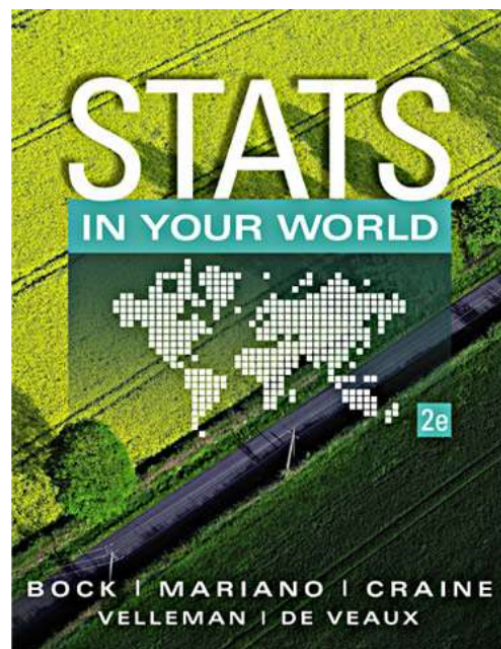


Chapter 12

Let Me Count the Ways



Dealing with Random Phenomena

- World is full of random events.
- Some events are predictable: change of seasons, eclipses, and weather.
- Many others are still essentially random: stock market, next car to pass by, and quantum mechanics.
- Understand randomness . . . in the long run, even truly random phenomena settle down in a way that's consistent and predictable.

The Law of Large Numbers

First a definition . . .

- When thinking about what happens with combinations of outcomes, things are simplified if the individual trials are **independent**.
 - This means that the outcome of one trial doesn't influence or change the outcome of another.
 - For example, coin flips are independent. Flipping heads several times in a row doesn't mean that the next flip is more likely to be tails.

I Have Magic Powers...

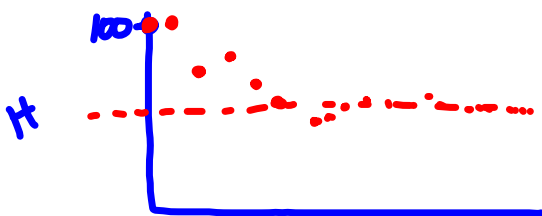
- On one side of the paper, write down what you would expect to see in 100 coin flips.
- On the other side of the paper, do 100 actual coin flips, recording the results.
- I will tell you which was the actual and which was your prediction.

The Law of Large Numbers (cont.)

Long Term
TRUE

~~✗~~ The Law of Large Numbers (LLN) says that as the number of independent trials increases, the long-run *relative frequency* of repeated events gets closer and closer to some value.

- The LLN guarantees that relative frequencies settle down in the long run, and we call the value that they approach the probability of the event.



H H T H T T T T H H H

LLN Experiment

- Randomly select cards 1 at a time and record the suit (H, S, C, D) for 100 trials. Be sure to shuffle between picks.
- Record the cumulative probability for selecting a Heart after each 25 trials (ex. $8/25$, $13/50$, $x/75$, $y/100$)
- We expect the LLN to tell us that the probability of selecting a Heart will settle out around _____.
- The more trials to complete, the closer the probability will get to _____.

The Nonexistent Law of Averages

short-term
FALSE!

- The LLN says nothing about short-run behavior.
- Relative frequencies even out *only in the long run*, and this long run is *really* long (*infinitely* long, in fact).

~~✗~~ The so called Law of Averages (that an outcome of a random event that hasn't occurred in many trials is "due" to occur) doesn't exist at all.

Ex: LofA says many heads in a row would cause there to be "due" a tail.

Homework:

Read pg. 288 - 294

Pg. 305 #8, 10, 13, 14

8. **Roulette** A casino claims that its roulette wheel is truly random. What should that claim mean?
10. **Survival** A doctor tells a patient just diagnosed with a serious disease that there's a 60% chance she'll live at least 5 years. Where do you think that probability comes from?

13. **Snow** After an unusually dry autumn, a radio announcer is heard to say, "Watch out! We'll pay for these sunny days later on this winter." Explain what he's trying to say, and comment on the validity of his reasoning.

14. **Cold streak** A batter who had failed to get a hit in seven consecutive times at bat then hits a gamewinning home run. When talking to reporters afterward, he says he was very confident that last time at bat because he knew he was "due for a hit."
Comment on his reasoning.