# Stat 134 lec 1

**Today** 0) announcements
1) ice breaker
2) Sec 1.1 — Sec 1.3

0) announcements
- section starts today
- class website www.stat134.org
- schedule on website
- my OH is after class in SLC
- talk with Mike Leong mleong@berkeley.edu

Stat 198 starts tomorrow

- some student comments

> At the outset, this course is not incredibly difficult, especially if you have any prior experience with statistics or probability. However, the course definitely picks up in difficulty during the middle and towards the end of the course. I would recommend attending all the lectures, every discussion section, doing all of the homework, doing the readings, and doing the practice problems provided on the course website. Online solutions can definitely help get through some problems, but I would advise not relying on online solutions too heavily as you might not develop the intuition, understanding, and knowledge necessary to perform well on the quizzes and tests.

> Do not fall behind and write the pre lectures notes before going to lecture

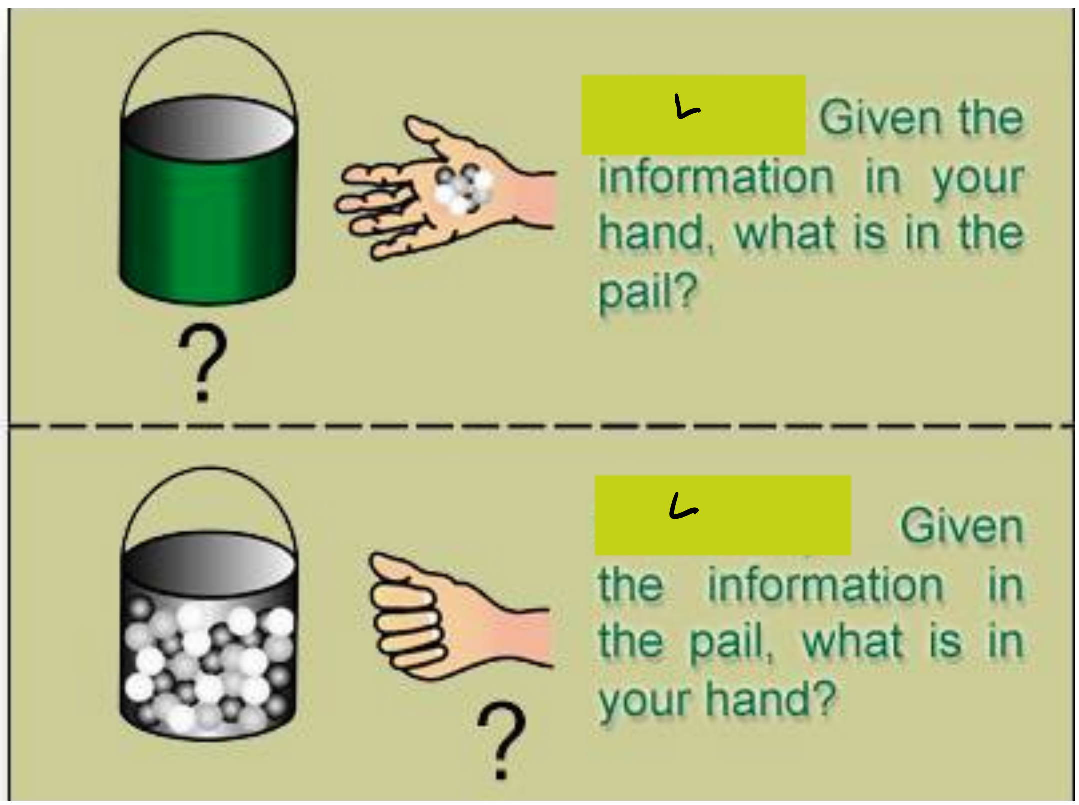
> Enroll in the adjunct section, it keeps you from falling behind. For practice, start with Minimal Practice (check your answers in the back of the textbook), then move on to homework problems, and finally work on Highly Recommended problems.

additional comments:

- Class is a safe environment for asking questions.
- I publish lecture notes and a summary video of the main ideas from class.
- Please sit near other people because I will always ask you to discuss.

1) icebreaker

Discuss which is probability and which is statistics:



Prelecture notes allow me to devote more class time to you actively solving problems.

2) Sec 1.1 Equally likely outcomes

We call the set of all outcomes of an experiment $\Omega$, 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

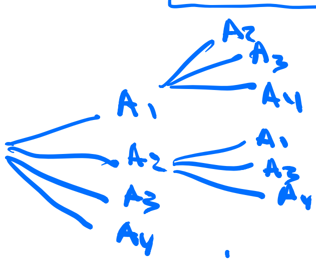
52 cards

ex #5e 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?

$$\Omega = \{(\overset{52}{*}, \overset{51}{*})\} \qquad \#\Omega = 52 \cdot 51$$

$$A = \{\underbrace{(ace, ace)}_{4\cdot 3}, \underbrace{(ace, nonace)}_{4\cdot 48}, \underbrace{(nonace, ace)}_{48\cdot 4}\}$$




$$\# A = 4(3+48+48) = 4 \cdot 99$$

$$\# \Omega = 52 \cdot 51$$

$$P(A) = \frac{4 \cdot 99}{52 \cdot 51} = .149$$

no ace in 2 cards

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

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

[ 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 ]

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

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

$$A = \left\{ \begin{array}{ll} (1, >2) & - \ 8 \\ (2, >4) & - \ 6 \\ (3, >6) & - \ 4 \\ (4, >8) & - \ 2 \\ (5, >10) & - \ 0 \end{array} \right.$$

$\#A = 20$

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

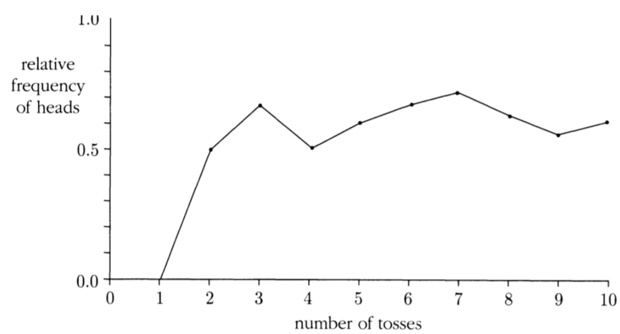
3) Sec 1.2 Interpretations

Probability has 2 interpretations

a) frequency interpretation.

eg what is the probability a particular coin lands heads.

— make an experiment. Law of averages.




b) Subjective interpretation. — will discuss in section 1.5

eg what is the probability a particular patient survives an operation?

Is there an answer to this question?
It depends on the heath of the patient, the doctor etc.

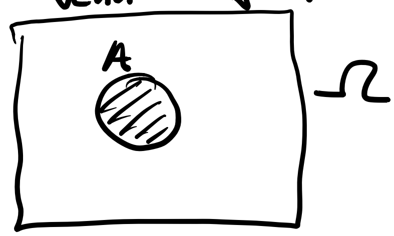
Your opinion may change over time as you acquire new data. this will change the value of your probability.

## Sec 1.3 Distributions

To define probability we start with an *outcome space*, $\Omega$, and assign to each element a nonnegative number and require that all numbers add up to 1.

**Axioms**

Venn Diagram

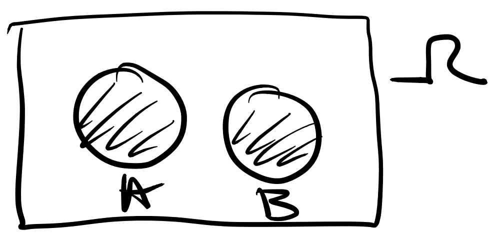



1) $P(A) \geq 0$ for all $A \subseteq \Omega$

2) $P(\Omega) = 1$

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

(addition rule)

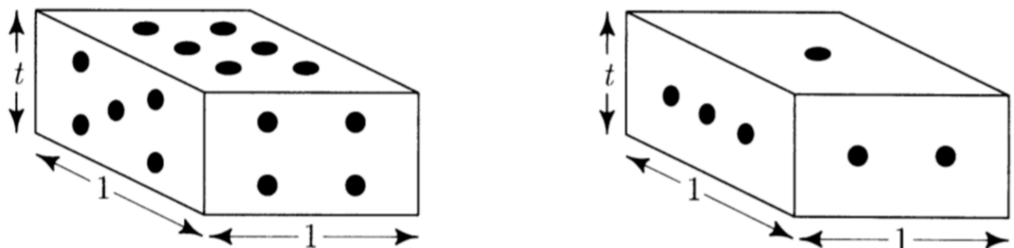


ex

**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.

**Soln**

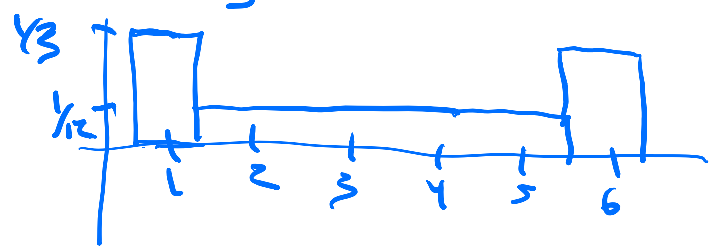
$2/3 + 4x = 1$

$\Rightarrow x = 1/12$

$P(1) = 1/3$

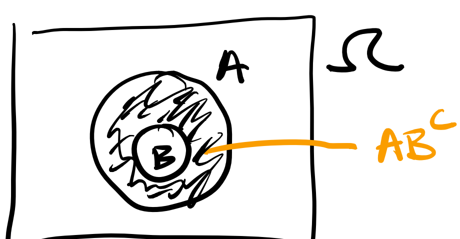
$P(2) = P(3) = P(4) = P(5) = 1/12$

$P(6) = 1/3$




## Difference rule

Suppose $B \subseteq A$



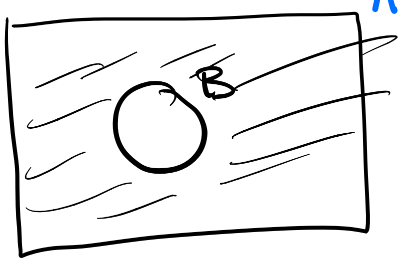

Prove a formula for $P(AB^c)$ in terms of $P(A)$ and $P(B)$.

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

$P(A) = P(B) + P(AB^c)$ add'n rule

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

## Complement rule




$A = \Omega$

$$P(B^c) = 1 - P(B),$$

Prove the complement rule using the difference rule.

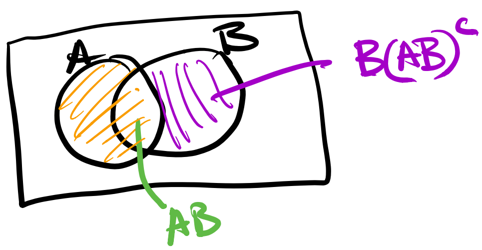
$A = \Omega$

$B^c = \Omega B^c$

$$P(B^c) = P(\Omega) - P(B) \quad \text{by diff rule}$$

$P(\Omega) = 1$

## Inclusion Exclusion Rule




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

$A \cup B = A \cup B(AB)^c$ disjoint union

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

$\uparrow\ P(B) - P(AB)$