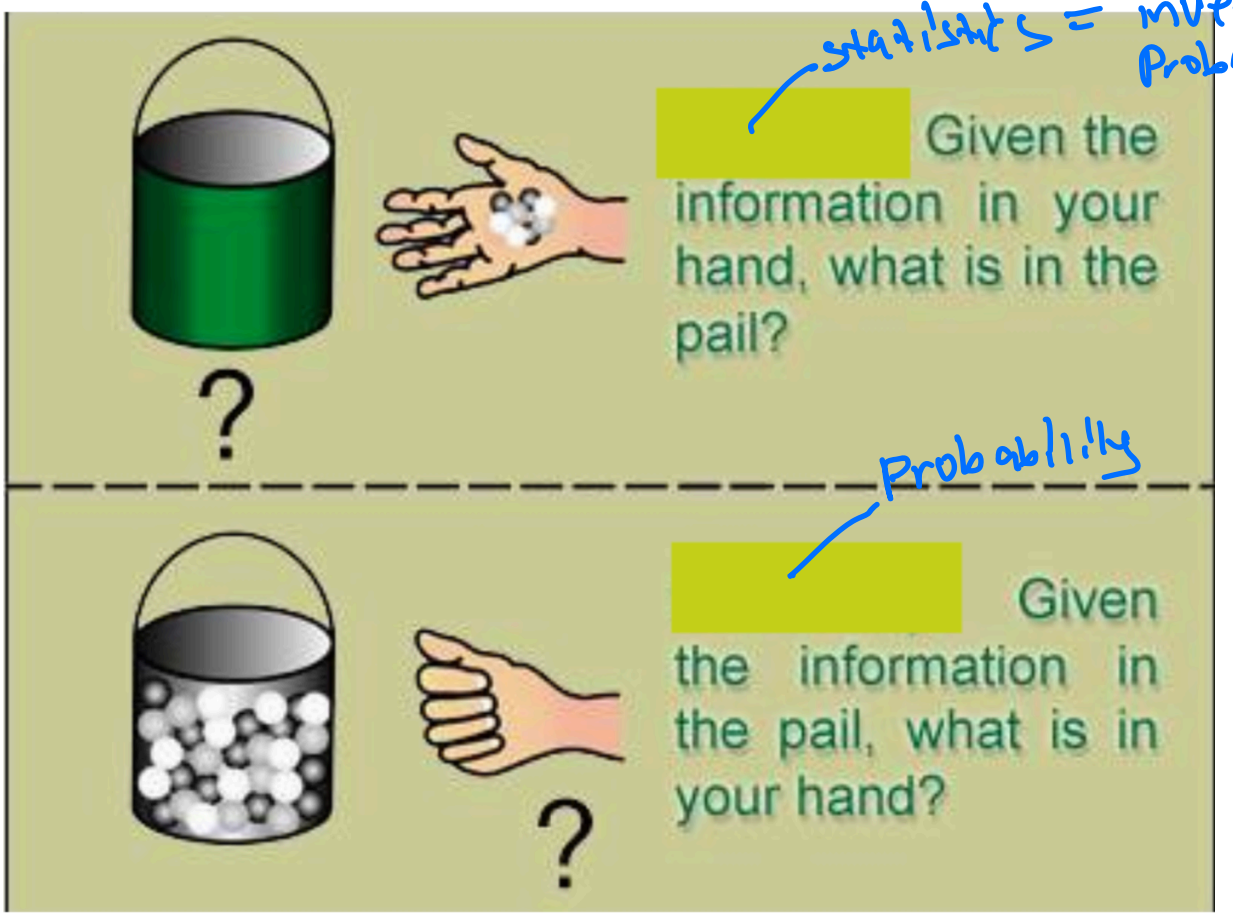
Stat 134 lec 1

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, Spring 2023

Instructor: Adam Lucas

Lectures: MWF 1-2 pm Dwinelle 155

Email: alucas@berkeley.edu

OFFICE HOURS: MWF 11-12pm 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.

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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 websites are http://www.stat134.org/ and bCourses. The Stat134.org website has section materials and info about office hours. bCourses has pre and post lecture notes, weekly homework solutions, quiz and exam solutions.

EdStem: There will be a student run EdStem site for this class. 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.

Daily Homework:

- Daily assignments (multiple choice) are posted on bCourses/Quizzes after each lecture and are due before the start of the next class.
- You are allowed multiple attempts and given the average score of the attempts.
- Your **lowest three** daily homework will be dropped.

Weekly Homework:

- Weekly 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 weekly 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:
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: Thursday February 2
Q2: Thursday February 16
Q3: Thursday March 23

You can drop your lowest quiz. 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 March 1, class time
- Midterm 2: Friday April 21, take home midterm (details TBA)
- Final: Tuesday May 9 8-11am.

Grading:

The final will clobber the first midterm **(only if you take it)** but not the second midterm.

The max of:

- 10% Weekly Homework, 5% Daily Homework, 10% Quizzes, 20% Midterm 1, 10% take home Midterm 2, 45% Final
- 10% Weekly Homework, 5% Daily Homework, 10% 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 weekly homework scores, your lowest three daily homework scores and your lowest quiz score will be dropped.

This class is graded on a curve so 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: 4 suits H, C, D, S
13 ranks Ace, 2–10, J, Q, K
52 Cards

ex (#Se p10) 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

A = get at least one ace among the 2 cards

$$P(A) = 1 - P(A^c) = 1 - \frac{48}{52}\cdot\frac{47}{51} = .149$$

$1 -$ ← complement rule; $P(A^c)$ ← no ace in 2 cards

Alternatively

$$P(A) = P(\text{ace, non ace}) + P(\text{non ace, ace}) + P(\text{ace, ace})$$

$$= \frac{4}{52}\cdot\frac{48}{51} + \frac{48}{52}\cdot\frac{4}{51} + \frac{4}{52}\cdot\frac{3}{51}$$

$$= \frac{2(4\cdot 48) + 4\cdot 3}{52\cdot 51} = .149$$

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

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

Ω = all pairs of numbers $\#\Omega = 100$

$A = \{ (1,>2) - 8,\ (2,>4) - 6,\ (3,>6) - 4,\ (4,>8) - 2 \}$

$\#A = 20$

$P(A) = \frac{\#A}{\#\Omega} = \frac{20}{100} = .2$

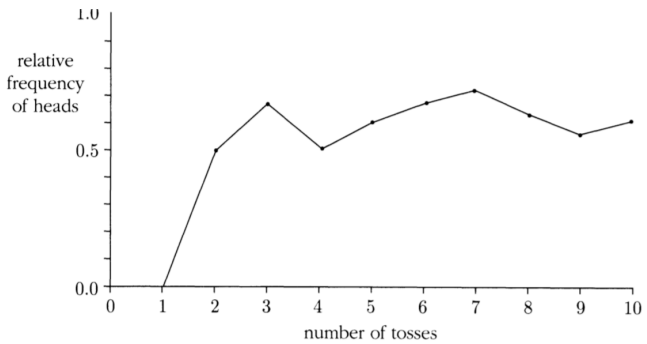
Sec 1.2 Interpretations

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 application 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, Ω, and assign to each element a nonnegative number and require that all numbers add up to 1.

Axioms

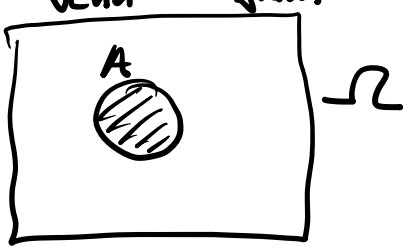
1) $P(A) \geq 0$ for all $A \subseteq \Omega$

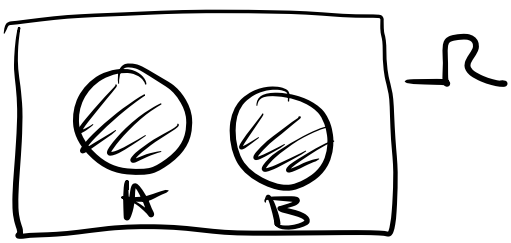
2) $P(\Omega) = 1$

3) If A and B are mutually exclusive sets then $P(A \cup B) = P(A) + P(B)$

(addition rule)

Venn Diagram

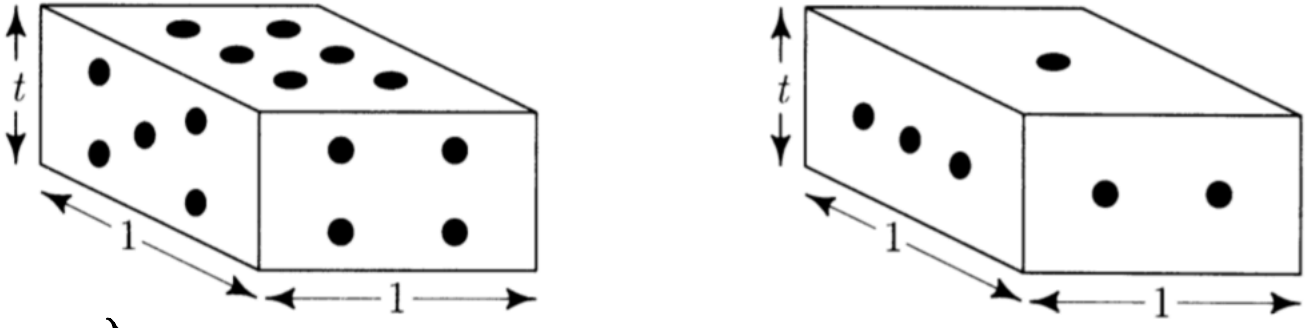




ex

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 $2/3$.

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

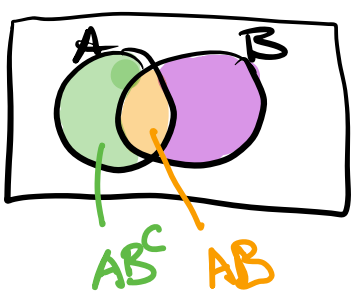
$\frac{1}{3} = 4 \cdot x$

↑ chance dont get 1 or 6

↑ chance of getting a non flat side

$\Rightarrow x = \frac{1}{12}$

Difference rule



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

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

$A = AB \cup AB^c$ disjoint union

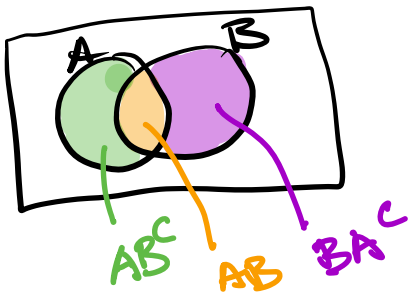
$P(A) = P(AB) + P(AB^c)$

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

Inclusion exclusion rule

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

Proof/



$A \cup B = AB^c \cup AB \cup BA^c$ disjoint union

$P(A \cup B) = P(AB^c) + P(AB) + P(BA^c)$ addition rule

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

$P(BA^c) = P(B) - P(AB)$

$= P(A) + P(B) - P(AB)$ difference rule.