Probability Distributions: Discrete

Introduction to Data Science Algorithms

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Administrivia

- New grader: Aditya Thyagarajan
- HW1 grading nearly done
- Will appear in Moodle (waiting for late days)

Refresher: Random variables

- Random variables take on values in a *sample space*.
- This week we will focus on *discrete* random variables:
  - Coin flip: $\{H, T\}$
  - Number of times a coin lands heads after N flips: $\{0, 1, 2, \ldots, N\}$
  - Number of words in a document: Positive integers $\{1, 2, \ldots\}$
- Reminder: we denote the random variable with a capital letter; denote a outcome with a lower case letter.
  - E.g., X is a coin flip, x is the value (H or T) of that coin flip.

Refresher: Discrete distributions

- A discrete distribution assigns a probability to every possible outcome in the sample space
- For example, if X is a coin flip, then

$$\begin{aligned} P(X = H) &= 0.5 \\ P(X = T) &= 0.5 \end{aligned}$$

- Probabilities have to be greater than or equal to 0 and probabilities over the entire sample space must sum to one

$$\sum_{x} P(X = x) = 1$$

Mathematical Conventions

0!

If $n! = n \cdot (n-1)!$ then $0! = 1$ if definition holds for $n > 0$.

n^0

Example for 3:

$$3^2 = 9 \tag{1}$$

$$3^1 = 3 \tag{2}$$

$$3^{-1} = \frac{1}{3} \tag{3}$$

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Today: Types of discrete distributions

- There are many different types of discrete distributions, with different definitions.
- Today we'll look at the most common discrete distributions.
  - And we'll introduce the concept of *parameters*.
- These discrete distributions (along with the continuous distributions next) are fundamental
- Regression, classification, and clustering