

Stat 394 Probability I

Lecture 0

Richard Li

June 19, 2017

About this course

- **Instructor:** Z. Richard Li
 - **Office:** C-14G Padelford
 - **Office Hours:** M 12:00-2:00 PM, in C14-G Padelford (may move to C-14A next door when office gets crowded)
 - **E-mail:** lizehang@uw.edu
- **TA:** Anna Green
 - **TA E-mail:** greena64@uw.edu
 - **TA Office Hours:** TBD
- **Course website:** Canvas
 - Syllabus, learning objectives, schedule, lecture slides, etc.
 - Important announcements!
 - Homeworks. (*first HW due next Monday!*)
 - Discussion thread for homework.
 - Please do not e-mail homework questions to me or to the TA. Use the discussion board instead.

Course expectations

- Pre-reqs:
 - Calculus at the level of MATH 124, 125, and 126.
 - Basic linear algebra, familiar with matrix notations.
 - Multivariate calculus if you are also taking 395 in term B (not required for 394).
- Textbook: *A First Course in Probability*, 9th ed. by Sheldon Ross
 - Previous editions are fine for learning the material.
 - Homework problems will be from the 9th edition.
 - Self-test problems after each chapters are good exercise.
 - We will cover mostly Chapter 2 - 4 and part of chapter 5 in this term.
 - You need to read and study Chapter 1 yourself (We will briefly introduce some of it today).

Evaluation

- Participation (10%)
- Homework (40%): There will be 5 homework sets. NO LATE HOMEWORKS ACCEPTED.
- Final (50%): closed book, closed notes; in class final exam on July 19, JHN 026.

Participation

- Course structures

- Lecture: Monday, Wednesday, and first hour on Friday.
- Problem session: second hour on Friday.
 - You will work on selected problems in groups
 - And share your solutions (verbally or on the white board)

- Participation credits

- Participation in the Friday problem session.
- Ask questions.
- Answer and explain questions from your peers.
- Participate in “*probability in the news*”. At least one news post is required for getting the participation credits.

Probability in the news

FiveThirtyEight



Politics Sports Science & Health **Economics** Culture

New: Politics podcast

JUN. 2, 2017 AT 11:05 AM

Don't Worry About The Job Market Yet, But Pay Attention

By Ben Casselman

Filed under Jobs Report



The U.S.'s [record streak of job growth](#) kept going in May, but the economy may be starting to flash some warning signs.

U.S. employers added 138,000 jobs in May, the Bureau of Labor Statistics [reported Friday](#). That was down a bit from April and was modestly below [economists' expectations](#). But taken on its own, May's job growth wasn't bad: It represented the 80th straight month of gains, the longest such streak on record. The economy has added more than 16 million jobs since the labor market bottomed out in early 2010.

RECOMMENDED

We Converted \$100 Into As Many Currencies As Possible

Why The 2018 Senate Elections Are Looking Bad For Both Parties

Should I Snub An Ex-Friend When I See Her At A Wedding?

source: <https://fivethirtyeight.com/features/dont-worry-about-the-job-market-yet-but-pay-attention/>

Probability in the news

There are some interesting fact/analysis raised in this article, e.g.,

- The unemployment rate fell to 4.3 percent in May, its lowest level since 2001.
- That might sound like good news. It isn't. Why?
- The government only considers people unemployed if they are actively looking for work.
- The labor force (everyone who is either working or actively looking for work) shrank by more than 400,000 people.
- Possible comment: naively reading off the unemployment rate drop can be misleading. This article provides a more in-depth view of the other driving force of unemployment rate: size of the labor force.

Probability in the news

- News from different regions & fields are welcome!
- You can agree or disagree with the news you post.
- Comment on the background of the issue so others can understand better.
- Engage in discussions.
- Be friendly in discussions.
- Do not post plain weather forecast, unless the use of probability is very very interesting.
- Do not post fictional news (e.g., the onion), unless the use of probability is very very interesting.

Course expectations

- What we will learn in this class
 - Probability theories, some statistics, some mathematical tools.
 - Using the tools of probability and statistics to solve problems.
 - Using probabilistic reasoning in real life.

More specifically

- Gambling!
- Not really, but the theory of probability is always associated with it.
- Some common tools
 - Coin: Heads (H) or Tails (T).
 - Die: $\{1, 2, 3, 4, 5, 6\}$
 - Full deck of cards: 52 cards
- A typical question you will see in this course:

Start with a shuffled deck of cards and distribute all 52 cards to 4 players, 13 cards to each. What is the probability that each player gets an Ace?

Next, assume that you are a player and you get a single Ace. What is the probability now that each player gets an Ace?

History of probabilities

- Modern probability is considered to be born in 1654 when a nobleman wrote a letter to the mathematician and philosopher Blaise Pascal:

I used to bet even money that I would get at least one 6 in four rolls of a fair die. The probability of this is 4 times the probability of getting a 6 in a single die, i.e., $4/6 = 2/3$; clearly I had an advantage and indeed I was making money.

Now I bet even money that within 24 rolls of two dice I get at least one double 6. This has the same advantage ($24/6^2 = 2/3$), but now I am losing money. Why?

History of probabilities

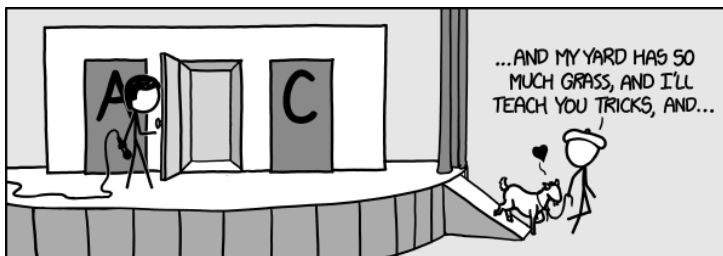
- This problem starts the correspondence between Pascal and Pierre de Fermat.
- And the series of correspondence is credited for the founding of probability theory.
- Now, do you see what's going wrong in the question?
- You will solve this problem in HW1 😊

Another example of probabilities

- In a family with 4 children, what is the probability of a 2 : 2 boy-girl split?
- Is it close to 1, since it is the most “balanced” possibility?
- Is it $1/5$, since there are 5 possible combinations?
- Again, you will solve this problem in HW1 😊

A more challenging example

- Suppose you're on a game show, and you're given the choice of three doors.
- Behind one door is a car; behind the others, goats.
- The host knows where the car is.
- You pick a door and the host opens another door and you see there is a goat.
- He then says to you, "Do you want to change your selection?"



Another mind twisting example

- Suppose I have two envelopes with money in them.
- One contains twice the money than the other.
- I give you one; you open it and see 100 dollars.
- Now I say

I can give you a chance to swap the envelope. You have 50% chance of gaining another 100 dollars, and 50% chance of losing 50 dollars. So it is to your advantage if you swap.

- Can you spot anything that does not make sense?
- No matter what you see in your envelop, you should always swap, so you don't need to open it at all.
- What's wrong?

Some other things you will see in this course

- What is the probability that among the n people, no 3 of them have their birthday on the same day?
- What is the probability of seeing at least 5 earthquakes in the next 10 weeks given the average rate at which earthquakes happen?
- A man carries 2 matchboxes. Each time he needs a match, he is equally likely to take it from either of them. When he first discovers that one of his matchboxes is empty, what is the probability that there are k matches in the other matchbox?
- What is the power of a single voter in a state with n total voters, in terms of electoral college votes?

Now let us lay out the actual plan

- Today: Combinatorial analysis
 - The fundamentals of probabilistic thinking: counting, permutations, combinations, etc.
- Week 1: Axioms of probability
 - The language we need to communicate probabilities.
- Week 2 & 3: Conditional probabilities and independence
 - The concepts of probability under partial information. (Remember swapping gate and envelope?)
- Week 3 & 4: Random variables
 - The ability to characterize more complicated problems

Before we get started

- Probability at the introductory level is not difficult.
- But human are typically “probability blind”.
- So, we are going to learn math tools to help us solve problems.
- But more importantly, we will train our minds to reason with probabilities, and not to be fooled by randomness.