Math 407: Probability Theory

Everything can change with little or no notice at any moment…

In particular, a class (lecture and/or discussion) can be moved to on-line mode on a very short notice, so please check your e-mail before every class.

Class number 39625R

Math 407 in Fall 2023 semester: Key dates

- August 21: first day of classes
- September 4: Labor Day, no class
- September 8: Last day to drop without a `W' AND with refund
- October 4: Midterm Exam 1
- October 6: Last day to drop without a `W', BUT WITH NO refund
- October 12, 13: Fall Break
- November 10: Last day to drop with a `W'; no class (Veterans Day)
- November 15: Midterm Exam 2
- November 22-26: Thanksgiving Break
- December 1: Computer project is due; Last day of classes
- December 11: Final exam (11am-1pm)

Class Schedule
Homework problems
Computer Project

A summary

- **Instructor:** Dr. Sergey Lototsky.
  Office: KAP 248 D.
  Phone: (213) 740-2389.
  E-mail: lototsky (at) usc (dot) edu.
  Lectures: MWF 9:00-9:50 pm, KAP 144.
  Office hours: MW 11:30am-12:30pm, F 10:30-11:30am [in-person/on zoom]

Please make sure to talk to me about your problems, questions, or concerns in this class. We can always arrange a special zoom meeting.

- **Teaching Assistant:** Bo Wu
  E-mail: bwu168 (at) usc (dot) edu

Discussions: T Th, 8-8:50am, 9-9:50am, DMC 106
Office hours: T 10-12, Th 10-11

- **Textbook:** "A First Course in Probability" by Sheldon Ross, published by Pearson. Any edition will do; the most recent is 10th, from 2019.

- **Objective:** To learn the basics of probability so that you are prepared for statistics (math 408). Some particular topics to master are (a) Law of Large Numbers (LLN) (b) Central Limit Theorem (CLT) (c) Normal (Gaussian) distribution (d) Poisson approximation.
- **Goal:** To learn everything there is in the book and a bit more.

- **The ultimate goal:** To make you interested enough in the subject so that you take more courses, in both probability and statistics, and enjoy them.

Course Work

- **There will be two one-hour exams: October 4 and November 15 (both Wednesdays) during regular lecture hours. Final exam is Monday, December 11, 11am-1pm.**
- Calculators are allowed during exams and quizzes.
- **Homework, Quizzes, etc.:** There will be 12 weekly quizzes, 12 homeworks, and a computer project. Check the schedule for the exact dates. You should know how to solve every homework problem and turn in each homework on the corresponding due date, but do not expect homework problems to be thoroughly graded. You are welcome to use any help with all the work other than quizzes and exams. During quizzes and exams, you are on your own, with only a writing/erasing instrument, and a calculator (without internet connection or any other communication capabilities). Devices such as tablets, smart phones, and laptop computers are not allowed during exams. If in doubt, please talk to me in advance about the particular calculator you plan to use.Please keep in mind that homework assignments are minimal requirements. To succeed in the class, you need to solve more problems, from the book and/or from other sources. Keep all your notes, including scratch paper, until after you are completely done with this class.Quizzes will take place during discussion sections, either on Tuesday or on Thursday. The exact dates are in the class schedule. **The teaching assistant is responsible for preparing, administering, and grading quizzes and for grading the homeworks; I will grade the computer project and (most probably) the exams.**

Grading:

- Quizzes 15% total
- Homeworks 15% total
- Two One-Hour Exams, 30% total (15% each)
- Computer Project 10%
- Final Exam 30%

To put is differently: you get 75% of the final grade from quizzes and exams and 25% of the final grade from homeworks and the project.

- Class Schedule
- Homework problems
- Computer project Due date is Friday, December 1. No extensions, but early submissions are welcome.
- **Missed work.** The general rule: no make-up exams or quizzes, and no late submissions of homeworks or projects (but early submissions, especially in electronic format, are welcome). **Emergencies will be handled on a case-by-case basis.** If you miss the final exam, with a valid excuse, you get an incomplete in the class; an incomplete is a major inconvenience for a number of people, including yourself, so, please, do not miss the final exam. **To encourage and reward consistent performance throughout the semester, I will not automatically drop any scores (such as the two lowest quizzes, etc.)**

Additional Information.

- **Students Requiring Special Accommodation**
  Any student requesting academic accommodations based on special needs is required to register with OSAS (Office of Student Accessibility Services) each semester. A letter of verification for approved accommodations can be obtained from OSAS. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. OSAS is located in GFS 120. To contact OSAS: (213) 740-0776 [tel.], SASfrntd@usc.edu [e-mail], on the web.
- **Academic Integrity**
  USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus (the Student Guidebook) contains the Student Conduct Code in Section 11.00, while the recommended sanctions are in Appendix A.
- **Academic Support** The Kortschak Center for Learning and Creativity

Previous exams in this class

Exam 1			F 2013	S 2017	F 2018	F 2021 [solutions]		F 2022
Exam 2			F 2013	S 2017	F 2018	F 2021 [solutions]		F 2022
Final	F 2008	F 2009	F 2013	S 2017	F 2018	F 2021		F 2022

Other materials

- **Mine**
  - Motivating puzzle 1
  - Lecture 1
  - Motivating puzzle 2
  - A summary of combinatorics
  - Some basic counting problems

- Counting triangles
- "Gifts to kids" problem
- MegaMillions: some analysis
- Some famous problems in probability
- 2nd order linear constant coefficients: ODEs vs FDEs
- About Ramsey
- Random variables: general definitions and an easy diagram
- A summary of discrete random variables
- Two computations: the Basel problem and the Gaussian integral
- Gaussian distribution: a time line
- Normal approximation: Binomial(N=30, p=0.5), Binomial(N=30, p=0.1), Poisson(36.6), MatLab codes
- Gaussian objects: Normal random variables, CLT, and more
- Cauchy distribution
- The normal tail
- Gamma and Beta Functions
- A summary of characteristic functions
- About harmonic numbers
- Basic inequalities
- Convergence of random variables and an illustration
- Arrivals in the Poisson process and an illustration of clustering
- A summary of discrete-time Markov chains
- A summary of random object generation
- Buffon's needle and more
- The Weierstrass (polynomial) approximation theorem

- **Found on line**
  - When the obvious pattern breaks and the related math story
  - Venn diagrams and other nice pictures
  - Ordered partitions of a set (asymptotic of the Fubini numbers)
  - Partitions and the chain rule from calculus
  - About Catalan numbers
  - (Almost) everything you need to know about probability distributions
  - Poisson distribution and process by R. Arratia
  - Buffon's needle: an application and a story
  - Sylvester's four point problem
  - Occupancy problems
  - Coupon collection problem
  - Benford's Law
  - A research paper on random sudoku tables [by USC people]
  - A research paper on probability and number theory [more than two relatively prime numbers]
  - Size-biasing [a survey paper by USC Math Professors]
  - Generating a uniform distribution on the sphere