STAT 155 – Spring 2022
Exam 1 (CH 1-3)

Exam Details

Course Percentage: 30%
Total Points: 100

Exam Policies

- Students are allowed to use a calculator and course materials (lecture notes, course textbook, homework, quizzes, discussion notes) during the exam. Students should not use resources outside of the course materials and should not discuss or work on the exam with anybody. **Exams are not open internet/resources and collaboration is strictly prohibited.**
- Students may complete the exam electronically using a tablet or by writing on blank paper or a printed exam copy.
- Students will be required to upload a PDF of their solutions to Canvas.
- Students should remain logged in to the Zoom meeting with their camera on and mic muted for the entirety of the exam.
- The Professor and TAs will be available to students through Zoom chat during the scheduled exam time.
- Note: The exam Zoom meeting will be recorded.

Exam Instructions

9:30 – 10:50am Read and complete the exam questions.

10:50 – 11am Upload a PDF file to Canvas showing solutions.

Solutions should include all appropriate steps, statistical notation, mathematical work, and numerical results. Be sure to number your problems and show your work in an organized manner. *Numerical calculations should be rounded to 4 decimal places.*

Good Luck!

Exam Honor Pledge

HONOR PLEDGE: I agree that I will complete this exam with integrity and honesty. The work I submit for the exam will solely be my own. I will not use any non-approved materials, electronic devices, or other aids to assist me on the exam.

By uploading your PDF solutions to Canvas, you are agreeing that you have completed the exam in accordance with the above Honor Pledge.

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Question 1: A large manufacturing plant houses several individual machines. A mechanical engineer must investigate all machine failures. Suppose a Poisson distribution is used to model Y, the number of machine failures per month, and that the expected number of failures is 7.

a) What is the probability of 7 machine failures occurring in a month? [6pts]

b) What is the probability that there will be at least one machine failure in a month? [6pts]

c) What is the probability that there are no machine failures in two weeks? Assume 1 month = 4 weeks. [6pts]

Question 2: A smoke detector system uses two devices, A and B. If smoke is present, the probability that it will be detected by device A is 0.95; by device B, 0.93. Assume the devices work independently of one another. The following events are defined:

A: device A detects smoke **B**: device B detects smoke

a) If smoke is present, what is the probability that it will be detected by at least one of the devices? [6pts]

b) If smoke is present, what is the probability that it will not be detected by either device? [4pts]

Question 3: A mechanical engineer analyzing the runtime of oil pumps (measured in years) tracks the time until a pump fails and is pulled out of ground for repair or replacement. A random sample of runtimes are provided below:

1.2 4.9 5.7 5.9 6.3 6.5 6.8 6.8 6.9 7.1 7.3 8.0

a) Create a stem and leaf plot for the data and comment on the shape. Do there appear to be any outliers? [6pts]

b) What is the mean runtime for the oil pumps in this sample? [6pts]

c) The standard deviation for this sample is 1.75. What proportion of oil pumps have a runtime within 1 standard deviation of the mean? [4pts]

d) Suppose the trimmed mean is calculated by eliminating the smallest and largest runtimes. How do you expect the trimmed mean to compare to the mean? i.e., will it be larger or smaller? Support your answer appropriately. [4pts]

e) Suppose the observation 1.2 years is changed to 4.5 years. Which of the following descriptive statistics would change in value? Select all that apply. [6pts]

☐ Mean ☐ Median ☐ Mode ☐ Quartiles

☐ Range ☐ Variance ☐ Standard Deviation ☐ IQR

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Question 4: The number of batteries used to power electronic devices varies depending on the type of device and type of battery required. Assume the following cumulative distribution function (cdf) for *X*, the number of batteries needed to power an electronic device.

$$F(x) = \begin{cases} 0 & x < 1 \\ 0.38 & 1 \le x < 2 \\ 0.62 & 2 \le x < 3 \\ 0.78 & 3 \le x < 4 \\ 0.98 & 4 \le x < 6 \\ 1 & 6 \le x \end{cases}$$

a) Find the mean number of batteries required to power electronic devices? [8pts]

b) What is the probability that no more than 2 batteries are required to power an electronic device? [4pts]

c) Elsa has an electronic device and 4 batteries. Should she be confident that she has enough batteries for the device? Support your answer appropriately. [6pts]

Question 5: The average human leg (including feet) is composed of 30 bones. A man admitted to a hospital after a serious car accident reportedly has 6 broken bones in his leg. How many different combinations of broken bones are possible? [4pts]

Question 6: Suppose 48% of computer programmers use Python. A random sample of thirty computer programmers are surveyed and the number that use Python is recorded.

a) In a sample of thirty computer programmers, what is the expected number of Python users? [4pts]

b) Find the probability that exactly half of the sampled computer programmers use Python. [6pts]

Question 7: Nearly half of adults in the U.S. have hypertension (i.e., high blood pressure). To control hypertension, many doctors prescribe their patients medication. When filling prescriptions at the pharmacy, customers are given the option of using name-brand medication or generic. Of all medications filled at the pharmacy, 30% are name brand and 70% are generic. If a name brand prescription is ordered, there is a 2% chance it is for hypertension. If a generic prescription is ordered, there is a 3% chance it is for hypertension. The following events are defined for use:

B: prescription filled is named Brand
H: prescription is used to treat Hypertension

a) What proportion of medication filled at the pharmacy is for treating hypertension? [8pts]

b) Suppose the next person in line at the pharmacy is filling a prescription for treating hypertension. What is the probability he will opt for the name brand drug? [6pts]

STAT 155 – Fall 2021
Exam 2 (CH 4-6)

Exam Details

Course Percentage: 25%
Total Points: 100

Exam Policies

- Students are required to log in to the Zoom meeting during the exam time (cameras on / mics muted).
- The Professor and TAs will be available to students through Zoom chat during the scheduled exam time.
- Students are allowed to use a calculator, course notes, course textbook and a calculator during the exam. Students should not use resources outside of the course materials and should not discuss or work on the exam with anybody. **Exams are not open internet/resources and collaboration is strictly prohibited.**
- Students may complete the exam electronically on a tablet (using Microsoft OneNote, Notability, or similar app) or by writing on blank paper or a printed exam copy.
- Students will be required to upload a pdf for each of their solutions to Canvas.

Exam Instructions

7:50 – 8am Complete the exam Honor Pledge (10 points) in Canvas

8 –11am - Read and complete each exam question. 1-2 questions will be released every half hour (i.e., 8am, 8:30am, 9am, 9:30am, 10am, 10:30am). You will have 25 minutes to complete the solution and upload a pdf file showing your work / solution. Once the 25 minutes (from the question release time) has passed, no other submissions will be allowed (i.e., you will not be able to go back to that question).

Solutions should include statistical notation, mathematical work, and numerical results. Be sure to number your problems and show your work in an organized manner. The Standard Normal Table should be used to find probabilities associated with the Normal Distribution (students may check their work using SALT in WebAssign). *Numerical calculations should be rounded to 4 decimal places.*

Good Luck!

Exam Starts Here

HONOR PLEDGE: Please write and sign your full name at the top of your first exam page to signify your agreement with the following statement:

> I agree that I will complete this exam with integrity and honesty. The work I submit for the exam will solely be my own. I will not use any non-approved materials, electronic devices, or other aids to assist me on the exam.

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Exam 2 (CH 4-6)

Question 1: A low resting heart rate generally implies better cardiovascular fitness. Consider the following data on the resting heart rates (beats per minute) for a random sample of eight professional athletes:

47	62	49	52	50	45	44	55

a) Calculate a point estimate of the mean resting heart rate of all professional athletes. [4 pts]

b) Calculate a point estimate of the resting heart rate that separates the lowest 50% of all professional athletes from the highest 50%. [4 pts]

c) Calculate the point estimate of the proportion of all professional athletes whose resting heart rate exceeds 50 beats per minute. [4 pts]

Question 2: According to covid19.ca.gov, 68.1% of California residents are fully vaccinated (as of 12/4/21). Consider a random sample of 350 California residents. Let X denote the number among these that are fully vaccinated. What is the (approximate) probability that X is between 220 and 260 (inclusive)? [6 pts]

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Question 3: Ever craved an ice cream shake from the local drive-thru restaurant just to find out the ice cream machine is broken? WHY IS IT ALWAYS BROKEN?! Let the random variable X represent the length of time (in days) between successive break downs of the ice cream machine at the local drive-thru restaurant. Suppose X follows an exponential distribution with $\lambda=0.06$.

a) What is the expected time between two successive breakdowns? [2 pts]

b) What is the standard deviation of the time between successive breakdowns? [2 pts]

c) What is the probability that the next occurrence of the ice cream machine breaking down is at most 15 days? [5 pts]

d) How many days represents the 80^{th} percentile? [4 pts]

e) Suppose it has been two weeks (i.e., 14 days) since the ice cream machine broke down last. What is the probability that it will be at least three weeks (i.e., 21 days) until the ice cream machine breaks down? [5 pts]

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Question 4: Let X and Y be continuous random variables with joint pdf

$$f(x, y) = 0.125(6 - x - y) \qquad \begin{array}{l} 0 < x < 2 \\ 2 < y < 4 \end{array}$$

Note: $E[X] = \frac{5}{6}$, $E[Y] = \frac{17}{6}$, $Var[X] = \frac{11}{36}$, $Var[Y] = \frac{11}{36}$

a) Find *E[XY]*. [10 pts]

b) Find *Corr(X,Y)*. Comment on the relationship between *X* and *Y*. [8 pts]

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Question 5: Suppose the breaking strength of a particular type of 8mm wire rope follows a normal distribution with mean $\mu = 8500\ lb_f$ (pound of force) and standard deviation $\sigma = 182\ lb_f$.

a) What is the probability that the breaking strength of a randomly selected wire rope of this type exceeds 9000 lb_f? [4 pts]

b) What is the probability that the breaking strength of a randomly selected wire rope of this type is between 8000 lb_f and 8500 lb_f? [5 pts]

c) What is the breaking strength that separates the highest 10% of all breaking strengths for this type of wire rope from the lowest 90%? i.e., Find the 90th percentile. [4 pts]

d) Consider a random sample of 6 pieces of this type of rope. How likely is it that the sample mean breaking strength is less than 8750 lb_f? [5 pts]

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Question 6: Suppose the pdf of *X* is $f(x\,;\theta) = \frac{2x}{\theta^2}$ where $0 < x \le \theta$. A random sample of six observations yields data $x_1 = 1.3,\ x_2 = 2.2,\ x_3 = 0.9,\ x_4 = 1.5,\ x_5 = 1.0,\ x_6 = 2.1.$ Use the method of moments to obtain an estimator of the parameter θ compute the estimate for the given data. [10 pts]

Question 7: The error involved in making a certain measurement is a continuous random variable *Y* with the following pdf.

$$f(y) = \frac{3}{32}(4 - y^2) \qquad -2 < y < 2$$

When $Y = 0$, the measurement is accurate (i.e., no error). Find the probability that a measurement is within an allowable threshold of 0.25. In other words, find $P(-0.25 < Y < 0.25)$. [8 pts]