

Chapter 11

Understanding Randomness

At the end of this chapter, you should be able to

- Identify a random event.
- Describe the properties of random events.
- Use random number table to study random events.

What is Randomness?

- Random events
 - Outcome unknown before event
 - No Structure in Short Term
 - Structure in Long Term

Examples of Random Events

- Flipping a coin
- Rolling a die
- Shuffling your playlist
- Lottery

Models for Random Events

- Flipping a coin
 - 50% Heads, 50% Tails
- Rolling a die
 - $1/6$ 1, $1/6$ 2, $1/6$ 3, $1/6$ 4, $1/6$ 5, $1/6$ 6

Random Events and Simulations

- If you flip a coin 10 times, what proportion of times will you get 7 or more heads?
- How many rolls of a die are needed to obtain the first 6?

Simulations

- Based on Random Event
- Use Random Numbers
- Should do many trials to get accurate estimate.

How do we get random numbers?

- Computers?
 - Pseudorandom numbers
- Random events
 - Radioactive decay
 - Random movements of molecules
- Table in Appendix E
 - List of numbers 0 through 9.
 - Organized by rows and in columns of 5.

Simulation - Coins

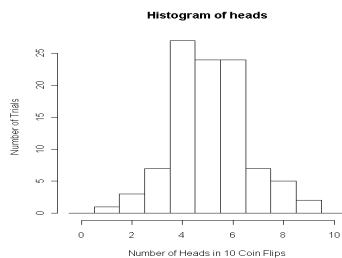
- Flip a Coin
 - 0,1,2,3,4 Heads
 - 5,6,7,8,9 Tails
- Repeat for 10 Flips
- Count Number of Heads
- Simulate many times

Simulation

Random Numbers

Trial 1 = 0 7 1 0 2 1 1 5 5 7 _____
Trial 2 = 3 3 6 6 5 3 0 4 0 3 _____
Trial 3 = 9 1 3 1 1 9 9 2 3 5 _____
Trial 4 = 3 6 2 8 6 3 5 0 1 3 _____
Trial 5 = 4 3 1 0 9 8 1 0 8 7 _____
Trial 6 = 0 7 9 0 8 4 0 1 8 7 _____
Trial 7 = 9 6 8 3 9 0 1 1 5 0 _____
Trial 8 = 6 8 3 0 1 6 3 5 5 8 _____
Trial 9 = 5 6 4 6 9 0 2 6 5 4 _____
Trial 10 = 1 4 5 6 4 0 6 8 3 9 _____

Many More Trials



Simulation – Dice

- Roll a Die
 - 1,2,3,4,5,6 = Number on Die
 - 7,8,9,0 = Nothing, Throw Out
- Continue “Rolling” Until 6 Appears
- Count Number of Rolls
- Simulate many times

Random Digits

0 1 4 0 4 8 2 9 4 8 2 6 2 6 9 0 1 7 9 1
 9 5 5 4 8 6 6 5 0 6 7 0 1 6 4 7 8 3 7 0
 6 2 1 3 6 7 9 2 5 4 9 9 9 5 6 0 9 4 7 9
 1 9 5 2 2 7 9 4 9 8 6 8 7 0 8 7 9 6 1 7
 9 3 8 4 8 4 7 5 7 3 5 5 6 4 6 6 0 9 8 1
 0 5 9 3 5 3 6 8 7 8 9 5 9 3 5 3 2 4 8 5
 4 5 6 3 5 0 6 9 8 7 9 2 3 6 6 3 2 3 9 0
 4 4 0 1 4 5 5 6 4 5 4 7 9 0 3 6 0 5 8 4
 4 4 8 5 5 8 1 1 0 0 8 4 2 2 7 5 2 0 8 6
 3 1 7 7 5 9 1 1 4 9 9 2 3 9 8 8 3 0 0 7

Random Digits (Remove 7,8,9,0)

1 4 4 2 4 2 6 2 6 1 1 5 5 4 6 6 5 6 1
 6 4 3 6 2 1 3 6 2 5 4 5 6 4 1 5 2 2 4
 6 6 1 3 4 4 5 3 5 5 6 4 6 6 1 5 3 5 3
 6 5 3 5 3 2 4 5 4 5 6 3 5 6 2 3 6 6 3
 2 3 4 4 1 4 5 5 6 4 5 4 3 6 5 4 4 4 5
 5 1 1 4 2 2 5 2 6 3 1 5 1 1 4 2 3 3

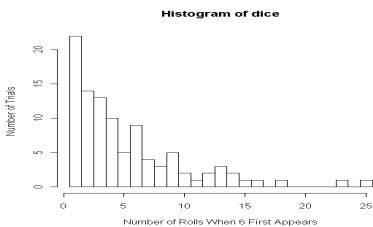
Find 6's

Trial 1 - 1 4 4 2 4 2 6 _____
 Trial 2 - 2 6 _____
 Trial 3 - 1 1 5 5 4 6 _____
 Trial 4 - 6 _____
 Trial 5 - 5 6 _____
 Trial 6 - 1 6 _____
 Trial 7 - 4 3 6 _____
 Trial 8 - 2 1 3 6 _____
 Trial 9 - 2 5 4 5 6 _____
 Trial 10 - 4 1 5 2 2 4 6 _____

Find 6's

Trial 11 - 6 _____
 Trial 12 - 1 3 4 4 5 3 5 5 6 _____
 Trial 13 - 4 6 _____
 Trial 14 - 6 _____
 Trial 15 - 1 5 3 5 3 6 _____
 Trial 16 - 5 3 5 3 2 4 5 4 5 6 _____
 Trial 17 - 3 5 6 _____
 Trial 18 - 2 3 6 _____
 Trial 19 - 6 _____
 Trial 20 - 3 2 3 4 4 1 4 5 5 6 _____

Many More Trials



Random Events

- Basis of many investigations in Statistics.
- Perform Simulations to understand Long-Term behavior.
- Use these ideas to look at
 - Random Samples
 - Randomized Experiments