CENGAGE | WEBASSIGN

c836907548@colostate.edu
(Sign out)

STAT 315 HW3 (Homework)

INSTRUCTOR
Aaron Nielsen
Colorado State University

Current Score

QUESTION	1	2	3	4	5	6	7	8
POINTS	6/6 ✓	17/17 ✓	15/15 ✓	5/5 ✓	3/4 ✓×	4/4 ✓	10/10 ✓	10/10 ✓

TOTAL SCORE

70/71 **98.6%**

Due Date

MON, MAY 20, 2024
11:59 PM MDT

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Assignment Submission & Scoring

Assignment Submission

For this assignment, you submit answers by question parts. The number of submissions remaining for each question part only changes if you submit or change the answer.

Assignment Scoring

Your last submission is used for your score.

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1. **[6/6 Points]** DETAILS MY NOTES PREVIOUS ANSWERS

Determine whether the following random variables are discrete or continuous and determine the support of random variable (i.e., the possible values for the random variable).

Note: You have one attempt per part.

(a) X = the number of unbroken eggs in a randomly chosen carton of a dozen eggs.

◉ Discrete

- ○ Continuous ✓

(b) What is the support of X?

- ○ All integers
- ◉ {0,1,2,3,...,12}
- ○ All real numbers between 0 and 12
- ○ All real numbers ✓

(c) Y = the number of manufactured computer chips inspected until a defective chip is found.

- ◉ Discrete
- ○ Continuous ✓

(d) What is the support of Y?

- ○ All positive real numbers
- ○ {0,1,2,3,...}
- ○ All real numbers
- ◉ {1,2,3,...} ✓

(e) Z = the length of a randomly selected snake.

- ◉ Continuous
- ○ Discrete ✓

(f) What is the support of Z?

- ○ {0,1,2,3,...}
- ○ All real numbers
- ○ {1,2,3,...}
- ◉ All positive real numbers ✓

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2. **[17/17 Points]** DETAILS MY NOTES PREVIOUS ANSWERS PRACTICE ANOTHER

Suppose that a telephone call center has six telephone lines. Let X denote the number of lines in use at a specified time. The PMF of X is given in the following table.

x	0	1	2	3	4	5	6
p(x)	0.05	0.01	0.8	0.06	0.04	0.02	0.02

Calculate the probability of the following events.

(a) P(at least three lines in use) .14 ✔

(b) P(fewer than three lines in use) .86 ✔

(c) P(between two and five lines in use, inclusive) 0.92 ✔

(d) P(at least three lines **not in use**) .92 ✔

Fill in the following table and use it to answer the following questions.

x	0	1	2	3	4	5	6	Row Sum
p(x)	0.05	0.01	0.8	0.06	0.04	0.02	0.02	1 ✔
$x \cdot p(x)$	0 ✔	0.01 ✔	1.6 ✔	.18 ✔	.16 ✔	.10 ✔	.12 ✔	2.17 ✔
$x^2 \cdot p(x)$	0 ✔	0.01 ✔	3.2 ✔	0.54 ✔	0.64 ✔	0.5 ✔	0.72 ✔	5.61 ✔

(e) What is the expected value of X? 2.17 ✔

(f) What is $E[X^2]$? 5.61 ✔

(g) What is Var(X)? 0.901 ✔

(h) What is the standard deviation of X? .949 ✔

3. **[15/15 Points]** DETAILS MY NOTES PREVIOUS ANSWERS

Suppose that you read through this year's issues of the New York Times and record the number that appears in a news article (e.g., income of a CEO, number of casualties in a battle, the national debt, etc). Now suppose that you only look at the leading digit of each number which could be 1, 2, 3, 4, 5, 6, 7, 8, or 9. Your first thought might be that the leading digit X of a randomly selected number would be equally likely to be one of nine possibilities (i.e., a discrete uniform distribution).

(a) Fill in the following PMF if all number are equally likely. Round these numbers to three decimal places.

PMF assuming uniform distribution

x	1	2	3	4	5	6	7	8	9
p(x)	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111

(b) What is the expected value of X given that all numbers are equally likely? 5

(c) What is the variance of X given that all numbers are equally likely? 6.667

It turns out that all leading numbers are not equally likely to occur. According to Benford's Law, $p(x) = \log_{10}[(x+1)/x]$. Fill in the following PMF using Benford's Law. Round these numbers to three decimal places.

PMF assuming Benford's distribution

x	1	2	3	4	5	6	7	8	9
p(x)	0.301	0.176	0.125	0.097	0.079	0.067	0.058	0.051	0.046

(d) What is the expected value of X given that the numbers are distributed according to Benford's Law? 3.441

(e) What is the variance of X given that the numbers are distributed according to Benford's Law? 6.061

4. **[5/5 Points]** DETAILS MY NOTES PREVIOUS ANSWERS

Suppose you test ten batteries to see how many of them work. The probability that a given battery works is 0.73. Let X be the number of working batteries.

(a) What is an appropriate random variable to model X? You have one attempt on this part.

- (•) Binomial
- ( ) Discrete Uniform
- ( ) Poisson
- ( ) Normal

(b) What is the expected value of X? 7.3

(c) What is the standard deviation of X? 1.404

(d) What is the probability that exactly 8 batteries work? 0.265

(e) What is the probability that at least 8 batteries work? 0.466

5. [3/4 Points] DETAILS MY NOTES PREVIOUS ANSWERS

Suppose that the number of students that skip class is distributed as a Poisson random variable with lambda = 5.

(a) What is the expected number of absent students? 5 ✓

(b) What is the variance of the number of absent students? 5 ✓

(c) What is the probability that no student is absent on a given day? 0.007 ✗

(d) What is the probability that two or more students are absent on a given day? 0.960 ✓

6. [4/4 Points] DETAILS MY NOTES PREVIOUS ANSWERS

Determine the appropriate random variable to model the following applications. You have one attempt on each part.

(a) 12 chemical reactions are performed independently and have a probability 0.83 of producing a toxic gas. Let X be the number of times that toxic gas was produced from the 12 experiments.

- (●) Binomial
- ( ) Bernoulli
- ( ) Poisson
- ( ) Discrete Uniform

✓

(b) 55 numbered balls, marked from 1 to 55, are mixed for a lottery. Let Y be the number of the first ball drawn.

- ( ) Poisson
- ( ) Binomial
- ( ) Bernoulli
- (●) Discrete Uniform

✓

(c) Customers show up at a local coffee shop independently with rate of 5 customers per hour. Let Z be the number of customers that show up to the coffee shop in the next hour.

- ( ) Discrete Uniform
- (●) Poisson
- ( ) Bernoulli
- ( ) Binomial

✓

(d) An emergency power system will output 1 if there is a power failure and 0 if there is not a power failure. Let W be the outputted number.

- ( ) Poisson

- Discrete Uniform
- Binomial
- (•) Bernoulli ✓

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7. [10/10 Points] DETAILS MY NOTES PREVIOUS ANSWERS

This exercise requires you to use R. For all answers in this problem, round to two decimal places.

Read and follow along in R with Chapter 3 of the R Companion.

(a) I have read and completed Chapter 3 of the R Companion.

- (•) True ✓
- False

In problem 4, you should have found that the number of working batteries is distributed as a Binomial(n=10,p=0.73) random variable. We are going to simulate some data following this distribution and see if our sample gives us results similar to problem 4.

First, let's generate 10,000 random variables distributed as Binomial(n=10,p=0.73).

```
set.seed(2020)
data = rbinom(n=10000,size=10,prob=0.73)
```

(b) What is the sample mean of this dataset? 7.320 ✓

(c) What is the sample variance of this dataset? 1.950 ✓

(d) What is the probability that X=8 in our sample? 0.27 ✓

(e) What is the probability that X is at least 8 in our sample? 0.48 ✓

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8. [10/10 Points] DETAILS MY NOTES PREVIOUS ANSWERS

This exercise requires you to use R. Round all answers in this problem to two decimal places.

In this exercise, you will use R to calculate probabilities. In particular, you will use functions like "pbinom", "dbinom", "ppois", or other similar functions.

For parts (a)-(c), suppose Lebron James' career free throw percentage is 73.3% and suppose he shoots 100 free throws in practice.

(a) What is the probability that he makes at most 80 free throws? 0.95 ✓

(b) Following up with the last part, what is the probability that Lebron makes more than 75 free throws? 0.31 ✓

(c) What is the probability that Lebron makes exactly 73 free throws? 0.09 ✓

For parts (d)-(e), suppose that the number of calls per hour to the Comcast help center can be modeled as a Poisson random variable with rate parameter lambda = 1000. Let X be the number of calls to Comcast in the next hour.

parameter lambda = 1000. Let X be the number of calls to comcast in the next hour.

(d) What is the probability that X is less than or equal to 1000? 0.51

(e) What is the probability that X is more than 950? 0.94

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