due: 3/28

Group _____

Name: _____

- 1) Twenty percent of babies in a particular large city are born by a Cesarean section (Csection). You are interested in gathering information about hospital experiences of parents who did not have their baby by C-section. You randomly survey parents of babies from the population of the city until you find 7 babies not born by C-section.
- a) Why is this a Negative Binomial situation?
- b) What are the possible values of X?
- c) What is the PMF of X?
- d) What is the probability that you will have to survey exactly 10 parents to find the seventh one not born by C-section?
- e) What is the probability that you have to survey parents of at least 8 babies to find the seventh one not born by a C-Section.
- f) Given that you have to survey parents of at least 8 babies to find the seventh one not born by C-section, what is the probability that you have to survey exactly 11 parents?
- g) Assuming that you survey 10 parents, what is the probability that seven of them had babies not born by C-section?
- h) How are parts d) and g) different?

2) Approximately 8.33% of men are colorblind. You survey men from a large population until you find 2 who are colorblind.

a) Explain in words what X is in this situation and what values it can take.

b) Why is this a Negative Binomial distribution situation? What are the parameters?

c) What is the probability that you will have to ask between 12 and 14 men (inclusive) to find the 2nd who is colorblind?

d) What is the expected value of X?

e) What is the variance of X?

g) Show the labeled graph of the mass for this story (you may just plot every 4th point). Draw an arrow to indicate where the mean is. You may stop when your points look like they are on the x-axis on your scale.

h) Show the labeled graph of the CDF for this story (you may just plot every 4th point). You may stop at the same point as in part g)

- 3) A charitable organization is conducting a raffle in which the grand prize is a new car. Five thousand tickets, numbered 0001, 0002, ..., 5000 are sold at \$10 each. At the grand-prize drawing, one ticket stub will be selected at random from the 5000 ticket stubs
- a) Why is this a Discrete Uniform distribution, and what is the parameter?

b) Explain in words what X is terms of the story? What values can it take on?

c) Suppose that you hold tickets numbered 1003 – 1025. What is the probability that you win the grand prize?

Calculate the following even though they don't really mean anything.

- d) What is the expected value of the winning number?
- e) What is the standard deviation?
- f) Describe in words what the graph of the mass for tickets would look like.
- g) Describe in words what the graph of the CDF for the numbers of the tickets would look like.

- 4) Suppose that we roll an n-sided die until a '1' is rolled. Let X be the number of times it takes to roll the ninth '1'. This problem does not have numeric answers.
- a) Why is this a Negative Binomial situation?
- b) What are the possible values of X?
- c) What is the PMF of X?
- d) What is the probability that it will take exactly 40 rolls?
- e) What is the probability that it will take more than 9 rolls?
- f) Given that it will take more than 9 rolls to roll the ninth '1', what is the probability that it will take exactly 40 rolls?

- g) What is the expected number of rolls?
- h) What is the standard deviation of the number of rolls?

5) You throw darts at a board with 20 equally likely spaces. You throw until you hit "1", then you throw until you hit "2", then you throw until you hit "3", etc., and finally you throw until you hit "20". Let X be the number of throws you make to achieve this goal.

a) What are the expected value and standard deviation of X? Hint: What is the distribution?

b) Let Y be the number of throws needed until the 20th time hitting '1'. What are the expected value and standard deviation of Y? Hint: What is the distribution?

c) Why were your answers to X and Y the same? Is this a coincidence?

6) BONUS: Hint: You will need to find the analytical formulas for the summations. a) Show that the expected value of a Discrete Uniform random variable on the set {1, 2, ..., N} is $\mathbb{E}(X) = \frac{N+1}{2}$.

b) Show that the variance is $Var(X) = \frac{N^2 - 1}{12}$

7) Twelve percent of single women in the kingdom have feet which will fit into a glass slipper. Prince Charming thinks he must continue finding women who fit such a slipper, so that he has a collection to choose from. He would like 10 women who fit the slipper to compete on a "Bachelor"-type show for his hand in marriage.

a) How many women should he expected to have to check until he finds 10 women who fit the glass slipper?

a) What is the standard deviation of the number of women that he will have to find until he finds 10 women who fit the glass slipper?

c) What is the probability he has to check 75 women?

d) Given that he has to check between 74 and 78 women (exclusive), what is the probability he has to check exactly 75 women?

e) What is the probability that he will find exactly 10 women who fit the glass slipper if he checks 75 women?

f) Why are the answers to parts c) and e) different?