Q01

Let X be a Geometric distributed random variable with parameter $p = 0.05$ (i.e. $X \sim \text{Geom}(0.05)$).

a.

Compute $p(X = 3)$

b.

Compute $p(X < 4)$

c.

Compute $p(X > 4)$

d.

In your own words, what sort of process does the random variable above describe?

Q02

Let X be a Binomial distributed random variable with parameters $N = 15$ and $\theta = 0.40$ (i.e. $X \sim \text{Binom}(15, 0.40)$).

a.

Compute $p(X = 1)$

b.

Compute $p(X < 14)$

c.

Compute $p(X > 15)$

d.

In your own words, what sort of process does the random variable above describe?

Q03

Let X be a Bernoulli distributed random variable with parameter $p = 0.2$ (i.e. $X \sim \text{Bern}(0.2)$).

a.

Compute $\text{E}(X)$

b.

Compute $\text{Var}(X)$

c.

What potential values does a Bernoulli distributed random variable take?

d.

Interpret the expectation of this Bernoulli distributed random variable. What would you say to someone who asked "Why is the expectation not any of the values this r.v. can take?"

Q04

Let X be a Normally distributed random variable with parameters $\mu = 0$ and $\sigma = 1$ (i.e. $X \sim \text{Normal}(0, 1)$).

a.

Compute $f(X = 2.1)$, where f is the probability density function corresponding to the Normal distribution.

b.

Compute $p(X = 2.1)$, where p is the probability

c.

Compute $p(X < 3)$

d.

Compute $p(X > -3)$

e.

For a Normally distributed random variable X, is $p(X > a) = p(Xa)$? Why or why not?

Q05

Let X be a Poisson distributed random variable with parameter $\lambda = 2.1$ (i.e. $X \sim \text{Pois}(2.1)$).

a.

Compute $p(X = 2)$

b.

Compute $p(X > 2)$

c.

Compute $p(X < 2)$

Q06 (3.39 in the book)

Customers at a coffee shop. A coffee shop serves an average of 75 customers per hour during the morning rush.

a.

What are the mean and the standard deviation of the number of customers this coffee shop serves in one hour during this time of day?

b.

Would it be considered unusually low if only 60 customers showed up to this coffee shop in one hour during this time of day?

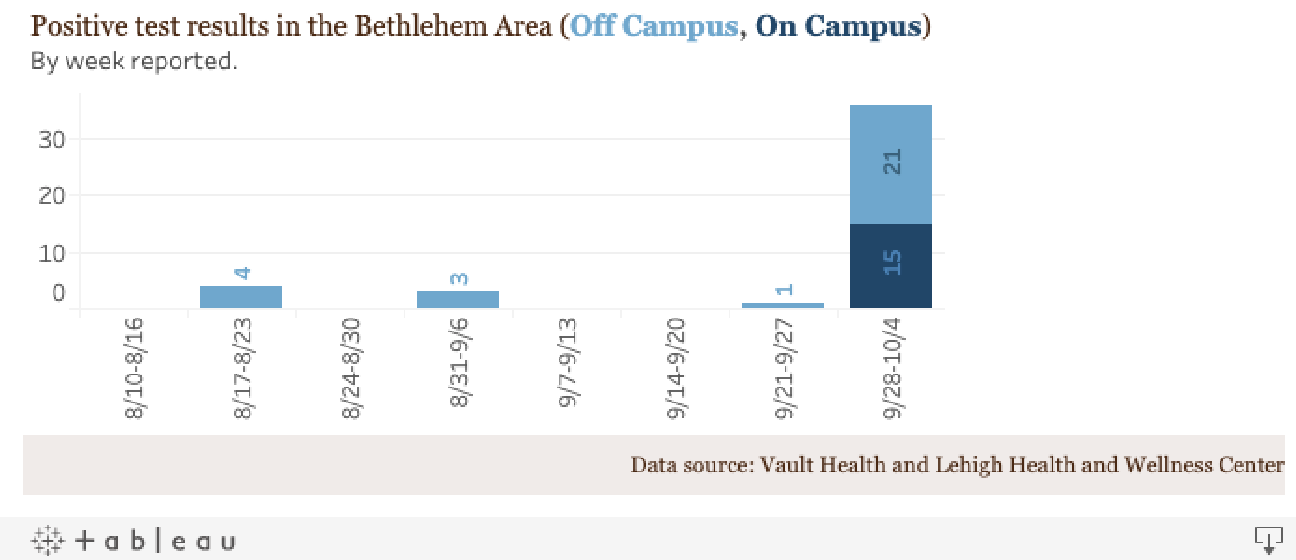
c.

Calculate the probability that this coffee shop serves 70 customers in one hour during this time of day.

Q07

Suppose you decided to model the number of confirmed cases of COVID-19 in the Bethlehem area using a Poisson distributed random variable. Here is data taken the Lehigh University dashboard as of 2020-10-05T09:48:00.

Of the **44** positive cases, **11** students tested positive as a result of initial or ongoing surveillance testing, **20** tested positive after undergoing diagnostic testing conducted by the Lehigh Health and Wellness Center, and **13** were reported from tests administered elsewhere (see "Additional Reported Information").
Correction from 9/7/2020 to 9/14/2020: One positive case was previously misidentified as coming from a diagnostic test when it was instead the result of a pre-arrival/surveillance test. The numbers were changed to reflect this correction.



Let's estimate the number of new confirmed cases per week from data up to 2020-09-27. This estimate would be roughly 1.14 cases per week.

a.

Define a Poisson distributed random variable—C—with the above estimate.

b.

Please compute $p(C = 1)$

c.

Please compute $p(C = 3)$

d.

Please compute $p(C = 4)$

e.

Please compute $p(C = 36)$

f.

Please compute $p(C > 5)$

g.

Please describe the expectation, variance of your r.v. and how unexpected a reported 36 cases were give recent data. Does this unexpected 36 cases mean a Poisson r.v. is no good at capturing the probability of the number of cases each week? Why do you think this unexpected event wasn;t predicted from a Pois r.v.?