Introduction

MATH/STAT 394: Probability I
Summer 2021 A Term

Introduction to Probability
D. Anderson, T.Seppäläinen, B. Valkó

Aaron Osgood-Zimmerman

Department of Statistics

UNIVERSITY of WASHINGTON

Outline

Logistics

Teaching Team

- Instructor: Aaron Osgood-Zimmerman
- Grader: TBD

Synchronous Learning

- MWF 8:30–10:40 by Zoom, two 1 hour sessions with a 10min break
- Recordings available online (via Panopto) the day of the lecture
- ?? Every 4^{th} hour will be small breakout group work with peers
- Office hours Tu/Th 11-noon

Asynchronous Learning

- ?? To make up for the breakout group hour, I will be releasing video recordings of every 4^{th} lecture
- Recordings available online (via Panopto) a few hours after breakout groups

Interactions

During the lecture

- Please raise hands on Zoom or ask questions on the chat
- Answer questions on the chat, I'll ask you to unmute yourself if necessary

Outside the lecture

- Use Piazza, register with the pwd *bayes*
- Post questions on Piazza, anonymously or not
- Ask questions about the course, the homework or the exams
- You are encouraged to ask/answer questions from your comrades!
- In this remote setting, use Piazza to have as much interactions as you would have normally

Feedback

Feedback

- If you have any constructive comment about the course, feel free to reach out directly by email, anonymously, or in office hours
- Mutual respect is essential for the course in both mails, messages, and comments. Send polite, respectful messages
- I will try to be as responsive to suggestions as possible given the remote and compressed nature of this course, while taking into account what may work best for one vs the whole and my finite time.

Coursework

Coursework

- 5 homeworks
  - 40% of the grade
  - available on Friday afternoons and due the following Friday at midnight
  - first HW is available now, due this friday
  - last HW will be due at noon on Tuesday of the final week of the term (final will be given out that Wednesday)
- 2 take-home exams
  - midterm is 20% of the grade, final is 30% of the grade
  - 24-hour take-home, noon-noon
- Class Participation
  - 20% of the grade
  - Regular in-class multiple choice questions
  - small breakout group problem sets every "4th" lecture hour
- Yes, this adds up to 110%, your worst category (homework, exams, participation) will be worth 10% less

Coursework

Grading Policies

- All answers to homework/exams require a clear and complete mathematical explanation
- No late homework/exams will be accepted.
- For an extension due to personal reasons, ask before the deadline
- The assignments will have to be uploaded via Gradescope
- You can either type your solution or scan *legible* handwritten solutions.
- You are strongly encouraged to submit typeset solutions (it is an incredibly useful skill) using LaTeX, Emacs auxtex/org-mode, Gnu TeXmacs, or similar

Learning Goals

- Affective goals how is our relationship with math?
  - We will come to see success, and grades, in math classes as a product of effort rather than innate ability (there's no such thing as "math people" and "non-math people").
  - We will discover that solving math problems is as much an art as it is a procedure.
  - We will develop resilience in problem solving by allowing failure of one approach to motivate other approaches that will succeed.

- Cognitive goals what will we learn about math as a whole (rather than just probability)?
  - We will learn to prove theorems in the abstract ("prove that the following statement holds") in addition to performing calculations ("compute the _____ of _____") and derivations ("show that the _____ of _____ is_____").
  - We will learn how to communicate math effectively, as good writing is necessary for good math and good presentation skills are required to share you knowledge with others.

Academic Integrity

Why?

- With our learning goals in mind, the purpose of this course is to help you learn
- As such, you need to demonstrate your understanding so we can provide you feedback

How?

- Don't plagiarize
- Feel free to collaborate with others on homeworks (exams are to be worked individually)
- But you must submit your own solutions
- Remote context is clearly hard. Yet, copying others' work is not a solution that will serve you well in this course or afterwards
- Consider the coursework as training exercises for your future applications.
- Do your best, make mistakes and learn from them such that one day you'll have understood your weaknesses and overpass them.

Academic Integrity

Consequences

- We assign a grade of 0.0 for the exam/homework
- We report the incident to the Committee on Academic Conduct
- This may impact your future at the University.

Other Comments

Please see the course syllabus for:

- DRS (Disability Resources for Students) accommodations (please let me know ASAP)
- Respecting diversity in our classroom
- Alternative texts (both course references and topical (probability/statistics) pleasure reading
- Practicing the material
- Discussing with me my career experience as a geostatistics health-focused and computational statistician
- Recommendation letters

Content

Textbook

Introduction to Probability by Anderson D., Seppäläinen T., Valkò B.

- The course follows closely the book if you need further examples/explanations

Content

- Probability definitions
- Conditional probabilities, independence
- Random variables, expectation, variance
- Limit theorems

Logistics

If you have any questions about the logistics,
ask them on Piazza or Canvas if you cannot access Piazza

Outline

Probability

Probability is used to **measure** how likely an **uncertain** event is to occur

Uncertainty, a famous example

- In 1887 King Oscar II of Sweden and Norway offered a prize to determine precisely the movement of celestial objects
- In 1890 Henri Poincarre showed that it was impossible: the smallest variation in the initial values can build up over time into huge discrepancies.
- We need tools beyond deterministic equations to describe such systems
- Nowadays, all quantum mechanics are based on the description of atoms by the probability they could be at a given position with a given speed

Measure

- The core of probability is to provide measuring tools
- In fact, a more abstract field used in probability is called measure theory
- Think of it as generalizations of integrals/sums and the operations that can be done on it

A Bit of History

- Earliest known forms of probability and statistics were developed by Middle Eastern mathematicians
- Letters btw Pierre Fermat, Blaise Pascal in 1654 for gambling
- Bernoulli, Laplace, Legendre, Gauss followed and Gauss gave the "law of facility of error" which led to the central limit theorem in the 19th century
- Real foundations of probability in the 20th century with Markov and Kolmogorov
- Nowadays, probability is used in almost all fields, it is the theoretical framework for statistics
- And statistics are used in almost all disciplines

Applications

Examples of random events

- Roll of two dice, lottery, flip of a coin
- Stock markets
- Weather
- Earthquakes
- ...

Fields

- Thermodynamics
- Sociology
- Economy
- Physics
- ...