6.3 Binomial and Geometric **Random Variables**

**Geometric Settings**

In a binomial setting, the number of trials *n* is fixed and the binomial random variable *X* counts the number of successes. In other situations, the goal is to repeat a chance behavior *until a success occurs*. These situations are called **geometric settings.**

The four conditions for a geometric setting are

1. **B**inary? The possible outcomes of each trial can be classified as “success” or “failure.”
2. **I**ndependent?Trials must be independent; that is, knowing the result of one trial must not have any effect on the result of any other trial.
3. **T**rials?The goal is to count the number of trials until the first success occurs*.*
4. **S**uccess?On each trial, the probability *p* of success must be the same.

The number of trials *Y* that it takes to get a success in a geometric setting is a **geometric random variable.** The probability distribution of *Y* is a **geometric distribution** with parameter *p*, the probability of a success on any trial. The possible values of *Y* are 1, 2, 3, ….

Example: The Birthday Game

The random variable of interest in this game is *Y* = the number of guesses it takes to correctly identify the birth day of one of your teacher’s friends. What is the probability the first student guesses correctly? The second? Third? What is the probability the *k*th student guesses corrrectly?

**Verify Y is a geometric random variable**

**Calculate *P*(*Y* = 1), *P*(*Y* = 2), *P*(*Y* = 3), and *P*(*Y* = k)**

**Geometric Probability**

If *Y* has the geometric distribution with probability *p* of success on each trial, the possible values of *Y* are 1, 2, 3, … . If *k* is any one of these values,



**Using the Calculator for Geometric Probabilities**

**For the probability of a single value**

Menu --- 5 Probability --- 5 Distributions --- F Geometric PDF

**For the probability of multiple values**

Menu --- 5 Probability --- 5 Distributions --- G Geometric CDF

Example: Inheriting Blood Type

Each child of a particular pair of parents has probability 0.25 of having blood type O.

**(a) Find the probability that the 3rd child is the first with type O**

1. **Find the probability that it takes no more than 2 children to have one with type O**

**(c) Find the probability that it takes more than 4 children to have one with type O**

**Mean of a Geometric Random Variable**

If Y is a geometric random variable with probability p of success on each trial, then its mean (expected value) is



Example: The Birthday Game