UNIVERSITY OF CALIFORNIA, LOS ANGELES
Civil and Environmental Engineering Department

CEE 110 Introduction to Probability and Statistics for Engineers

Final Exam
(Monday June 8, 2020)

- Students are allowed to view class lecture notes.
- Useful tables are included at the end of the exam.
- Students may use any calculator during the exam, but the entire answer process must be clear on the written answer sheet. All problems must be worked as if only a basic calculator was available.
- The exam has *five* problems with multiple parts. The credit for each part is indicated.
- Full credit will be given for answers that are worked out correctly. You may leave your answer in terms of a correct symbolic equation if you like (partial credits). To obtain credit, be sure to show as much work as possible! You should draw a box around your final answer to each problem.
- You are not allowed to talk during the exam.
- Before submitting your solution, make sure all pages of your solution are legible
- Make sure your name is on all exam sheets.
- Submit your solution through the GradeScope.

- Honor Code: Section 102.01 of UCLA's UCLA Student Conduct Code prohibits all forms of academic misconduct or research misconduct, including, but not limited to, cheating, fabrication or falsification, plagiarism, multiple submissions, facilitating academic dishonesty, coercion regarding grading or evaluation of coursework, or unauthorized collaboration. By submitting your assignment and exam for grading you acknowledge these terms / you declare that your work is solely your own and that you have not communicated with anyone other than the instructor and proctors in any way during the exam."
- You should write this in the beginning of your solution: "On my honor, I have neither received nor given any unauthorized assistance on this examination. Agreed by *Your Name and Signature*"

Good Luck!

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Name:_____ Student ID: _____

1. Zebra mussel was originally native to the lakes of Russia. However, it has been accidentally introduced in many other areas and becomes an invasive species in North America. Zebra mussels feed by straining suspended matter from water. The following samples show measurements of the rates (mL/mg/h) at which mussels filter suspended matters in water.

   18.2 10.8 21.4 20.1 29.0 19.8 24.5

   a) Find the quartiles of the data (3 pt)

   b) Is it plausible that the distribution is normal? (5 pt)

   c) What is the sample mean and standard deviation? Round a number to two decimal places. (2 pt)

   d) Compare the CIs of 95% and 99% levels. Suppose the mean and standard deviation derived from c) is the same as those for the sample mean. (10 pt)

2. Suppose 3 tsunami stroke Los Angeles per year between 1961 and 1990, which follows a Poisson distribution.

   a) What is the probability that at least one tsunami strikes Los Angeles in the next one year? (5 pt)

   b) What is the probability that it will be at least one year until the next tsunami strikes Los Angeles? (5 pt)

   c) If one year has passed without a tsunami, what is the probability that it will be within another six months until the next tsunami hits Los Angeles? (5 pt)

   d) Let T be the time until the occurrence of the fifth tsunami. Find the probability of T is between 1 and 2 years? (5 pt)

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3. The size of coronavirus has the mean of 130 nm and the standard deviation of 10 nm. Suppose a random sample of 100 coronavirus is examined.

   a) Find the probability that the sample mean thickness exceeds 131 nm. (5 pt)

   b) Suppose the range for the size of coronavirus is 130 ± 1 nm. What proportion of the size of coronavirus of the samples meets the range? (5 pt)

   c) What is the 90th percentile of the sample mean? (5 pt)

   d) If 10% of the coronavirus is inactive. For 500 samples of the coronavirus, what is the probability that more than 460 will be active? (5pt)

4. The joint probability density function of the number of hours for two mountain bike tires filled to a pressure of 25 psi. X is for the front tire and Y is for the rear tire.

$$f(x,y) = \begin{cases} k(x+y)^2 & 0 < x < 1, \quad 0 < y < 1 \\ 0 & otherwise \end{cases}$$

   a) What is the value of k to make the join density function legitimate? (5 pt)

   b) Compute the marginal density function of the number of hours for each tire. (5 pt)

   c) Evaluate whether X and Y are independent and make a justification. (5 pt)

   d) Compute the covariance of X and Y. (5 pt)

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5. We are interested in the half-life of cesium-137 in the Pacific Ocean to determine its mean half-life is greater than 30 years with a random sample of size 15. The sample mean is 30.15 years and the sample standard deviation is 0.2 years.

   a) What are the appropriate hypotheses? (4 pt)

   b) What is the rejection region for 1%? (4 pt)

   c) Test hypothesis with the significance level of 1% and explain your conclusion. (4 pt)

   d) What is the p-value? Compare the conclusion with previous hypothesis testing. (4 pt)

   e) Find a 99% confidence interval for the half-life and compare the conclusion with previous hypothesis testing and p-value. (4 pt)