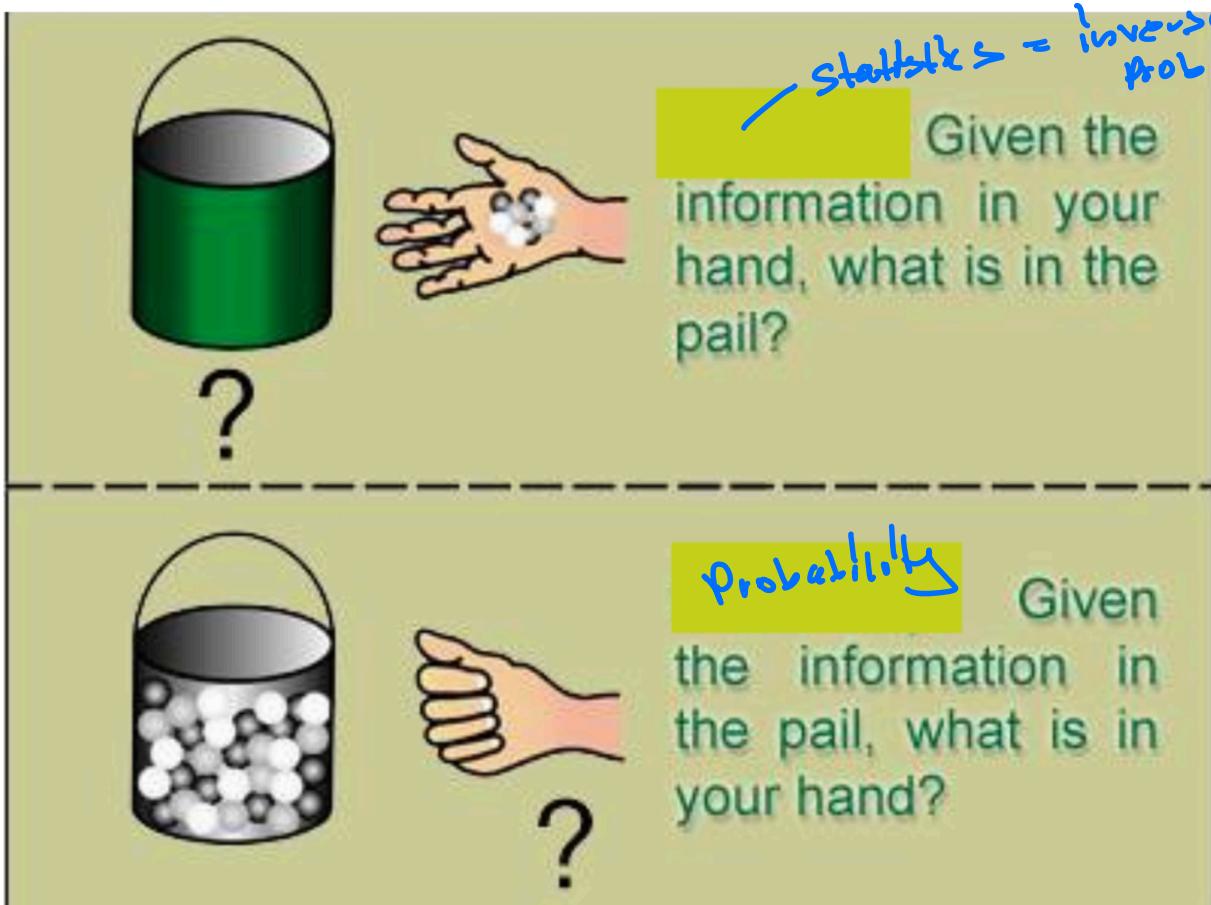


warmup

Which is Probability and Which is Statistics?



- Today
- ① Go over syllabus
 - ② Introduce Mike
 - ③ Sections 1.1 - 1.3

Stat 134: Concepts of Probability, Fall 2022

Instructor: Adam Lucas

Lectures: MWF 9-10am 2050 Valley Life Sciences

Email: alucas@berkeley.edu

This class isn't recorded

OFFICE HOURS: MWF 10am after class in the Student Learning Center Atrium

TEXT: *Probability* by Jim Pitman. Students can view and download the text online at [SpringerLink](#) (campus network access required). An affordable paperback copy may also be purchased through this link.

GSIs:

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Office hours of the GSIs are held in the Student Learning Center. Times will be posted on the Stat 134 webpage.

Prerequisites: Mastery of the material in Appendices 1-4 of the text, fluency with calculus (derivatives and integrals) in two variables, and – these are crucial – clear logical reasoning and strong problem-solving skills. Test yourself on some [practice problems](#).

Class website: The primary class website is <http://www.stat134.org/>. This will contain lecture notes and video links. B-courses is a secondary website for the class. I will post pre-lecture notes on b-courses/pages for you to download before class.

Ed Discussion: There will be a student run Ed Discussion site for this class (Ed Discussion is equivalent to Piazza). You can find a link to Ed Discussion in bCourses. The top 10 student answers (i.e. students who respond to other student's questions) will get up to 1% extra credit added to their final grade total in b-courses after the curve.

Homework:

- Assignments are posted on the Homework tab [here](#). They are usually due Wednesday on [Gradescope](#).
- Papers will be graded on a 0/1 scale. Each assignment will consist of 8 problems. A good attempt at 6 or more problems will receive the score of 1; anything else will get 0. Course staff will define what constitutes a "good attempt." We will be looking for reasoning and detailed work shown – it is assumed that you will show work or provide reasoning whether or not the question asks for it.

- Your **two lowest** homework scores will be dropped from the computation of the homework component of your final grade. If you add the class after the first HW is due you must use one of your drops.
- No late homework will be accepted and cheating will not be tolerated. While you are encouraged to work with other people, you must write up your own solutions.

Extra Credit: *Ed Discussion*

Be a top 10 Piazza answerer. This is also worth up to one percent EC.

Quizzes:

There will be three quizzes during the term, in section, on dates listed in the calendar below. There will be a convenient time for international students. You must take your quiz in the section in which you are enrolled. Students with DSP accommodations must contact Prof. Lucas to make arrangements as necessary.

Q1: Wednesday September 14

Q2: Monday September 26

Q3: Wednesday March 30

You can drop your lowest quiz score. We will attempt to keep the difficulty of the quizzes uniform but it is out of our control if students do better on one quiz than another and no normalization of quiz scores will be made.

Exams:

- Midterm 1: Wednesday October 5, class time
- Midterm 2: Friday November 18, take home midterm (details TBA)
- Final: Thursday December 15 7-10pm.

Grading:

The final will clobber the first midterm but not the second midterm.

The max of:

- 10% Homework, 15% Quizzes, 20% Midterm 1, 10% take home Midterm 2, 45% Final
- 10% Homework, 15% Quizzes, 10% take home Midterm 2, 65% Final

If you don't take the final exam you will not pass the class.

Your lowest two homework scores and your lowest quiz score will be dropped.

This class isn't graded on a curve. The following cutoffs for letter grades are as follows:

A+: top five or six students in the class

A: 80%

A-: 73%

B+: 69%

B: 60%

B-: 53%

C+: 48%

C: 41%

C-: 35%

F: < 35%

Based on historical averages, this results in approximately 30%A, 30%B, 30%C in the class.

Academic Honesty: Being an online class academic honesty is of particular concern. Please know that I take the Berkeley honor code very seriously and have years of experience catching cheaters. If we suspect someone of cheating, we reserve the right to give the student an oral quiz or exam and test if the student understands what they wrote.

Please familiarize yourself with UCBs Academic Honesty Policy (see the Center for Student Conduct website: <http://sa.berkeley.edu/conduct>). I encourage you to discuss homework problems with other students and to work together, but copying is never appropriate. (You should never write down anything you don't understand!) I strongly encourage you to familiarize yourself with the definition of *plagiarism*, and to avoid engaging in it. **Violations of the USB's Academic Honesty Policy, including instances of plagiarism, will be reported to the University** and an appropriate penalty will be implemented. (This may range from a failing grade on an assignment to an "F" for the course, in addition to writing letters of reflection and apology to USB's administration.)

Resources

Quick Links

Homework: <http://www.stat.berkeley.edu/~ani/s134s17/rec.html> The full list of assigned problems for the entire semester is posted at this link. There, you will also find helpful

strategies for tackling the problems - I highly recommend you read through it at least once

Reading Guide: <http://www.stat.berkeley.edu/~ani/s134s17/contents.html>

Students with Disabilities: Students needing accommodations should speak with me after class or during office hours and see <http://dsp.berkeley.edu> to learn about Berkeley's policy.

① Sec 1.1 Equally likely outcomes

We call the set of all outcomes of an experiment Ω , the outcome space, or the Sample space.

let $A \subseteq \Omega$

$$P(A) = \frac{\# A}{\# \Omega}$$

Deck of cards: $\frac{4 \text{ suits } H, C, D, S}{13 \text{ ranks } \text{Ace}, 2-10, J, Q, K} \frac{}{52 \text{ cards}}$

Ex #Se p 10
Suppose a deck of cards is shuffled and the top 2 cards are dealt. What is the chance you get at least one ace among the 2 cards

$$\begin{aligned} P(A) &= 1 - P(A^c) \\ &\quad (\text{no aces}) \\ &= 1 - \frac{48}{52} \cdot \frac{47}{51} = \boxed{.149} \end{aligned}$$

Ex Two draws are made at random with replacement from the box



Find the chance the 2nd number is bigger than twice the first.

$\Omega = \text{all pairs of numbers}$ ($\#\Omega = 10 \cdot 10 = 100$)

$$A = \begin{cases} (1, 2) - 8 \\ (2, 4) - 6 \\ (3, 6) - 4 \\ (4, 8) - 2 \end{cases} \quad \#\Omega = 20$$
$$P(A) = \frac{\#\Omega}{\#\Omega} = \frac{20}{100} = \boxed{.2}$$

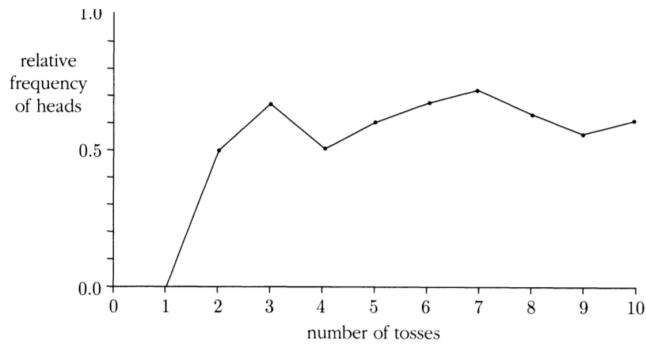
Sec 1.2 Interpretations

Probability has 2 interpretations

a) frequency interpretation.

~~ex~~ what is the probability a particular coin lands heads.

- make an experiment, Law of averages.



we often broaden the applications of probability:

b) subjective interpretation

~~ex~~ what is the probability a particular patient survives an operation?

Is there an answer to this question?

It depends on the health of the patient, the doctor etc.
we will discuss posterior probability and
Bayes rule in section 1.5.

Sec 1.3 Distributions

To define probability we start with an outcome space, \mathcal{R} , and assign to each element a non-negative number and require that all numbers add up to 1.

Axioms

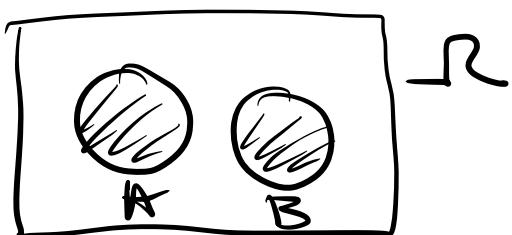
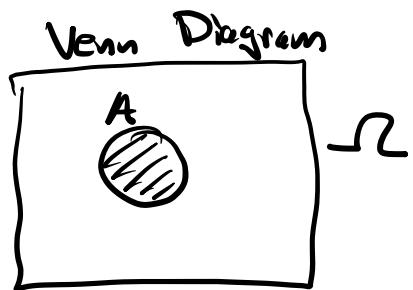
1) $P(A) \geq 0$ for all $A \subseteq \mathcal{R}$

2) $P(\mathcal{R}) = 1$

3) If A and B are mutually exclusive sets then

$$P(A \cup B) = P(A) + P(B)$$

(addition rule)

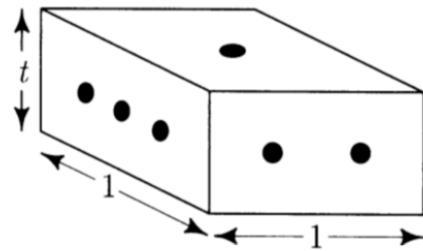
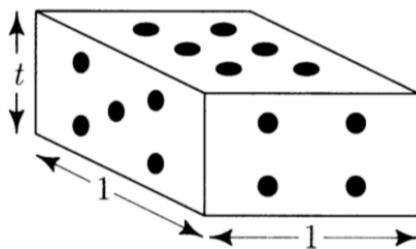


ex

Example 3. Shapes.

P 24

A *shape* is a 6-sided die with faces cut as shown in the following diagram:



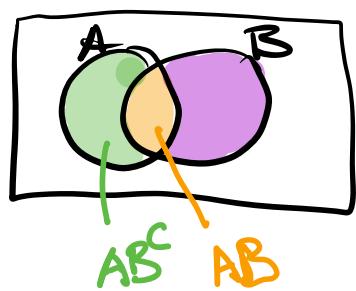
Suppose the thickness of the die, t , is such that the chance of landing flat (1 or 6) is $\frac{2}{3}$.

Find the probability distribution of the shape.
Draw a histogram.

$$\frac{1}{3} = 4 \cdot x \Rightarrow x = \frac{1}{12}$$



Difference rule



Prove a formula for $P(AB^c)$ in terms of $P(A)$ and $P(AB)$

$$A = AB^c \cup AB \quad \text{disjoint union}$$

by addition rule

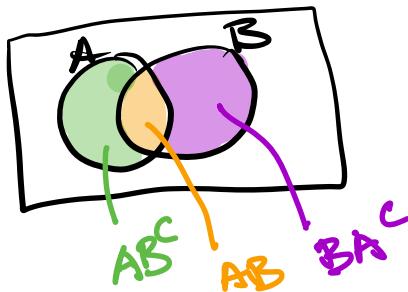
$$P(A) = P(AB^c) + P(AB)$$

$$\Rightarrow P(AB^c) = P(A) - P(AB)$$

Inclusion exclusion rule

$$P(A \cup B) = P(A) + P(B) - P(AB)$$

Proof/



$$A \cup B = AB^c \cup AB \cup BA^c \quad \text{disjoint union}$$

$$\begin{aligned} P(A \cup B) &= P(AB^c) + P(AB) + P(BA^c) && \text{addition rule} \\ &\quad \parallel && \parallel \\ P(A) - P(AB) && & P(B) - P(AB) \end{aligned}$$

by the difference rule discussed above.

$$= P(A) + P(B) - P(AB)$$