SYLLABUS (Jan 7 8pm revision) Math 407 Section 39625R
Spring 2021 (online, thanks to COVID)
12pm lecture MWF

Professor Richard Arratia,
email: `rarratia@usc.edu` Please put 407 in the subject line of any email that you send me!

Office hours to be announced.
TA: to be assigned
Office, which I haven't seen since March 9, 2020: KAP 406C

Text: There is 1 textbook.
Title: Introduction to Probability
Authors: Anderson et al, which is approximately David Anderson, Timo Seppalainen, and Benedek Valko
ISBN: 9781108415859
You should be able to buy a copy for around $60.

Grading policy:
20 percent Homework, from the text.
10 percent Quizzes
40 percent projects, which are (all, or mostly) Matlab assignments;
10 percent Midterm 1.
20 percent Final exam

unspecified small percent Typo-spotting bonus points

We emphasize *indicators* and *expectations*, all semester long. We avoid measure theory, pretending that *all* subsets of the sample space are events. We will cover the basic discrete distributions (Bernoulli, Binomial, Geometric, Poisson), with additional material including Stirling's formula, entropy (exponential growth/decay rates), and, at the end of the semester, generating functions, and some Huffman coding. We cover second moments, variance, the Cauchy-Schwarz inequality, Bayes's Theorem. We cover basic continuous distributions (Uniform, Exponential, Normal) and the change of variables relation arising when a smooth function is applied to a random variable having a density. We study the basic Poisson process. We learn how to apply the Central Limit Theorem, without proof.

Course philosophy: Probability theory is a very lively subject. Blaise Pascal (1623–1662) said "Probability is common sense made precise." Probability theory is both a branch of science, making falsifiable predictions about real world experiments, and a branch of mathematics, so

that starting from a few simple assumptions, logical consequences can be proved. Elementary probability is mostly algebra, combinatorics, and calculus, featuring exact formulas. But approximations, and limits, are also very important.

I am a probabilist; starting from my doctoral degree in 1979,
see `https://en.wikipedia.org/wiki/Brownian_web`.
You can retrace my PhD ancestry via the Mathematics Geneology Project
`https://www.genealogy.math.ndsu.nodak.edu/id.php?id=9633`
and clicking on successive ancestors. One path through the tree is: David Griffeath (Cornell 1976,) Frank Spitzer (U. Michigan 1953,) Don Darling (Caltech 1947,) Morgan Ward (Caltech 1928,) Eric Temple Bell (Columbia 1912,) Frank Cole (Harvard 1886,) Felix Klein (Bonn 1868,) Rudolf Lipschitz (Berlin 1853,) Gustav Dirichlet (Bonn 1827,) Simeon Poisson (Paris 1800,) Joseph Lagrange (advisor Euler, 1750s, no degree,) Leonhard Euler (Basel 1726,) Johann Bernoulli (1694,) Jacob Bernoulli (1690 or 1694,) Gottfried Leibnitz (1666). Another path uses Poisson's second advisor, Pierre-Simon Laplace (1769, lived 1749–1827). I had no idea, when studying for my PhD, what a distinguished family tree I was on the verge of lucking in to!

You can enjoy browsing my recent papers at
`https://arxiv.org/search/?query=arratia_r&searchtype=author&abstracts=show`;
see especially a fun paper about lotteries, 'Some people have all the luck',
   `https://arxiv.org/pdf/1503.02902.pdf` .
You may also enjoy clicking on `https://en.wikipedia.org/wiki/Richard_Arratia` and
`https://scholar.google.com/citations?user=l7ubIk8AAAAJ&hl=en`.

Some details of the grading scheme.
You are always encouraged to study together, but you are NOT allowed to copy work! Academic integrity violations will be pursued; both the person who copies, and the person who is copied from, would be guilty. Homework refers to problems from the text; projects are my own creations. For both, you should present your own work, in your own words. If you do look something up, please name the source!

Although a TA/grader has not yet been assigned, I imagine that I will soon have a TA, who can then tell me his/her preferences for the mechanics of upload — maybe `blackboard`, maybe `gradescope`. I think the HW grading scheme should be two-part, with one score where the reader reports how much of an assignment was done, e.g., 8 of the 10 problems have some response that passes muster at a quick glance, and one score that will use the bulk of the grader's time: correctness, for one or two problems. For each assignment, I will tell the grader which problem(s) to grade carefully, but I won't tell you which, until after the HW is due. A moderate penalty, e.g., 10% per day or per week late, might be offered, to encourage people to not give up if running a bit behind.

Exams, including quizzes, are open book, which means completely open to notes you have collected and organized *before* seeing the exam; you are not allowed to search the internet after opening the exam. There is, intentionally, a lot of time pressure, to encourage you to rehearse

answering my sample exam questions, and small variants, as part of your preparation.

'Quizzes' are weekly, give or take a day or so. The purpose is to focus your attention on a few tasks; you will see in advance a sample copy, and then the actual quiz will mostly repeat the same questions, though with different constants, and with a small amount of new types of questions. They are supposed to take 10 minutes, but I will probably assign 20, allowing time for upload to gradescope.

The midterm and final will be similar to the quizzes, though targeted for 50 minutes and for 120 minutes, plus upload time. Again, you will see a sample in advance. As per
 `https://classes.usc.edu/term-20211/finals/`,
our final will be Friday May 7, 11am to 1pm.

I am aware that there are internet sites that collect old exams, and that some enterprising students will be able to find my old midterms and quizzes. So the policy, above, of providing official samples in advance, should make it unnecessary, and minimally productive, to search the internet!

Bonus points will be awarded, at my discretion. The primary bonus activity is typo-spotting; the first person to chime up in lecture (or later via email) with a query, that is answered by saying "Oh, I wrote it incorrectly, or left out something important", should be rewarded with a bonus point. The idea is: if something going by in lecture, or on a quiz or exam, confuses you — it might be my fault, so it helps everyone if you speak up quickly. I also care about typos in my handouts. Another bonus activity might be internet-mining; I would like to have a comprehensive collection of exam materials from my previous teachings of 407, and I will reward people who forward me copies, of anything not already in my collection. The total extent of bonus points is meant to be moderate; the most diligent student might get the equivalent of raising a final exam score by 10 or 20 points.