Probability Review: Random Variables

Skills:

- Construct a probability distribution for a random variable
- Find the mean and standard deviation for a random variable
- Calculate binomial and geometric probabilities

Definition

A **random variable** holds the numeric (quantitative) result of a random experiment
This forces every experiment to result in a number
Variables come in two varieties…discrete and continuous.
(*we'll focus on discrete for now*)

The Distribution of a Variable

A Probability Distribution is something (graph, chart, etc.) that tells what values the variable can take, and how often it takes each value

For discrete variables, this is usually a chart/ table.

Remember that the probabilities must add up to 1

Describing a Distribution

Just like we did earlier, we want to find measures of **center** and **variation**
We'll let the calculator find the **mean** and **standard deviation**
Variable in L1
Probabilities in L2
1-Var Stats L1,L2

The Bad News

You'll have to show the work for these calculations...even though your calculator does them for you.

Expected Value

...this is a code phrase for the **mean**

Example

Five thousand lottery tickets are sold for \$1 each. One ticket will win \$1,000, two tickets will win \$500 each, and ten tickets will win \$100 each. Let X denote the net gain from the purchase of a randomly selected ticket.

[a] Construct the probability distribution of X.
[b] Compute the expected value of X.
[c] Compute the standard deviation σ of X.

Binomial Random Variables

- There must be a fixed number of trials
- Each trial can result in “success” or “failure”
- Each trial must be independent of the others
- Each trial must have the same probability for success
- The variable counts the number of successes that occurred

Binomial Probability

There is a formula to determine the probability of k successes in n trials of a binomial experiment

Let's just use the calculator, shall we?

Binompdf()

Using the Calculator

Put the values of x into L1
At the top of L2, use Binompdf()
On the home screen, sum(L2)

Mean and Standard Deviation

The mean of a binomial variable is $\mu_B = n \cdot p$

The standard deviation of a binomial variable is

$$\sigma_B = \sqrt{n \cdot p \cdot (1 - p)}$$

Example

Suppose that exactly 12% of teens aged 14 to 18 have debit cards. Let X = the number of teens in a random sample of size 50 who have a debit card.

[a] What's the probability that 5 or fewer have debit cards?
[b] How many should we expect to have debit cards?
[c] What is the standard deviation of the number with debit cards?

Geometric Random Variables

- The experiment is repeated until success occurs
- Each trial can result in “success” or “failure”
- Each trial must be independent of the others
- Each trial must have the same probability for success
- The variable counts the number of trials required to achieve one success

Geometric Probability

There is a formula to determine the probability of *k* trials to achieve one success in a geometric experiment...
Let's just use the calculator, shall we?
Geometpdf()

Example

Lawrence likes to shoot a bow and arrow in his free time. On any shot, he has about a 10% chance of hitting the bull's-eye. As a challenge one day, Lawrence decides to keep shooting until he gets a bull's-eye. Let Y = the number of shots he takes.

[a] What is the probability that it takes fewer than three shots?
[b] What is the probability that it takes more than three shots?