Probability with Engineering Applications [Fa25]

ECE 313

Agenda

Course staff – Instructor & TA

Course logistics

- Website, grading, HW, etc.

Course content + course Teaser

- Am I in the right class?

Course staff - Instructor

Yu-Lin Wei

https://yulinlw2.web.illinois.edu/

UIUC Ph.D. at ECE graduated last year

Research area

acoustic signal processing, IoT,
wireless/ visible light communication, indoor positioning,
applied machine learning

Course Logistics

Webpage: https://courses.grainger.illinois.edu/ece313/fa2025/
Office Hour: Tuesday 10AM-11AM @ ECEB 3036

Course Load: 13 weekly HWs + 2 midterms + 1 final
Grading Policy: 15% HW + (15-30%) midterms + (35-40%) final

Refer to the course website for MUCH more details
https://courses.grainger.illinois.edu/ece313/fa2025/

Some Questions

Slido

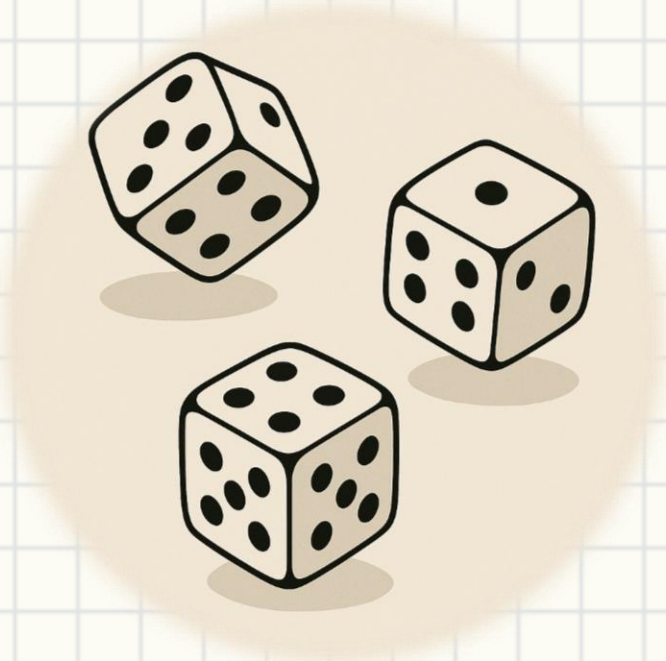
This section will use Slido for some interactions!
https://app.sli.do/event/wjsmJt8n9gAcqmtPxzt2FK

Am I in the right class?

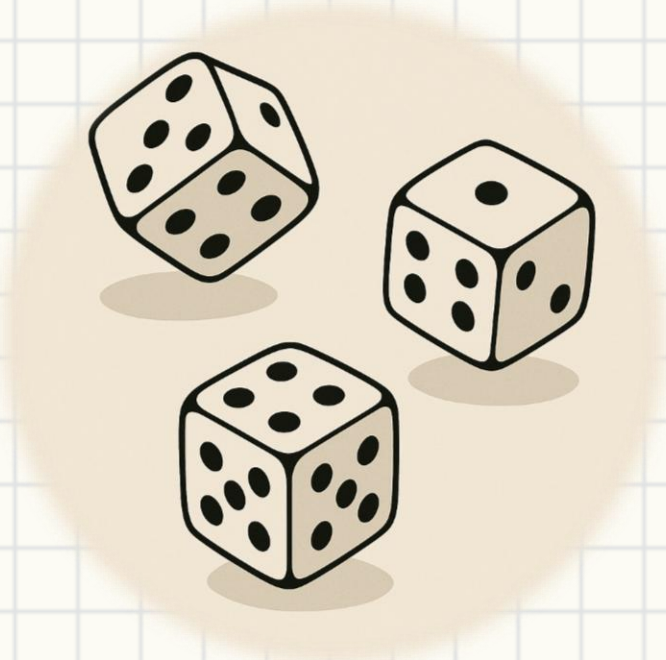
- What is probability
- Why should I know probability?
- What to expect in 313
- Probability vs. statistics

What is probability?

- Textbook
  - Roll dices
  - Balls in bins
- Real-world things
  - Poker games
  - Rainy/ Sunny
- Engineering problems
  - Prediction
  - Modeling
  - Generation



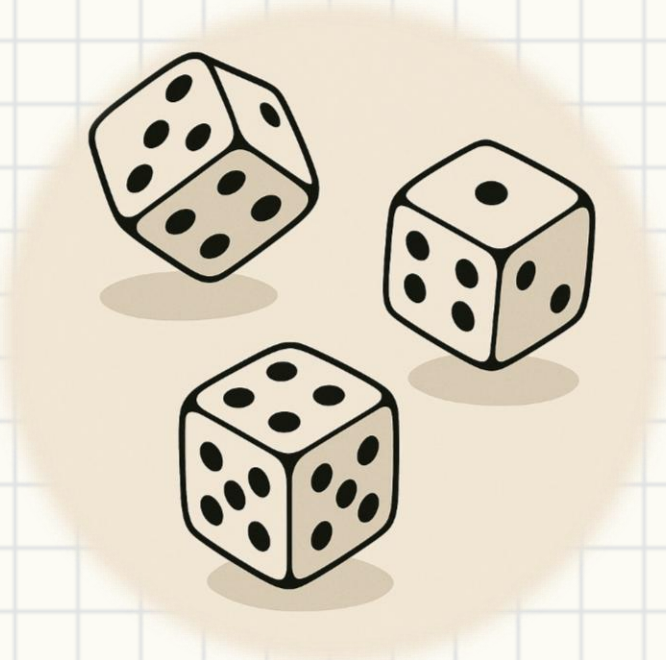
Why should I know probability?



- Common in our daily life
  - Probable, maybe, unlikely, …
  - What's the chance that I'll get an A?
  - How likely is it going to rain if
    - 50% humidity?
    - Given I'm at Chicago?
    - And it's summer?

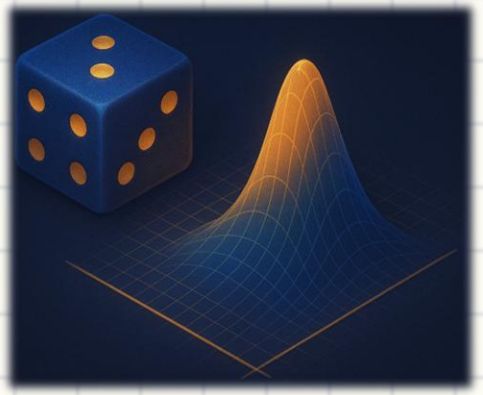
- Reason the events
  - Why am I always waiting for late buses?
  - Why are my friends more popular than me?
  - Why is everyone so calmed when the fire alarm beeps?

Why should I know probability (ECE)?



- Circuits - Thermal noise in circuits
- Communication - RF signal detection
- Network – packet drop rate, flow control
- Reliable systems – Failure rates
- ML – Variational inference
- And many others…

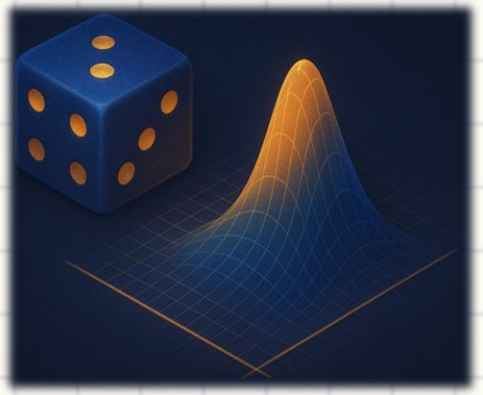
What to expect in 313



- You will learn foundations/ axioms
  - Describe a probable event
  - Ideal cases
  - Compute the probability
  - Examples

- NOT covered but important
  - Formulate a probability problem
  - Application-depend approach

Probability vs. Statistics



- Similar, but there are some differences
  - Probability assumes a model (precisely), statistics inference from data
  - What's the probability of 6 Head out of 10 tosses on a fair coin?
  - We got 6 Head out of 10 tosses on a coin, is the coin a fair coin?
    - I have 95% confidence it's fair

Slido!

Which options are probability related?

A. Average and variance of heights of students

B. Whether a customer will click the ad

C. Best move for tic-tac-toe

D. Best move for Go

E. Best route from ECE building to Union

#4632012

How to describe/ define a probability event?

Probability Terminologies

- Experiment / Outcome / Trial
- Experiment
  - Toss a fair coin
- Outcome
  - {Head} or {Tail}
- Trial
  - Do this x times – x trials

Sample space

- The set of all possible outcomes of an experiment is called a sample space Ω of the experiment

- For example :
  - Tossing a coin
  - Rolling a die
  - Measuring a noise voltage

A simple probability assignment

- Experiment of rolling a fair die
  - What's the probability that the outcome is odd?
  - We call this odd subset an "event"

What is an event

- A subset of the sample space Ω
- For example
  - $A = \{\quad\}$ are events defined on a sample space $\Omega = \{\quad\}$