Distribution Types

- Uniform sample spaces
- Coin, die, cards
- Non-uniform spaces
- Tetrahedral die

Uniform Probability Spaces

Generally, outcomes may have different probabilities

Rain P(rain) = 10% P(no rain) = 90%

Uniform (equiprobable) spaces Uniform distribution

All outcomes are equally likely

Coin P(h) = P(t) = ½

Drastically simplifies probability specification

Uniform Probability Spaces

All outcomes are equally likely

$\forall\, x \in \Omega \quad P(x) = p$

$1 = \sum_{x\in\Omega} P(x) = \sum_{x\in\Omega} p = |\Omega| \cdot p$

$p = 1/|\Omega|$

$\sum_{x\in\{3,5\}} x^2 = 3^2+5^2 = 34$

$\sum_{x\in\{3,5\}} x = 3+5 = 8$

$\sum_{x\in\{3,5\}} p = p+p = 2p$

$\sum_{x\in\Omega} p = p+\ldots+p = |\Omega| \cdot p$

Fair coin $P(h) = P(t) = p$ $1 = P(h) + P(t) = 2\cdot p$ $p = ½$

Uniform spaces Every outcome has probability $1/|\Omega|$ Ⓤ

All you need to know is $|\Omega|$!

Notetation

Draw Uniformly, Randomly

Fair Coin

$\Omega = \{ \text{heads, tails} \} = \{ h, t \}$

$|\Omega| = 2$

Flip, or toss

Equally likely $P(h) = P(t)$

Ⓤ $P(h) = P(t) = \frac{1}{|\Omega|} = \frac{1}{2}$

Fair Die

$\Omega = \{ 1, 2, 3, 4, 5, 6 \}$

$|\Omega| = 6$

Roll

Equally likely

$P(1) = \ldots = P(6)$

Ⓤ $P(1) = \ldots = P(6) = \frac{1}{|\Omega|} = \frac{1}{6}$

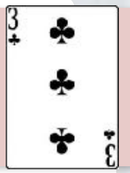
Deck of Cards

$\Omega = \{ \text{cards} \}$

$|\Omega| = 52$

Draw a card

Equally likely $\textcircled{U}$

$$P(\text{  }) = \ldots = P(\text{  }) = \frac{1}{|\Omega|} = \frac{1}{52}$$

Uniform → Non

Uniform, equiprobable, spaces

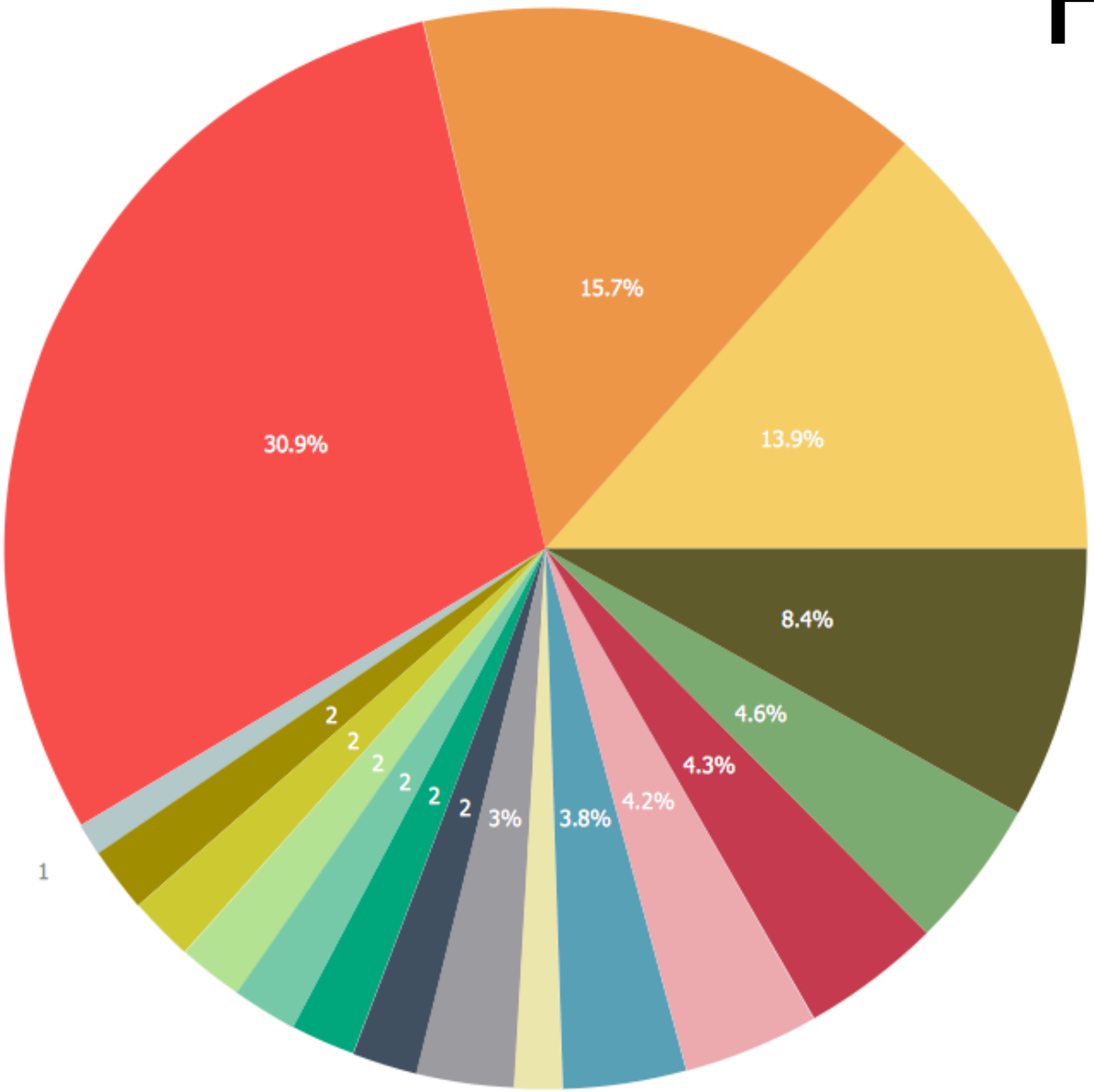
Coin Die Cards

In nature, nonuniform spaces abound

rain grades words illnesses

web pages people ….

Pie Chart



- Financial professions, including management
- Medical
- Executives, managers, supervisors (non-finance)
- Pilots
- Farmers & ranchers
- Government, teachers, social services
- Unknown
- Arts, media, sports
- Professors and scientists
- Entrepreneur not elsewhere classified
- Business operations (non-finance)
- Real estate
- Blue collar or miscellaneous service
- Skilled sales (except finance or real real estate)
- Not working or deceased
- Computer, math, engineering, technical
- Lawyers

Challenge

Non-uniform distribution we can remember

Tetrahedral Die

4-sided, pyramid die

Used in games, D&D

In games die equiprobable

We assume different probabilities

Easy to remember

Face	1	2	3	4
Probability	.1	.2	.3	.4

Conveniently, add to 1

Probability distribution

Do’s and Don’ts

Random notation may be confusing at first

Which expressions are valid?

P(X = 3)

fair die: ⅙

P(3)

$\stackrel{\text{def}}{=}$ P(X = 3)

P(x)

specify x, e.g., for ∀x, P(x)=¼

P(1 = 3)

0

P(X)

random value

Possible, but less common.
Make sure it's what you mean.

P(x = 3)

Even less likely, probably wrong

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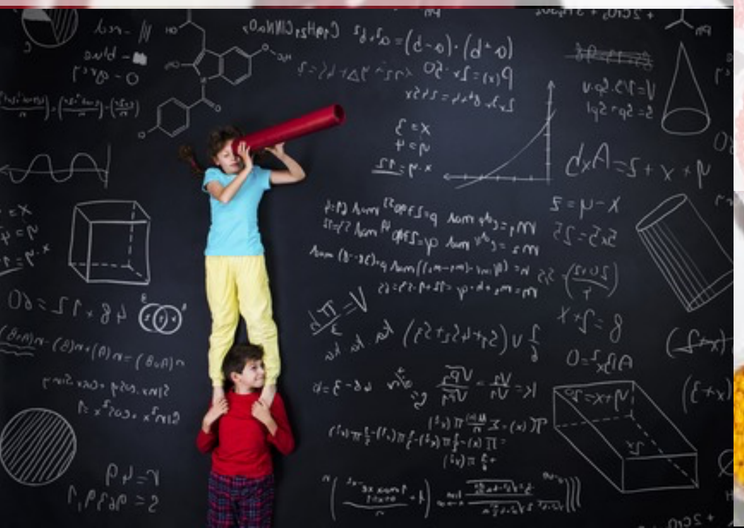

Events