Crafting with Data

Reality, Illusions, Truth & the Future

Instructor: Rob Faludi

Plan for Today

- IRB
- Coin Tosses
- Exercise Zero: Birthdays
- Exercise One: Measuring
- Present New York Data project results
- Probability
- Readings & Assignments

IRB Results

- Please hand in your IRB test passing grade

Coin tosses

- Please hand in your coin toss results, identified only with your name

Feeling Random

- recognize
- trust
- patternlessness as a pattern
- hard to do

Exercise Zero: Birthdays

- What's your birthday?
- Any matches?
- What day of the month were you born?
- Any matches?
- RANDOM ISN'T ALWAYS WHAT WE EXPECT

Exercise One: Measuring

- Individually, measure how tall your classmates are
    - Try to use a unique method
    - Do not share answers
    - Write down your results
- When you are done, we'll go around the room and add each measurement to our database, examine the data and plot the data
- Histograms in spreadsheets: BINS, FREQUENCY, CHARTS

Histograms in Spreadsheets

- data
- uniform
- normal
- bins
- frequency
- charts

Coincidences

- million events per day
- things become sure to occur together
- pattern-seeking

New York Data: Results

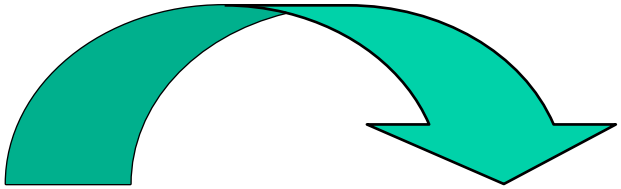
- question you had
- how you collected data
- analysis attempted
- answers you may now have

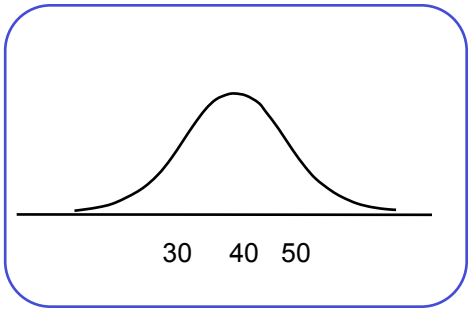
Probability

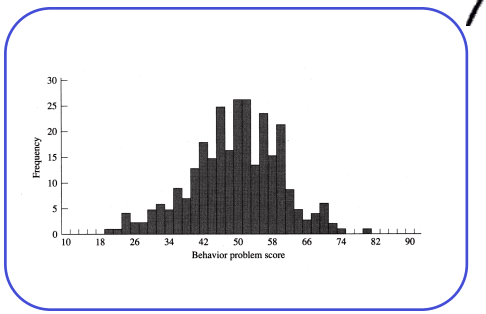
...with thanks to Larry Maloney

Nature

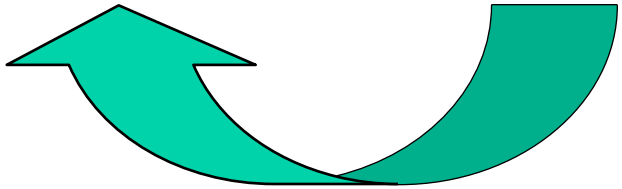
Experimentation







Scientist



Data Analysis

Mathematical Probability

Probability of an event

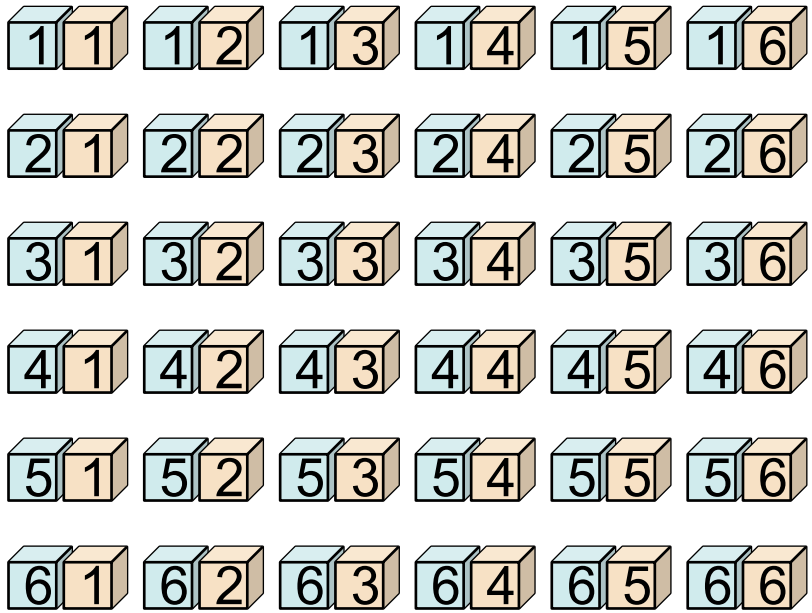
$$P[A] = \sum p_i$$

A. N. Kolmogorov

Mathematical Probability

Examples

$$p_i = 1/36$$

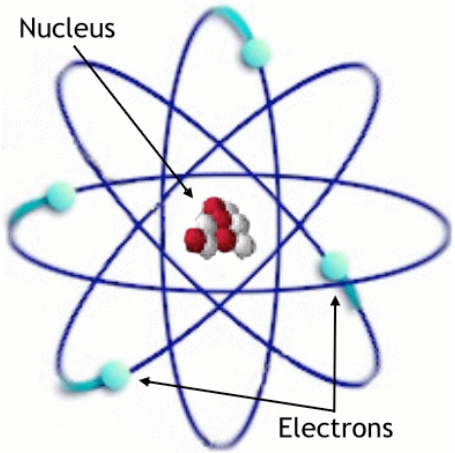


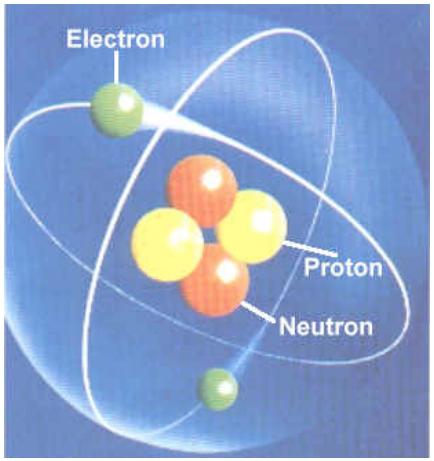
Two Dice

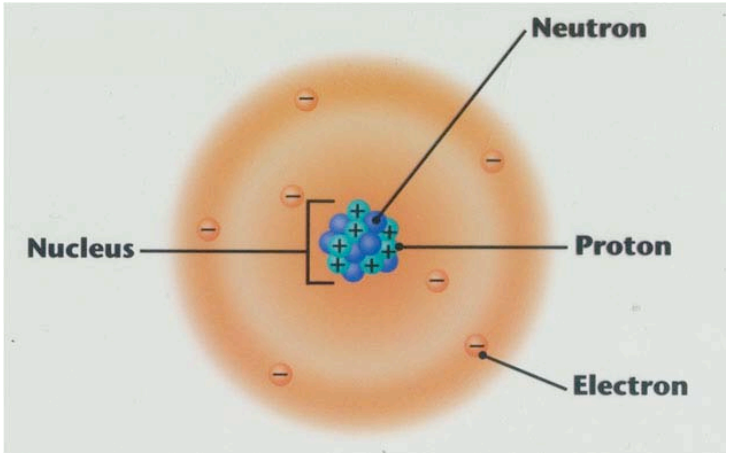
36 outcomes

What Causes Random?

- random is the meaningless part in confirmation and prediction
- not clear on what causes it
- quantum mechanics
- electron cloud
- parallel universes (Hugh Everett)
- structure?

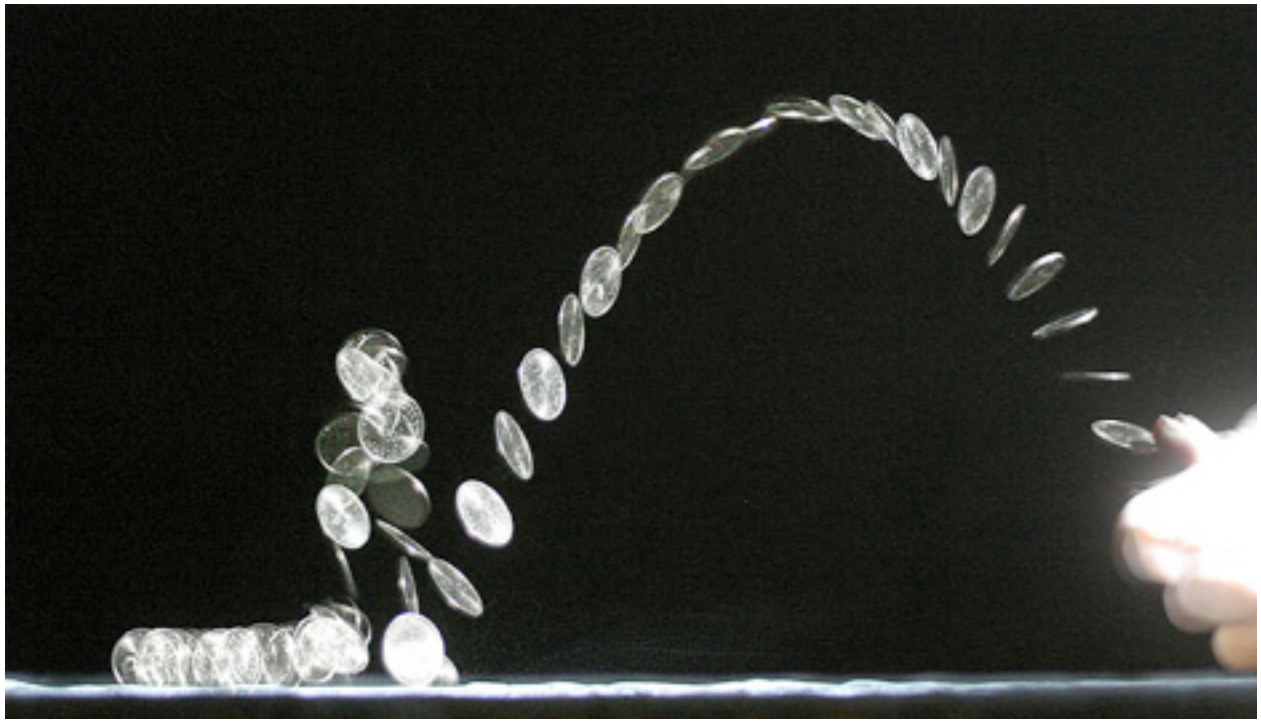






Cumulative Probability

$$P[AB] = P[A] * P[B]$$



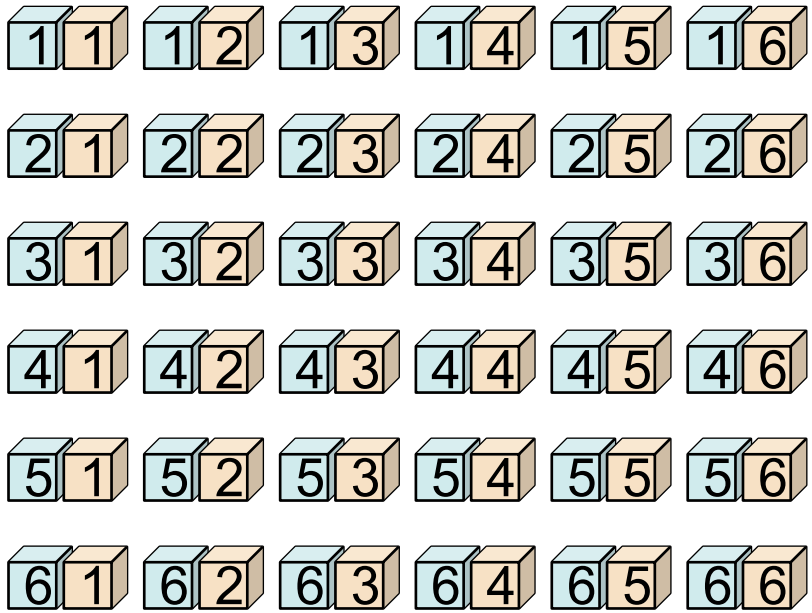
Conditional Probability

$$P[A \mid B] = P[AB] / P[B] \qquad if \; P\Big[B\Big] \neq 0$$

Mathematical Probability

Examples

$$p_i = 1/36$$



Two Dice

36 outcomes

One-in-a-million

- happens
- always happens
- three-in-a-row
- what's random will become predictable

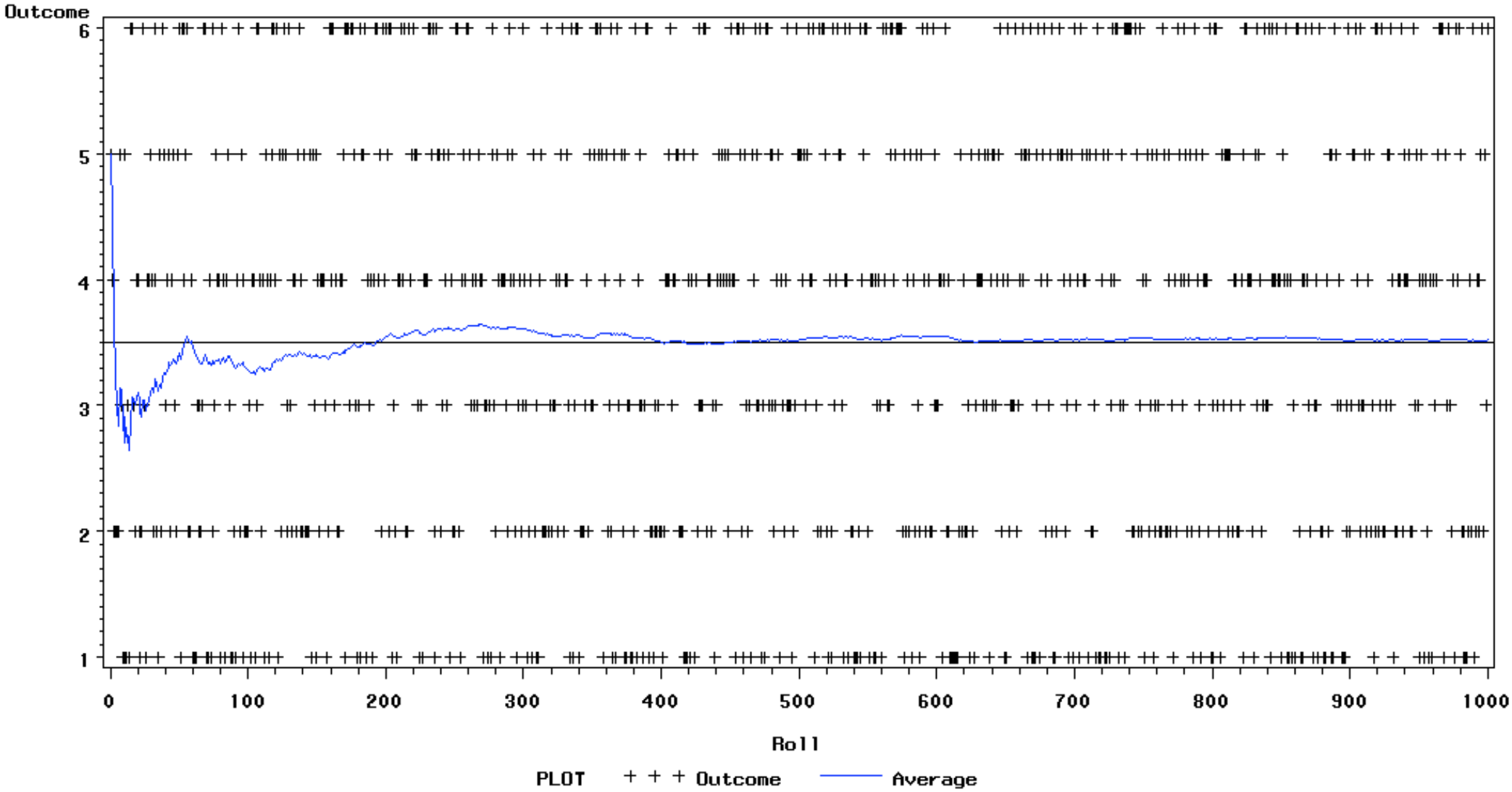
Law of Large Numbers

- All about the mean of a distribution

- sample average converges to the expected mean as *n* increases

LAW OF LARGE NUMBERS IN AVERAGE OF DIE ROLLS

AVERAGE CONVERGES TO EXPECTED VALUE OF 3.5



Central Limit Theorem

- All about the shape of the distribution

- As the sample size n increases, the distribution of the sample average of these random variables approaches the normal distribution with a mean μ and variance σ2 / n irrespective of the shape of the original distribution.

Hands-on Statistics

http://www.mathsisfun.com/probability/quincunx.html

Anyone who considers arithmetical methods of producing random digits is, of course, in a state of sin.

-- John von Neumann

Random in Processing, Arduino

- random()
- http://processing.org/reference/random_.html
- http://www.arduino.cc/en/Reference/Random
- randomSeed()
- http://processing.org/reference/randomSeed_.html
- http://arduino.cc/en/Reference/RandomSeed

Statistics in Java

- http://commons.apache.org/math/
- http://commons.apache.org/math/userguide/stat.html

Readings and Assignments

- Readings
  - none this week, *you have plenty to do*
- Assignments
  - New York assignment: revise and re-present a final view of your data.
  - Build either a real quincunx OR make a program to simulate a quincunx (or if you're feeling inspired, build any device or program that incorporates the probability density distribution (normal curve) in its fundamental operation)