ECE 302: Introduction to Probability

Fall 2024
(Last Updated: August 18, 2024)

Lecture Time: Tuesday and Thursday 4:30pm - 5:45pm
Lecture Location: Nelson Hall of Food Science Room 1195
Course Webpage: https://gauenk.github.io/ece302_fall24.html
Piazza: https://piazza.com/class/lzrlbkdauuz2li/
Office Hours: All office hours are posted on the course webpage
CRN: 33392
Credit Hours: 3 hours

Instructor: Kent Gauen, gauenk@purdue.edu

Graduate TAs (GTAs):

TBD

Duties: The GTA will be responsible for hosting Office Hours, managing Homework grades, and monitoring Piazza. The GTA will focus their efforts on more challenging aspects of the course. They have full authority to handle requests (late homeworks, absences due to medical issues, DRC requests). The GTA oversees the UTA team along with the instructor.

Undergraduate TAs (UTA):

TBD

Duties: The UTA team serves as your primary point of contact for questions about ECE 302 course content. The UTA team hosts office hours, grades your homework, and answers Piazza questions.

Course Objectives:

ECE 302 course presents an introduction to probability and random process for Electrical and Computer Engineering students. The goal of this class is to build up your literacy in probability. Much like any langauge course, we will be committed to formalism. This class starts your journey of learning *the language of data*. Application are wide-spread include computer vision, natual language processing, audio processing, geospatial data analysis, robitic manipulation, and more. Official learning outcomes are available here. By then end of this course, you will have

- an ability to formulate simple engineering problems using a probabilistic approach
- experience in using computers to solve probability problems
- a solid background in probability and random processes that can help you take further coursework

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Textbook:

- S. H. Chan, Introduction to Probability for Data Science, Michigan University Publishing, 2021. Freely available on https://probability4datascience.com/

Additional References:

- Ward, M., & Gundlach, E. (2015). Introduction to Probability (1st ed.). W.H. Freeman.
- Statistical Rethinking: A Bayesian Course with Examples in R and Stan availble on https://github.com/rmcelreath/stat_rethinking_2023; There are several good lecture notes and homework problems.
- Schaum's Outline of Probability, Random Variables, and Random Processes, Fourth Edition (Paperback); 405 fully solved problems.

Pre-requisites:

(MA 26200 or MA 26600 or MA 36600) and ECE 30100 [may be taken concurrently]

ECE 302 requires students to be familiar with calculus. We will be using two-dimensional integrals.

The dependency of ECE 301 is only to prepare you to work for convolution and Fourier Transforms.

Our homework requires a bit of Python programming, but the work will be doable even if you are uncomfortable with or newer to coding.

Grades:

- Homework: 35%. There are 11 homework assignments. We will drop the worst homework. Please submit your homework through **Gradescope** by Friday at 11:59pm EDT. A random subset of homework problems will be chosen to be graded for each homework assignment. Each homework problem will be graded on correctness and completeness using the following scale:
  - 2 = Complete and Correct
  - 1 = Incomplete and/or Some Major Mistakes
  - 0 = No attempt and/or Many Major Mistakes
- Late Homework: We allow one late homework submission without penalty, as long as it is no more than 4 days late. Further late homework will be accepted with the following penalties:
  - 1 day late = 40% penalty
  - 2 days late = 60% penalty
  - 3 days late = 80% penalty
  - 4 or more days late = 100% penalty (no points)
- Two Midterms: 20% Each. There are two midterm exams. All exams are in-person, closed note, and does not allow calculators.
  - Midterm 1: September 19th
  - Midterm 2: October 31st
- Final Exam: 25%. The final exam date will be given by Purdue later in the semester. The final exam is in-person, closed note, and does not allow calculators.

Grades Cut-Offs:

The following lists the guaranteed grade ranges. Grades are usually curved at the end of the semester, but the curve will only improve your grade. We reserve the right to add "+" or "-" to any grade in any range.

- A: 85% - 100%
- B: 75% - 85%
- C or C-: 65% - 75%
- D or F: 0% - 65%

Make-up Exam Policy:

We do NOT offer make-up exams unless the circumstance is exceptional, e.g., serious illness (with doctor certificate) and civil service (Jury duty or military training, with proofs). Should any of these happen, please reach out to the instructor. No make-up exam will be made due to travel schedule. You should not travel before the end of the final exam week (including the last Saturday). We reserve the right to decline any makeup exam request. If you must miss an exam, please email Kent Gauen (gauenk@purdue.edu). Please note if you must miss an exam, this will likely *not* result in a 0%. We will discuss details on a case-by-case basis.

Re-Grade Policy

Homework: Please submit a re-grade request within 48 hours of the published grade.

Exam: Please submit your request to Gradescope within 48 hours of the published grade. When submitting your request, please write your question clearly. Our re-grade policy is that we will give you points which you deserve if the mistake is proven on our side. However, if we find new mistakes that are not spotted in the first grading, we will take your points off, regardless of where these mistakes are. If after re-grade you are still unhappy, you can appeal to the GTA and/or instructor.

Any decision made by the GTA and/or instructor will be final.

Academic Dishonesty:

We respect you as adults, and we expect you behave as adults. Therefore, we ask you to be honest and ethical in the course. In that respect, any action that might give a student unfair advantage on homework or exams will be considered dishonest. Examples include, but are not limited to:

- Sharing information during exam
- Using forbidden material or device during exam
- Viewing and/or working on an exam before or after the official time allowed
- Requesting a re-grade of work that has been altered
- Copying from your friend's homework
- Submitting works generated by ChatGPT (and any kinds of AI tools)
- Plagiarism, including copying questions from books without properly citing them

All cases of academic dishonesty will be reported to the Office of Student Rights and Responsibilities, and will result in punishment. Possible punishments include, but are not limited to, a score of zero on work related to the cheating incident, a failing grade for the course, and, in severe cases, expulsion from the university.

Copyright of Course Material:

All ECE 302 course material, including lecture, homework, project, solutions and exams are protected by copyright law. Without Prof Stanley Chan's permission and Kent Gauen's permission, you are not allowed to distribute through any media including online sources. Below is an excerpt from http://www.purdue.edu/studentregulations/student_conduct/misc.html:

... Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally. Notes taken in class are, however, generally considered to be "derivative works" of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor...

Emergency Procedure:

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

Nondiscrimination Statement:

A hyperlink to Purdue's full Nondiscrimination Policy Statement is included here.

Basic Needs Security:

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday.

Mental Health/Wellness Statement:

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try Therapy Assistance Online (TAO), a web and app-based mental health resource available courtesy of CAPS.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc., sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell.

Attendance Policy:

Attendance of lectures is not required, but the lectures will not be posted online. Midterms 1 and 2 will be in-class, and attendance is (of course) required.

Schedule

The following outline is a tentative schedule of the topics that we will cover in this course. Please refer to the course website for the finalized version.

Week	Date	The Story Line	Topic		Homework
1	Aug 20	Basic Concepts	Course Logistics. Review	1.1, 1.2, 1.3, 1.4, 1.5	
	Aug 22	Basic Concepts	Sets, Probability Space, Axioms	2.1, 2.2, 2.3	HW0
2	Aug 27	Basic Concepts	Conditional Probability, Independence	2.4, 2.5	
	Aug 29	Basic Concepts	Bayes Theorem, Random Variables	2.6, 3.1	HW1
3	Sept 3	Discrete Random Variables	PMF, CDF	3.2, 3.3	
	Sept 5	Discrete Random Variables	Expectation, Variance	3.4, 3.5	HW2
4	Sept 10	Discrete Random Variables	Bernoulli, Binomial	3.6, 3.7	
	Sept 12	Discrete Random Variables	Geometric, Poisson	3.8, 3.9	HW3
5	Sept 17	Exam Prep	Review Midterm 1 Content		
	Sept 19	Exam	Midterm 1. In-class, no calculator, closed-note		
6	Sept 24	Continuous Random Variables	PDF, Expectation	4.1, 4.2	
	Sept 26	Continuous Random Variables	CDF & Mode	4.3 & 4.4	HW4
7	Oct 1	Continuous Random Variables	Uniform, Exponential	4.5, 4.6	
	Oct 3	Continuous Random Variables	Gaussian, Function of random variable	4.7, 4.8	HW5
8	Oct 8	No Class	Fall Break		
	Oct 10	Handling Dependency	Joint PDF, Joint expectation	5.1, 5.2	HW6
9	Oct 15	Handling Dependency	Conditional Expectation	5.3, 5.4	
	Oct 17	Handling Dependency	Function of two variables	5.5	HW7
10	Oct 22	Handling Dependency	Sum of two variables	5.6	
	Oct 24	Handling Dependency	Random Vectors	5.8	HW8
11	Oct 29	Exam Prep	Review Midterm 2 Content		
	Oct 31	Exam	Midterm 2. In-class, no calculator, closed-note		
12	Nov 5	Extracting Information	ML estimation (MLE)	8.1, 8.2	
	Nov 7	Extracting Information	MLE with a Neural Network	Class Notes	HW9
13	Nov 12	Odds and Ends	Law of Large Numbers, Central Limit Theorem	6.3, 6.4, 6.5	
	Nov 14	Odds and Ends	Moment Gen. and Characteristic Function	6.1, 6.2	HW10
14	Nov 19	Stochastic Processes	Intro to Random Processes & Mean Functions	10.1, 10.2	
	Nov 21	Stochastic Processes	Autocorrelations & Autocovariance	10.3, 10.4	
15	Nov 26	Stochastic Processes	Poisson Process		
	Nov 28	No Class	Thanksgiving Break		HW11
16	Dec 3	Fun Day	DRAW: A Fun Application of Probability	DRAW	
	Dec 5	Exam Prep	Review Final Exam Content		
17	Finals (TBD)		Final Exam. No calculator, closed-note		

