Chapter 11 Summary
Understanding Randomness

What have we learned?

- We will harness the power of randomness.
- A simulation model can help us investigate a question for which:
  - many outcomes are possible,
  - we can't (or don't want to) collect data, and
  - a mathematical answer is hard to calculate.
- We base our simulations on random values.
- Like all models, simulations can provide us with useful insights about the real world.

Why Be Random?

- What is it about chance outcomes being random that makes random selection seem fair? Two things:
  - Nobody can guess the outcome before it happens.
  - When we want things to be fair, usually some underlying set of outcomes will be equally likely (although in many games some combinations of outcomes are more likely than others).
- Example:
  - Pick "heads" or "tails."
  - Flip a fair coin. Does the outcome match your choice? Did you know before flipping the coin whether or not it would match?
- Statisticians don't think of randomness as the annoying tendency of things to be unpredictable or haphazard.
- Statisticians use randomness as a tool.
- But, truly random values are surprisingly hard to get…

It's Not Easy Being Random

- It's surprisingly difficult to generate random values even when they're equally likely.
- Computers have become a popular way to generate random numbers.
  - Even though they often do much better than humans, computers can't generate truly random numbers either.
  - Since computers follow programs, the "random" numbers we get from computers are really pseudorandom.
  - Fortunately, pseudorandom values are good enough for most purposes.
- There *are* ways to generate random numbers so that they are both equally likely and truly random.
- The best ways we know to generate data that give a fair and accurate picture of the world rely on randomness, and the ways in which we draw conclusions from those data depend on the randomness, too.

A Simulation

- A simulation consists of a collection of things that happen at random.
  - The most basic event is called a component of the simulation.
  - Each component has a set of possible outcomes, one of which will occur at random.

A Simulation (cont.)

- The sequence of events we want to investigate is called a trial.
    - Trials usually involve several components.
    - After the trial, we record what happened—our response variable.

There are seven steps to a simulation…

1. Identify the component to be repeated.
2. Explain how you will model the outcome.
3. Explain how you will simulate the trial.
4. State clearly what the response variable is.
5. Run several trials.
6. Analyze the response variable.
7. State your conclusion (in the context of the problem, as always).

What Can Go Wrong?

- Don't overstate your case.
    - Always be sure to indicate that future results will not match your simulated results exactly.
- Model the outcome chances accurately.
- Run enough trials.