STAT 107 – Fall 2020

Binomial Distribution

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Example 1:

We are flipping 3 loaded coins. With these coins, the probability of getting tail is 0.3. Let X be the number of heads we get.

x	$f(x)$
0	0.027
1	0.189
2	0.441
3	0.343

$E(X) = 2.1$

$Var(X) = 0.63$

$S = \{$ TTT, TTH, THT, THH, HTT, HTH, HHT, HHH $\}$

Binomial Distribution

1. The number of trials, n, is fixed.
2. Each trial has two possible outcomes: "success" and "failure."
3. The probability of "success", p, is the same from trial to trial.
4. The trials are independent.
5. X = the number of "successes" in n independent trials.

Then,

$$P(X = k) = \binom{n}{k} \cdot p^k \cdot (1-p)^{n-k}$$

where $k = 0, 1, \cdots, n$

with $\binom{n}{k} = \frac{n!}{k!(n-k)!}$

$$E(X) = n \cdot p. \qquad Var(X) = n \cdot p \cdot (1-p)$$

Example 1:

We are flipping 3 loaded coins. With these coins, the probability of getting tail is 0.3. Let X be the number of heads we get.

a) What is the probability of getting 2 heads?

b) On average, how many heads will we get each time?

c) Find the variance and the standard deviation of X?

Example 2:
An automobile salesman thinks that the probability of making a sale is 0.30. If he talks to five customers on a particular day, what is the probability that he will make exactly 2 sales? (Assume independence.)

Example 3:
Often On-time Parcel Service (OOPS) delivers a package to the wrong address with probability 0.05 on any delivery. Suppose that each delivery is independent of all the others. There were 7 packages delivered on a particular day.

a) What is the probability that at least 1 of them was delivered to the wrong address?

b) What is the probability that exactly 2 of them were delivered to the wrong address?

c) What is the probability that at most 2 of them were delivered to the wrong address?

d) What is the probability that at least 2 of them were delivered to the wrong address?

Computing Binomial Distribution Probabilities using scipy.stats in Python

```
from scipy.stats import binom

binom.pmf(k=0, n=7, p=0.05) #P(X=0) when X ~ Binom(n=7, p=0.05)
binom.cdf(k=2, n=7, p=0.05) #P(X<=2)
binom.mean(n=7, p=0.05) #E(X)
binom.var(n=7, p=0.05) #Var(X)
```