Mathematical Foundations

Introduction to Data Science Algorithms

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SLIDES ADAPTED FROM DAVE BLEI AND LAUREN HANNAH

Independence

Random variables X and Y are *independent* if and only if $P(X = x, Y = y) = P(X = x)P(Y = y)$.
Mathematical examples:

- If I flip a coin twice, is the second outcome independent from the first outcome?

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Mathematical examples:

- If I flip a coin twice, is the second outcome independent from the first outcome?

- If I draw two socks from my (multicolored) laundry, is the color of the first sock independent from the color of the second sock?

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Intuitive Examples:

- Independent:
  - you use a Mac / the Hop bus is on schedule
  - snowfall in the Himalayas / your favorite color is blue

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- Independent:
  - you use a Mac / the Hop bus is on schedule
  - snowfall in the Himalayas / your favorite color is blue
- Not independent:
  - you vote for Mitt Romney / you are a Republican
  - there is a traffic jam on 25 / the Broncos are playing

Independence

Sometimes we make convenient assumptions.

- the values of two dice (ignoring gravity!)
- the value of the first die and the sum of the values
- whether it is raining and the number of taxi cabs
- whether it is raining and the amount of time it takes me to hail a cab
- the first two words in a sentence