Syllabus - INDENG 172
Probability and Risk Analysis for Engineers
Fall 2020

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Note: The syllabus and schedule are subject to change as the semester progresses. I will do my best to communicate any such changes in advance.

It is your responsibility to ensure that you read and understand the syllabus. If you have any questions, concerns, or are unclear about something please let me know.

Basic Information

Instructor: Daniel Pirutinsky (he/him)   dpirutinsky@berkeley.edu

GSI (Discussion 101): Ruijie "Jerry" Zhou (he/him)   ruijie@berkeley.edu
GSI (Discussion 102): Isaac Lopez (he/him)   isaac.meza@berkeley.edu
GSI (Discussion 103): Alexandra "Ally" Novales (she/her) allynovales@berkeley.edu

Meetings
Lecture TU/TH 11:00 AM - 12:30 PM

Discussion 101 F 4:00 PM - 5:00 PM
Discussion 103 F 4:00 PM - 5:00 PM (not formally available yet)
Discussion 102 F 5:00 PM - 6:00 PM

Office Hours
Daniel Pirutinsky: TU/TH 12:45PM and by appointment

Jerry Zhou: W/F 9:00 AM – 10:00 AM
Isaac Lopez: M/W 2:00 PM – 3:00 PM
Ally Novales: (tentative)Tu/Th 12:30 PM - 1:30 PM or 2:00 PM – 3:00 PM

Contents

Course Description

Prerequisites

Students should have a solid knowledge of calculus, including multiple variable integration, such as MATH 1A and MATH 1B or MATH 16A and MATH 16B. In addition, MATH 53 is highly recommended as a prerequisite.

Course Overview

This is an introductory course in probability designed to develop a good understanding of uncertain phenomena and the mathematical tools used to model and analyze it. Applications will be given in such areas as reliability theory, risk theory, inventory theory, financial models, and computer science, among others. To complement the theory, the course also covers the basics of stochastic simulation. This course is a probability course and cannot be used to fulfill any engineering unit or elective requirements.

Learning Objective

Students will learn how to model random phenomena and learn about a variety of areas where it is important to estimate the likelihood of uncertain events. Students will also learn how to use computer simulation to replicate and analyze these events.

Methods of Instruction

Live Lectures (Zoom): During regularly scheduled class time I will hold live lectures over Zoom. The purpose of the lecture is to motivate the material, give insight and intuition, and to engage you with the material itself. Students are strongly encouraged to attend these and participate by responding to my questions or asking their own. These

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will be recorded and posted to bCourses for review or for students who are unable to attend due to the exceptional nature of this remote semester.

Discussion Sections (Zoom): During regularly scheduled discussion section time, your GSI will hold live sections over Zoom. The purpose of the discussion section is to briefly review the material, provide an opportunity to ask more detailed questions, and most importantly, see worked examples of the style of problems that may appear on the exams. Students are strongly encouraged to attend these. These will be recorded and posted to bCourses for review or for students who are unable to attend due to the exceptional nature of this remote semester.

Additional Material: When appropriate and available, I will post copies of any slides, notes, practice exams, practice problems, etc.

Course Materials
Required Textbook

A First Course in Probability, 10th Edition, by Sheldon Ross, ISBN: 9780134753119

Earlier or later editions are acceptable, but you will be responsible for completing the correct homework assignments.

Additional Resources
Ten Great Ideas About Chance, by Persi Diaconis and Bryan Skyrms
Glossary of some common terms, developers.google.com/machine-learning/glossary/
Source for some fun questions, fivethirtyeight.com/tag/the-riddler/

Communication Technology
bCourses
Announcements, lecture materials, assignments, Zoom, Gradescope, Piazza, recorded lectures, and all other course materials will be available through the bCourses site. bCourses will be your main source of information about this course.

Piazza and Communication Policy
This term we will be using Piazza for class discussion and part of your participation grade will be based on your use of Piazza.

Find it on bCourses or at https://piazza.com/berkeley/fall2020/indeng172 and use access code: ENTh

We will use Piazza as the main electronic communication method for the course. The system is highly catered to getting you help fast and efficiently from classmates, the

GSIs, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza.

If you have a question or concern that is private in nature, please use a private post on Piazza so that only the course instructor and GSIs can see your message. You are encouraged to use public posts in situations where other students may benefit from the discussion. In the exceptional circumstances where your message should be kept confidential from the GSIs, please email the course instructor and begin the subject line with "[INDENG 172 Urgent]".

In summary, you should observe the following priority list for course related communications:

1. Make a public post on Piazza
2. Make a private post on Piazza that is for only the course instructor and GSIs
3. In exceptional circumstances, send an email to the course instructor using "[INDENG 172 Urgent]" to start the subject line.

We ask that you also please observe the following etiquette on Piazza:

1. Do not post answers: Please do not post any answers or your current results on Piazza. Instead, you should explain the key points of your question in a way that allows other students to figure out the essence of the problem on their own. Post problem spoilers after the due date. If you think that your post might give out too much information about the problem solution, then make it private and let the course staff know.
2. No pre-grading: We will not answer any questions of the form "Is this the correct way to solve Homework X, Problem Y?"
3. Aim for public posts: Other students may have the same question, so please try to make your posts public.
4. Formatting: Please format code using the code button and format mathematical equations using the fx button or $$math\_equation$$.
5. Piazza is not office hours: If a question is too broad or would require a long time to explain in person, etc. You may be asked to come to office hours to get it answered.
6. Discussion and collaboration: We encourage you to answer or comment on your fellow students' posts if you know the answer or would like to discuss. In fact, your participation in asking and answering questions will be part of your final grade.

Gradescope

All assignments (problem sets and exams) and must be submitted through Gradescope. You can find a link on bCourses, or https://www.gradescope.com/courses/170639. If you are not already signed up you can use the entry code M386EK, to gain access.

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Zoom

All Zoom meetings will be linked to in the Zoom section of the bCourses website. This includes recurring lecture, discussion, and office hours. If a private Zoom meeting is necessary, you will receive an email with a Zoom link.

Synchronous and Asynchronous

Lectures will be recorded and available to students. Attendance and participation in live synchronous lectures are strongly encouraged but not required. If a student is unable to participate in that way, they will be expected to view the recorded lecture and participate in group discussions asynchronously.

Grading (tentative)

Participation	10%
Problem Sets	15%
Midterm Exam	30%
Final Exam	45%

Participation

- You can earn a maximum of 4 points per week and a total of 26 points over the entire semester (so you do not need to do this every week!).
- You have multiple options for earning these points:
    - 2 points - One or more meaningful interactions during a live lecture (asking a question, answering my questions, raising a point, correcting my mistake, etc.)
    - 2 points - One or more meaningful interactions on Piazza (asking a question, answering a student's questions, explaining a topic, etc.)
    - 4 points - Submit a 'Create Your Own Question and Solution' about that week's material. (see section below)

'Create Your Own Question and Solution"

You may submit one 'Create Your Own Question and Solution' for possible inclusion on the exams. This question must be about the topic we covered in lectures that week, but other than that you are free to choose anything of interest to you.

The question and solution must be written by you and uniquely yours, but you may use the textbook, the reference material, the internet, or any other resources you want for inspiration. Make sure you cite your inspirational sources or declare that there are none.

I encourage you to take advantage of this as it will help you retain the material, be good practice for doing this on the exam (see Exam section below), and your question (or a variant) may even appear on future exams!

Problem Sets

There will be weekly problem sets of approximately 5 questions each. These will usually be posted before the first lecture of the week, and due before the first lecture of the next week.

I encourage you to work in groups of three to four people on problem sets, but everyone should write up their own solutions. There may be solutions to many of these problems from old or other courses on the internet; again, you should write up your own, in your own words, or showing your own steps. Since doing problems is the best way to prepare for exams, be sure that you clearly understand any parts that you may have gotten help with.

Your solutions must be submitted through Gradescope. Late problem set solutions will not be accepted. The lowest problem set grade will be dropped.

Your solutions will be graded as follows:
- 20 total points for each question (may be adjusted for problems of differing length or difficulty)
- 10 points - correct numerical solution
- 5 points - showing your work
- 5 points - demonstrating understanding of the basic concepts by explaining your steps and thought process

Exams

The Midterm will be made available on **October 13th 11:00 AM** and be due by **October 14th 11:00 AM**. It will cover all the material up until that point.

The Final exam will be made available on **December 15th 11:00 AM** and be due by **December 16th 11:00 AM**. It will cover all the material from the semester.

If you have any time conflicts or issues with this, please reach out as soon as you are aware of them so we can resolve them.

The format of the exams is (tentatively) set as follows:
- It will be a 'take home exam'
- You will have a 24-hour time period to complete it
- It will be open book and notes
- Your submitted solution must be typed/written by yourself and must be your work alone
- Show your work and give explanations to demonstrate that you understood the material

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- 2 'Create Your Own Question and Solution' (the topic, subject matter, or context may be given to you on the exam). These must be uniquely yours and remember to cite any source/inspiration in order to receive credit for this!

Your exams will be graded as follows:
- Standard Questions (similar in style and grading to Weekly Problem Sets)
- 'Create Your Own Question and Solution'
  - 30 total points for each question and solution
  - 3 points - Citing your inspiration or declaring that there is none (if your question is substantially similar to another students and you fail to cite your inspiration you will receive **no credit** for this question and the issue may be referred to the Center for Student Conduct)
  - 2 points - Question is of reasonably similar difficulty to weekly problem sets/standard questions
  - 5 points - Question is related to the specified context (e.g. related to a section in the textbook, an application, a concept, or the course in general)
  - 5 points - Question is expressed clearly and unambiguously
  - 5 points - Solution is numerically correct
  - 5 points - Solution shows work
  - 5 points - Question and Solution demonstrate understanding of the basic concept

Course Content

You will be responsible for Chapters 1 through 8 as well Section 9.2 of the textbook, except for the sections noted below.

Sections Not Covered

1.6 - The Number of Integer Solutions of Equations

2.6 - Probability as a Continuous Set Function

5.6 - Other Continuous Distributions

6.3.2 - Gamma Random Variables

6.6 - Order Statistics

6.7 - Joint Probability Distributions of Functions of Random Variables

6.8 - Exchangeable Random Variables

7.2.1 - Obtaining Bounds from Expectations via the Probabilistic Method

7.2.2 - The Maximum-Minimums Identity

7.3 - Moments of the Number of Events that Occur

7.8 - Additional Properties of Normal Random Variables
7.9 - General Definition of Expectation

8.6 - Bounding the Error Probability ...

Course Schedule (tentative)

Date	Topic	Notes
Week 1 8/27	Course Overview & Introduction	
Week 2 9/1 9/3	Combinatorics Sample Space & Events	Chapter 1 Section 2.2
Week 3 9/8 9/10	Axioms of Probability Probability Rules	Sections 2.3, 2.4 Section 2.5
Week 4 9/15 9/17	Conditional Probability & Bayes Theorem Independence	Sections 3.2, 3.3 Section 3.4, 3.5
Week 5 9/22 9/24	Discrete Random Variables Expectation & Variance	Sections 4.1, 4.2 Sections 4.3, 4.4, 4.5
Week 6 9/29 10/1	Bernoulli & Binomial Poisson & Others	Section 4.6 Section 4.7, 4.8
Week 7 10/6 10/8	Expected Value of Sums & CDFs Recap and Midterm Review	Sections 4.9, 4.10 (tentative!)
Week 8 **10/13** 10/15	**Mid Term** Continuous Random Variables	Sections 5.1, 5.2
Week 9 10/20 10/22	Uniform, Normal, & Exponential Distribution of a Function of a Random Variable	Sections 5.3,5.4,5.5 Section 5.7
Week 10 10/27	Joint Distributions	Sections 6.1, 6.2, 6.3

Date	Topic	Notes
10/29	Conditional Distributions	Sections 6.4, 6.5
Week 11 11/3 11/5	Expectation	Sections 7.1, 7.2, 7.4
Week 12 11/10 11/12	Conditional Expectation and MGFs	Sections 7.5, 7.6, 7.7
Week 13 11/17 11/19	Weak Law of Large Numbers & Central Limit Theorem	8.2, 8.3
Week 14 11/24 11/26	Strong Law of Large Numbers Thanksgiving Recess	8.4, 8.5
Week 15 12/1 12/3	Markov Chains Practical Simulation	9.2
Final Exam **12/16**	**Final Exam**	

Evaluation of Course

I strongly value students continued feedback, both positive and negative, throughout the semester. To that aim, there will be weekly opportunities to provide such feedback to your GSI at the end of discussion. You can choose to remain anonymous from me by requesting them not to share who you are. You can also post feedback on Piazza for me and the GSIs to see (it will not be anonymous to us). Of course, if there is anything that should be for me only, you can send me a direct email.

There will also be an opportunity to provide formal feedback and evaluate the course at the end of the semester.

Course Policies
Inclusion

We are committed to creating a learning environment welcoming of all students that supports a diversity of thoughts, perspectives and experiences, and respects your identities and backgrounds (including race/ethnicity, nationality, gender identity, socioeconomic class, sexual orientation, language, religion, ability, etc.) To help accomplish this:

If you have a name and/or set of pronouns that differ from those that appear in your official records, please let us know.

If you feel like your performance in the class is being impacted by your experiences outside of class (e.g., family matters, current events), please do not hesitate to come and talk with us. We want to be resources for you.

We (like many people) are still in the process of learning about diverse perspectives and identities. If something was said in class (by anyone) that made you feel uncomfortable, please talk to us about it. You may also contact the IEOR department's Faculty Equity Advisor, Prof. Paul Grirgas (pgrigas@berkeley.edu).

As a participant in this class, recognize that you can be proactive about making other students feel included and respected.

Berkeley honor code
Everyone in this class is expected to adhere to this code: "As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others."

Academic honesty
You are encouraged to form study groups and work together to understand course material, but all submitted work (unless explicitly exempted) should be your own. You may not copy other students' work. Academic integrity and ethical conduct are of utmost importance in the College of Engineering and at U.C. Berkeley.

Accommodation policy
I honor and respect the different learning needs of my students and am committed to ensuring you have the resources you need to succeed in this class. If you need religious or disability-related accommodations, if you have emergency medical information you wish to share with me, or if you need special arrangements in case the building must be evacuated, please share this information with me as soon as possible. See the Support Services and Resources section below for more details.

Support Services and Resources
I welcome the opportunity to work with you to ensure your learning experience is as effective as possible. If you anticipate or experience any barriers to learning in this

course, regardless of their cause, please reach out to me to discuss your concerns. I will do my best to develop an implementation plan together with you.

The Academic Accommodations Hub is the campus-wide portal for support resources and academic policies, including key accommodation information and links to mental health resources, resources for survivors of sexual violence and sexual harassment, and more. For College of Engineering specific information see Engineering Student Resources.

Below is a (non-comprehensive) list of various resources available to you which includes advising, tutoring, counseling, and financial aid, among many others. This will assist me achieve my goal of ensuring that my courses are Diverse, Equitable and Inclusive.

Note: Some of these services may have modified procedures due to the impact of Covid-19.

Disabled Students' Program (DSP)

If you have a disability, or think you may have a disability, you can work with the Disabled Students' Program (DSP) (260 César Chávez Student Center #4250; 510-642-0518; http://dsp.berkeley.edu) to request an official accommodation. Services are individually designed and based on the specific needs of each student as identified by DSP's Specialists. If you have already been approved for accommodations through DSP, please contact me so we can develop an implementation plan together.

Religious and Cultural Holidays

For religious and cultural holidays in which students may need academic accommodations, the Academic Accommodations Hub provides useful information; see Accommodation of Religious Creed.

Technical Equipment

Students in need of technical equipment for classes are strongly encouraged to apply for the Student Technology Equity Program (technology.berkeley.edu/STEP). The program provides free loaner laptops, Wi-Fi hotspots with paid data plans, web cameras, noise-cancelling headphones and other technology to students in need.

Center for Access to Engineering Excellence (CAEE)

The Center for Access to Engineering Excellence (227 Bechtel Engineering Center; https://engineering.berkeley.edu/student-services/academic-support) is an inclusive center that offers study spaces, nutritious snacks, and tutoring in >50 courses for Berkeley engineers and other majors across campus. The Center also offers a wide range of professional development, leadership, and wellness programs, and loans iclickers, laptops, and professional attire for interviews.

Counseling and Psychological Services

The main University Health Services Counseling and Psychological Services staff is located at the Tang Center (http://uhs.berkeley.edu; 2222 Bancroft Way; 642-9494) and provides confidential assistance to students managing problems that can emerge from illness such as financial, academic, legal, family concerns, and more.

To improve access for engineering students, a licensed psychologist from the Tang Center also holds walk-in appointments for confidential counseling in 241 Bechtel Engineering Center (check here for schedule: https://engineering.berkeley.edu/student-services/advising-counseling).

The Care Line (PATH to Care Center)

The Care Line (510-643-2005; https://care.berkeley.edu/care-line/) is a 24/7, confidential, free, campus-based resource for urgent support around sexual assault, sexual harassment, interpersonal violence, stalking, and invasion of sexual privacy. The Care Line will connect you with a confidential advocate for trauma-informed crisis support including time-sensitive information, securing urgent safety resources, and accompaniment to medical care or reporting.

Ombudsperson for Students

The Ombudsperson for Students (102 Sproul Hall; 642-5754; http://students.berkeley.edu/Ombuds) provides a confidential service for students involved in a University-related problem (academic or administrative), acting as a neutral complaint resolver and not as an advocate for any of the parties involved in a dispute. The Ombudsman can provide information on policies and procedures affecting students, facilitate students' contact with services able to assist in resolving the problem, and assist students in complaints concerning improper application of University policies or procedures. All matters referred to this office are held in strict confidence. The only exceptions, at the sole discretion of the Ombudsman, are cases where there appears to be imminent threat of serious harm.

UC Berkeley Food Pantry

The UC Berkeley Food Pantry (#68 Martin Luther King Student Union; https://pantry.berkeley.edu) aims to reduce food insecurity among students and staff at UC Berkeley, especially the lack of nutritious food. Students and staff can visit the pantry as many times as they need and take as much as they need while being mindful that it is a shared resource. The pantry operates on a self-assessed need basis; there are no eligibility requirements. The pantry is not for students and staff who need supplemental snacking food, but rather, core food support.