of the distribution?

4. (30 points) Let X be the random variable described by the table below. Let Y be the standardized version of X .

Outcome	3	1	-1	-3
Probability	1/4	1/4	1/4	1/4

- a) Calculate the mean and variance of X . Show your work!
- b) Sketch and fill in the following table for Y .

Outcome				
Probability				

5. (20 points) Recall that the confidence interval has the following property:

$$Pr\left\{p \in \left(\hat{p} - \frac{a}{2\sqrt{n}}, \hat{p} + \frac{a}{2\sqrt{n}}\right)\right\} \geq 1 - \frac{1}{a^2}$$

where $1 - \frac{1}{a^2}$ is the confidence level and n is the sample size. Suppose that we want to conduct a survey to estimate the true percentage of people in UIUC who support President Biden with a confidence level of 99% with at least $\pm 10\%$ accuracy (i.e. the half-width of the confidence interval is at most 0.10). How many samples should you take at least?

Academic Integrity Statement: By submitting your solutions to the quiz, you declare you have completed the quiz entirely by yourself. Any violation of the academic integrity requirement may cause an academic integrity report to be filed that could go into your student record. See Students' Quick Reference Guide to Academic Integrity for more information.