

# YData: An Introduction to Data Science

## Lecture 14: Chance

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Credit: [data8.org](https://data8.org)



# Announcements

# Control Statements

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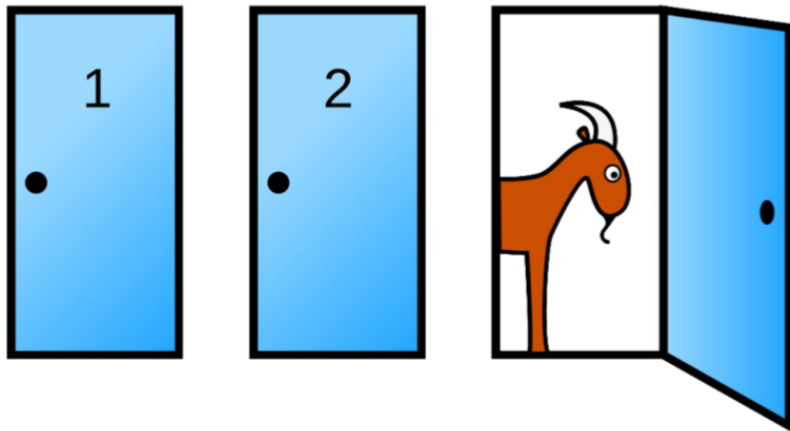
These statements control the sequence of computations that are performed in a program

- 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

- 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
  - $100\% - 70\% = 30\%$
  - $1 - 0.7 = 0.3$

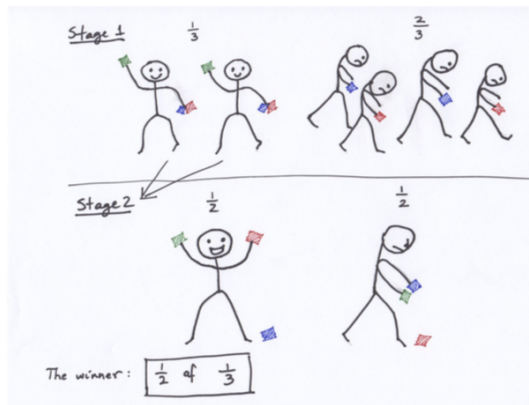


# Equally Likely Outcomes

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



- Tickets: Red Green Blue
- What's the chance of GR when sampling two cards without replacement?  
RB RG BR BG GR GB  $\implies P(\text{GR}) = 1/6$

# Multiplication Rule

Chance that two events A and B both happen

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

- 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 cards without replacement?

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

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

# Addition Rule

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

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

- 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  $\implies$   
 $P(\text{one R and one G}) = P(\text{GR}) + P(\text{RG}) = 1/6 + 1/6$

## Example: At Least One Head

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

(DEMO)