YData: An Introduction to Data Science

Lecture 14: Chance

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Credit: data8.org

Announcements

For today

- Control statements
- Some elementary probability
- The Monty Hall puzzle

Control Statements

Control Statements

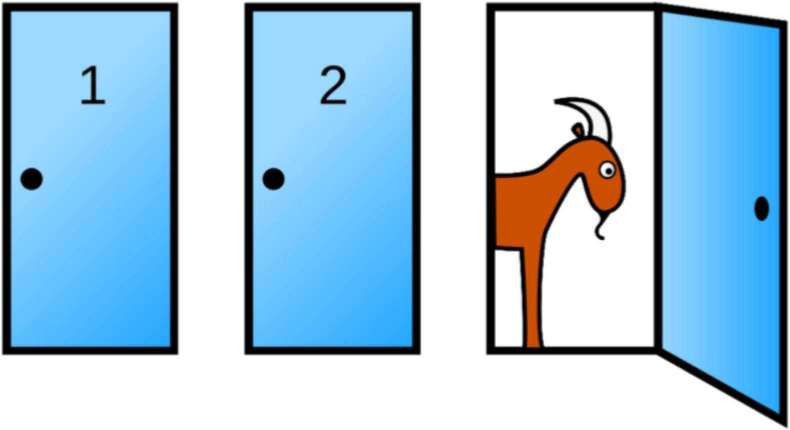
These statements control the sequence of computations that are performed in a program

- The keywords `if` and `for` begin control statements
- The purpose of `if` is to define functions that choose different behavior based on their arguments
- The purpose of `for` is to perform a computation for every element in a list or array

(DEMO)

The Monty Hall Problem

Monty Hall Problem



Probability

Basics

- Lowest value: 0
  - Chance of event that is impossible
- Highest value: 1 (or 100%)
  - Chance of event that is certain

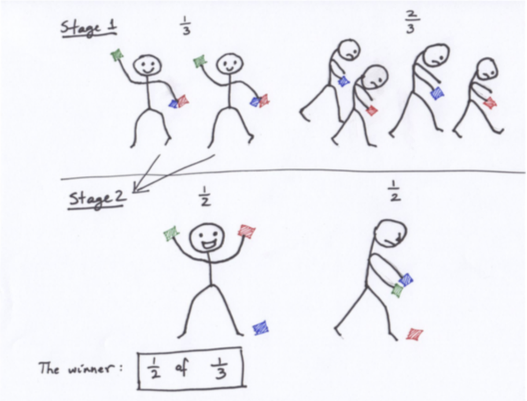
- If an event has chance 70%, then the chance that it doesn't happen is
  - 100% - 70% = 30%
  - 1 - 0.7 = 0.3

Equally Likely Outcomes

Assuming all outcomes are equally likely, the chance of an event A is:

$$P(A) = \frac{\text{number of outcomes that make A happen}}{\text{total number of outcomes}}$$

Fraction of a Fraction



- There are three tickets: Red Green Blue
- What's the chance of GR when sampling two tickets *without* replacement?
  RB RG BR BG GR GB $\implies$ P(GR) $= 1/6$

Multiplication Rule (aka the Chain Rule)

Chance that two events A and B both happen

$$= \text{P(A happens)} \times \text{P(B happens given that A has happened)}$$

- The answer is *less than or equal to* each of the two chances being multiplied
- The more conditions you have to satisfy, the less likely you are to satisfy them all

- Tickets: Red Green Blue: What's the chance of GR when sampling two tickets without replacement?

  RB RG BR BG GR GB $\implies$ P(GR) $= 1/6$

  P(G) $= 1/3$, P(R given G) $= 1/2 \implies$ P(GR) $= 1/3 \times 1/2 = 1/6$

Addition Rule

If event A can happen in exactly one of two ways, then

$$\text{P(A)} = \text{P(first way)} + \text{P(second way)}$$

- The answer is greater than or equal to the chance of each individual way

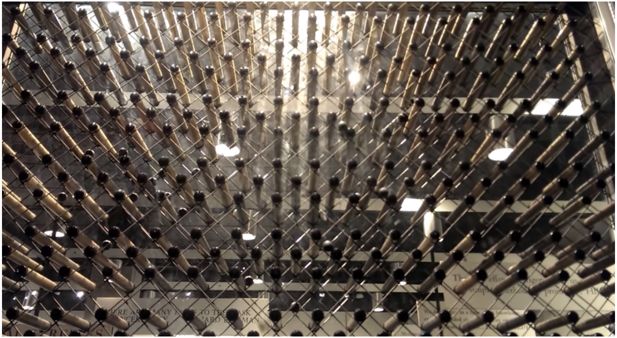
- Tickets: Red Green Blue: What is the chance of one R and one G?
  RB RG BR BG GR GB $\implies$
  $\text{P(one R and one G)} = \text{P(GR)} + \text{P(RG)} = 1/6 + 1/6$

Example: At Least One Head

- In 3 tosses:
  - Any outcome except TTT
  - P(TTT) $= (\frac{1}{2}) \times (\frac{1}{2}) \times (\frac{1}{2}) = \frac{1}{8}$
  - P(at least one head) $=$ 1 - P(TTT) $= \frac{7}{8} =$ 87.5%
- In 10 tosses:
  - 1 - $(\frac{1}{2})$**10
  - 99.9%

(DEMO)

Bean machine https://en.wikipedia.org/wiki/Bean_machine



https://www.youtube.com/watch?v=Asm7w6q7DsA

Food for Thought https://www.nytimes.com/2008/04/08/science/08tier.html