**Section 6.3 Notes: Geometric Distributions**

Let’s start with a simulation: Roll a die until the number six appears and keep a record of how many rolls it took before the six was obtained.

While in a binomial distribution the random variable was the number of successes in a fixed number of trials, in a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** the random variable is the number of trials it takes to achieve a success.

Examples: 1) flip a coin until you get heads

2) Roll a die until you get a 6

3) Throw darts at a dartboard until you hit the bull’s-eye

**What is a Geometric Distribution?**

1) Each trial in the experiment must have only two possible outcomes: \_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_

2) The probability of success, \_\_\_\_\_\_\_\_\_\_, does not change from trial to trial

3) The trials in the experiment are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4) The variable of interest is the number of trials required to reach the first success.

**Example:** We will take our simulation example to analyze various aspects of the geometric distribution.

Let’s first find the various probabilities associated with our dice simulation and come up with a probability distribution:

a.) The probability that a 6 will come up on the first roll is…

b.) The probability that a 6 will come up on the second roll is the probability that it WON’T come up on the first roll AND that it WILL come up on the second roll.

c.) The probability that a 6 will come up on the third roll is the probability that it WON’T come up on the first roll AND that it WON’T come up on the second roll AND that it WILL come up on the third roll.

d.) If we proceed in the manner above will come up with the following probability distribution:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| X | 1 | 2 | 3 | 4 | 5 | n |
| P(X) |  |  |  |  |  |  |

To find the **Probability** for a geometric distribution:

The **probability** that it takes ***more than*** n trials to see a success is:

The **Mean/Expected Value** of a geometric distribution (the average number of times we can expect to repeat the trials before a success occurs)

The **Variance/Standard Deviation** of a geometric distribution is

**Example continued…**How many times, on average, would you expect to roll the die until a 6 is obtained? What is the standard deviation for the distribution?

**Example 2:** Suppose we have data that suggest that 3% of a company’s hard disk drives are defective.

1. What is the probability that the first defective hard drive is the second unit tested?
2. What is the probabiltiy that the first defective hard drive is the fifth unit tested?
3. What is the probabiltiy that it will take more than 3 trials to find a defective hard drive?
4. How many hard drives would you expect to test before a defective one is identified?