DATA 8

Spring 2020

Lecture 14

Chance and Probability

Weekly Goals

- **Today**
  - Simulation
  - Chances
- Wednesday
  - Methods of sampling
  - Distributions of large random samples
- Friday
  - Models that involve chance
  - Assessing the consistency of the data and the model

Announcements

- HW3 and Lab 4 regrades due tonight!
- HW5 due this Thursday (Wednesday for a bonus point)
- Project 1 due this Friday (Thursday for a bonus point)
  - If working with a partner:
    - only one person should submit
    - make sure that you *both* add each other as partners on okpy

Control Statements

Control Statements

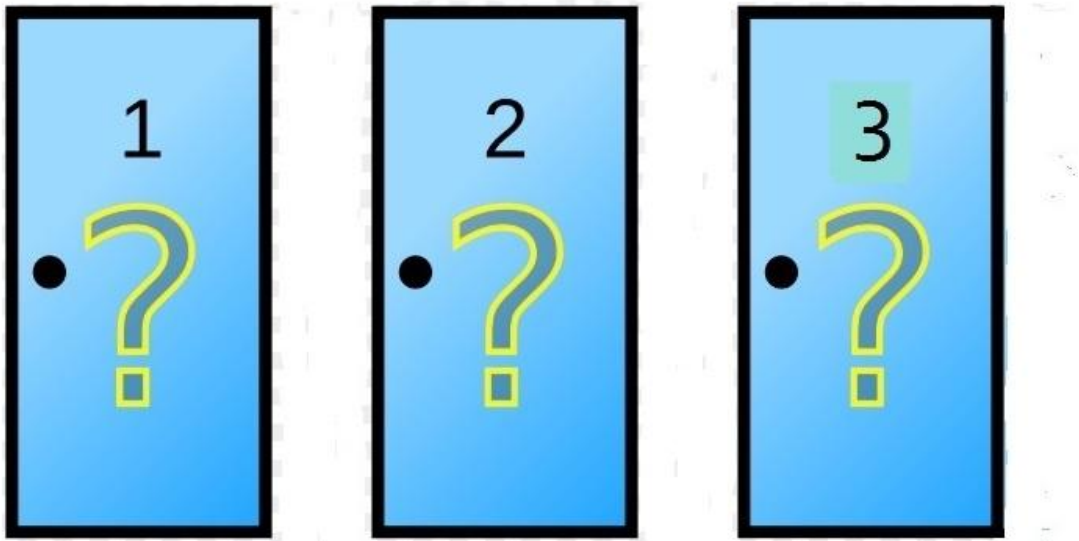
These statements *control* the sequence of computations that are performed in a program

- 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)

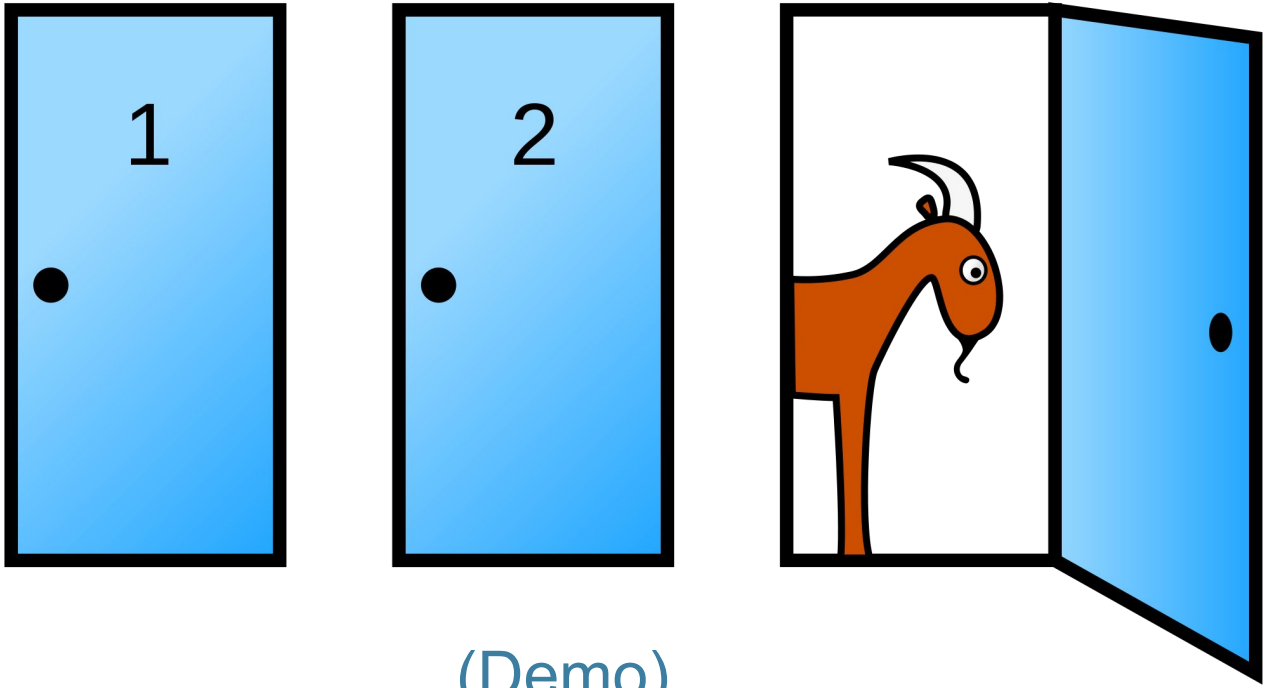
The Monty Hall Problem

Monty Hall Problem



https://probabilityandstats.files.wordpress.com/2017/05/monty-hall-pic-1.jpg

The Final Choice



https://en.wikipedia.org/wiki/Monty_Hall_problem

(Demo)

Probability

Basics

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

- **Complement**: 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:

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

A Question

- I have three cards: **ace of hearts**, **king of diamonds**, and **queen of spades**.
- I shuffle them and draw two cards *at random without replacement.*

- What is the chance that I get the Queen followed by the King?

(Demo)

Multiplication Rule

Chance that two events *A* and *B* both happen

= P(*A* happens) x 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

Another Question

- I have three cards: **ace of hearts**, **king of diamonds**, and **queen of spades**.
- I shuffle them and draw two cards *at random without replacement.*

- What is the chance that one of the cards I draw is a King and the other is Queen?

(Demo)

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

Complement: At Least One Head

- In 3 tosses:
  - Any outcome *except* TTT
  - P(TTT) = (1/2) x (1/2) x (1/2) = 1/8
  - P(at least one head) = 1 - P(TTT) = 1 - (1/8) = 87.5%

- In 10 tosses:
  - 1 - (1/2)**10 ≅ 99.9%

(Demo)