

Introduction to Course

CE 311S

COURSE CONTENT

Probability is the study of how random processes* behave.



* What is randomness?

We'll take **randomness** to mean anything which is currently unknown, but important for some reason. Things can be unknown for various reasons:

Partial information – when I flip a coin, I don't know all the forces, air currents, etc.

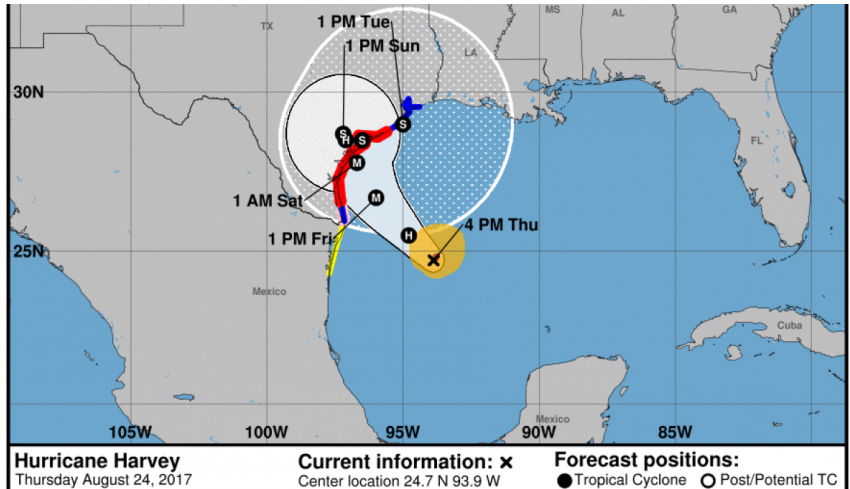
Beliefs – I don't know how other drivers around me will behave.

“True” randomness – some processes in physics (atomic decay, quantum pair production) are believed to be random without any other explanation.

The good news is that the math works out the same no matter what “kind” of randomness we are dealing with. For this reason we won't go much further into philosophical discussions of what is random or not. I like viewing probabilities as the long-run frequency of seeing an outcome if we could repeat the same process many times.

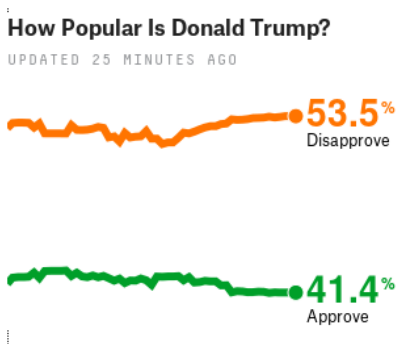
Real-world examples abound. Some recent cases:

Hurricane Harvey



How much rain will fall, where, and how fast? Do you issue an evacuation or not? Do we release water from a reservoir or not?

Interpreting polls and forecasting elections



What sample size is needed? How reliable are the estimates from polls?

Some civil engineering examples...

Structures: What wind load should we design a building to withstand?

Transportation: Where will people live and work in 30 years?

Water Resources: How can we manage reservoirs knowing there will be both droughts and flood years?

Construction Management: How long will a project actually take, and at what cost?

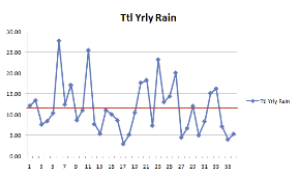
Geotechnical: What kind of soil *actually* exists where the foundation will be?

Every engineering design involves uncertain tradeoffs!

- 1 Design A costs \$100K and can withstand a 50 mph wind
- 2 Design B costs \$500K and can withstand a 75 mph wind
- 3 Design C costs \$1M and can withstand a 100 mph wind
- 4 Design D costs \$2M and can withstand a 150 mph wind

What should we build?

Statistics describes how we can use experiments to learn about random processes.



By combining probability and statistics, we have the tools to make decisions even without perfect information.

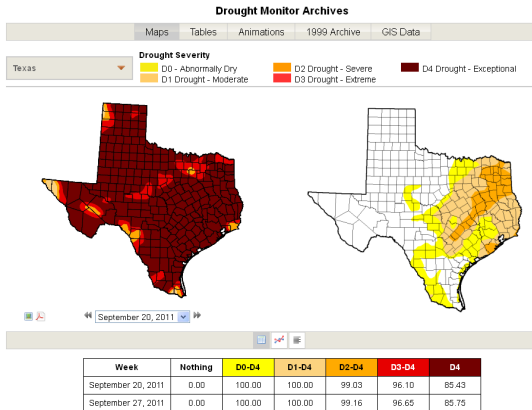
When I graduate, what will my job prospects be?

Figure 2: The US Unemployment Rate since 2000

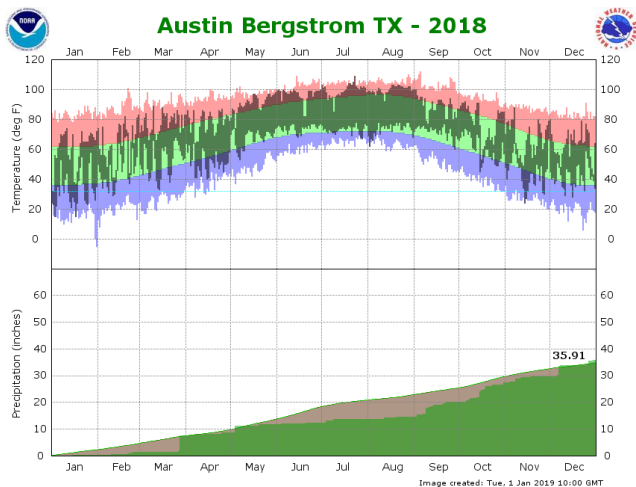


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What can past historical data tell us about the likelihood of different amounts of rain or wind?



Is our climate changing?



There is a lot of variability from year to year; how can we tell whether *long-term* trends are changing?

Taking a course in probability and statistics is important because **people are very bad at making rational decisions regarding uncertain events, especially when they are rare.**

- Why are people afraid to fly, but not to drive?
- Hurricane evacuations: playing it safe, or “crying wolf”?
- Swimming pools pose a greater risk to children than guns
- Purchasing insurance, or playing the lottery
- How does our society allocate resources to face threats?
- etc. etc. etc.

I'll try to point some of these out as we go through the course. As an engineer, you should be able to provide *quantitative* input to these kinds of decisions.

COURSE OVERVIEW

Course Staff

Instructor: Steve Boyles

TAs: Bushra Islam, Pin-Chun Cho, Jui Shriniva Dixit

Tutor: TBA

Office Hours: see Canvas → Announcements → Zoom links

Course website: <http://tinyurl.com/boyles311s>; submit all assignments on Canvas

Prerequisites

Probability and statistics involve a good deal of calculus. However, the math is usually *not* what students find difficult.

This may be one of the first classes you see where the hard part is figuring out what concepts and formulas apply to which problems.

Course Materials

The textbook is:

Pishro-Nik, Hossein. *Introduction to Probability*, free at www.probabilitycourse.com, \$20-35 for a hard copy on Amazon

There are also some videos online with this text. I suggest watching these if you are struggling with a concept.

I will also post lecture slides on Canvas, but these cannot replace your own notes.

Tips for getting the most out of the text

- Read ahead of time
- Try examples and solved problems on your own, with pencil and paper, *before* reading the solution. Give them an honest effort before seeing how to solve it.
- When you see formulas, theorems, etc. create small examples on your own and try to convince yourselves that they are true.
- Don't stop reading at the first thing you don't understand – make a note (or include it in your reading response) and try to keep going.
- Look for alternate explanations: other textbooks, Khan Academy videos, etc. Just beware of different notations.
- Post questions on Canvas.
- *During* class, ask about anything that is unclear. I will start each class by asking for questions.
- *After* class, read over the section again. If there are any remaining doubts, send a note to the TAs or me, or ask in class.

Most weeks in the course have a reading assignment due Sunday night.

Read the assigned sections in the book, watch the assigned videos, and make a post to the Canvas discussion board showing that you have thought about the material.

(This could be questions, comments, things you want me to talk more about in class, etc.)

Assignments

There will be two kinds of assignments in this course:

- Short **practice assignments** on basic concepts. You will submit these assignments online on Canvas.
- Longer **homework assignments** which are more complex and require synthesis of concepts, working with data sets, and so on.

Grading

Category	Weight
Assignments	25%
Discussion posts	5%
Exam 1 (week of 2/21)	20%
Exam 2 (week of 3/28)	20%
Final Exam (designated UT time)	30%

+/- grading will be used. If you need an extension, you must ask at least 48 hours in advance.

Miscellanea

- Consult catalog and departmental advisors for add/drop policy.
- Please coordinate with me and Services for Students with Disabilities if you have a disability requiring alternate accommodations.
- Academic dishonesty... don't do it.

Title IX

SB 212 is a new Texas law concerning reporting requirements for sexual harassment, sexual assault, dating violence, or stalking.

As of last year, all UT employees are required to report any information they witness or receive to UT's Title IX coordinator. **I am a mandatory reporter** and cannot keep such information confidential.

University Health Services, the Counseling and Mental Health Center, and Legal Services for Students **are** confidential resources.

For more information, see titleix.utexas.edu

A Birthday Example

What are the odds that two people in this room share the same birthday?