STAT 107 – Spring 2021

Geometric Distribution

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Geometric Distribution

X = the number of **independent** trials until the first "success."

Then,

$$P(X = k) = (1 - p)^{k-1} \cdot p \qquad \text{where } k = 1, 2, 3, \ldots$$

$$E(X) = \frac{1}{p} \qquad Var(X) = \frac{1 - p}{p^2}$$

Example 1:

A major oil company has decided to drill independent test wells in the Alaskan wilderness. The probability of any well producing oil is 0.30. Find the probability that the fifth well is the first to produce oil.

Example 2:

A slot machine at a casino randomly rewards 15% of the attempts. Assume that all attempts are independent.

a) What is the probability that your first reward occurs on your fourth trial?

b) What is the probability that your first reward occurs on your seventh trial?

c) What is the probability that you get three rewards in ten trials?

d) On average, how many attempts you have to make until your first reward?

e) What is the standard deviation of the number of attempts you make until your first reward?

f) What is the probability that it takes at least 3 attempts to get your first reward?

j) What is the probability that you will not get your first reward until **after** your 10 attempts?

Computing Geometric Distribution Probabilities using scipy.stats in Python

```
from scipy.stats import geom

geom.pmf(k=0, p=0.15) #P(X=0) when X ~ Geom(p=0.15)
geom.cdf(k=2, p=0.15) #P(X<=2)
geom.mean(p=0.15) #E(X)
geom.var(p=0.05) #Var(X)
geom.std(p=0.15) #SD(X)
```