
- Time and Room: MWF 9:30-10:30, 1311 EECS.
  Discussion: T 5-6, 1303 EECS.

Lectures serve to introduce new concepts. They have an overview nature, but also include some simple motivating applications. More complex examples are considered in the discussion sections, which you are expected to attend.

- Faculty Instructor: Serap Savari, 4225 EECS, savari@eecs.umich.edu, (734) 763-3561.
  Office hours: W 10:30-11:30, 1-4, or by appointment.

- Graduate Student Instructor: Changhun Bae, 2420 EECS, changhun@umich.edu.
  Office Hours: R 3-6.

- Tentative Course Web Page: http://www.eecs.umich.edu/courses/eecs401/

- Description: EECS 401 is a fundamental subject concerned with the nature, formulation and analysis of uncertain or random situations. Probabilistic modeling is a critical tool common to communication, signal processing and control theory.


- Prerequisites: (i) EECS 306 or graduate standing
  (ii) Exposure to mathematical concepts such as sets, functions, etc., is expected. An understanding of the application of calculus to the solution of physical problems and the ability to interpret mathematical calculations is required.

- Students may take either EECS 401 or Math 425, but not both.

Some of the differences between EECS 401 and Math 425:
(i) If you have not completed EECS 306 or an equivalent linear systems course, you should take Math 425.
(ii) Math 425 is a slower-paced course that covers probability theory but less of statistics and random processes. The statistics and random processes part of EECS 401 is essential material for students who go on to take communication courses.
(iii) EECS 401 is the only acceptable prerequisite to EECS 455.
(iv) EECS 401 is a four credit course. Math 425 is a three credit course.
(v) The degree requirements will differ for the EE-BSE degree depending upon which course you take, although the total number of credits needed to graduate is the same for both.

- The required text for the course is *Introduction to probability* by D. Bertsekas and J. Tsitsiklis.

The following books are on reserve:
(i) *A first course in probability* by S. Ross,
(ii) *Introduction to probability models* by S. Ross,
(iii) *The art of probability: for scientists and engineers* by R. Hamming,
(iv) *Fundamentals of applied probability theory* by A. Drake,
(v) *Elementary probability* by D. Stirzaker,
(vi) *Probability and random processes with applications to signal processing* by H. Stark and J. Woods,
(vii) *Probability and stochastic processes for engineers* by C. Helstrom,
(viii) *Probability and random processes for electrical engineering* by A. Leon-Garcia,

- **Homework:** There will be approximately eleven problem sets. Your lowest score will be dropped in determining your homework average. Late homework will not be accepted, except in extenuating circumstances such as serious illness.

- **Collaboration policy:** All homework assignments are to be completed on your own. You are allowed to consult with other students during the conceptualization of a solution, but all written work, whether in scrap or final form, is to be generated by you working alone. You are also not allowed to use, or in anyway derive advantage from, the existence of solutions prepared in prior years. Violation of this policy is an honor code violation, subject to the honor code penalties.

- **Study habits:** The study of probability and random processes is fun but can require considerable patience because you have to learn a completely different way of thinking about systems. It would be difficult to absorb these new ideas by just pulling all-nighters before the homework is due and cramming before exams. **This is not a course where you can do well on exams solely by blindly applying formulas.** In order to get the most out of the course, try to stay ahead. By the weekend, make sure you have at least reviewed the material covered in the lectures and readings of the preceding week. In addition to reading, working out extra exercises on your own will help in improving your understanding of the material. With diligent practice, you can prepare yourself to the point where, on exams, instinct takes over and the problems seem straightforward.

- **E-mail announcements:** Announcements (e.g. announcements of homework assignments, homework problem hints and corrections, exam schedules, etc.) will be emailed to the class.

- **Exams:** Diagnostic quiz in discussion section next week
  First midterm (1.5 hours, closed book) on Friday, February 16 at 5:00 PM. Room EECS 1301.
  Second midterm (2 hours, closed book) on Friday, March 23 at 5:00 PM. Room EECS 1301.
  Final exam (2 hours, closed book) on Wednesday, April 25 at 10:30 AM.

- **Grading:** 0% diagnostic quiz (unless you don’t take it, in which case
  5% is **deducted** from your final grade)
  10% homework (your lowest score won’t be counted)
  20% first midterm exam
  30% second midterm exam
  40% final exam

The final letter grade will be determined primarily by the curve set by the undergraduate students in the course. The separation between letter grades for graduate students may be slightly different than for the undergraduates. For undergraduates the break between B and B− will be approximately set at the average. **Your grade will be solely based on your performance in this course** and not on outside factors like your wish to graduate this semester.
Course Outline

Week 1: Discussion of syllabus.  
Reading: §1.1-1.2

Reading: §1.1-1.3, 1.5

Week 3: No class on Monday, January 15. 
Theorem of total probability. Bayes’ rule. Combinatorics.  
Reading: §1.4, 1.6, 1.7

Week 4: More combinatorics.  
Random variables. Probability mass functions. Expectation, variance, LOTUS.  
Reading: §1.6, 1.7, 2.1-2.4

Week 5: Data compression and Huffman coding.  
Joint probability mass functions. Functions of random variables.  
Conditional probability mass function. Conditional expectation.  
Reading: §2.3, 2.5, 2.6

Week 6: Independence and conditional independence of random variables.  
Continuous random variables and probability density functions.  
Multiple continuous random variables.  
Reading: §2.7, 2.8, 3.1-3.3, 3.5

Week 7: First midterm on Friday, February 16, 5-6:30 PM. Room EECS 1301.  
Conditional probability density functions.  
Independence, expectation, and variance for conditional random variables. Double conditioning.  
Derived probability density functions.  
Reading: §3.4-3.7, 4.3

Week 8: Sums of independent random variables. Convolution.  
Transforms. Moment-generating properties.  
Reading: §4.1-4.4

Week 9: Significance testing. Hypothesis testing. Estimation.  
Reading: §4.6 and supplementary readings

Reading: §5.1, 5.2

Week 11: Second midterm on Friday, March 23, 5-7 PM. Room EECS 1301.  
More on Poisson processes.  
Reading: §5.2, 5.3
Week 12: Markov chains: state classification, steady-state probabilities.
Reading: §6.1-6.3

Markov and Chebyshev inequalities.
Weak law of large numbers. Convergence in probability.
Reading: §6.2, 6.3, 7.1-7.3

Week 14: Gaussian random variables. Bivariate normal distribution.
Central limit theorem. Approximations based on the central limit theorem.
Reading: §3.3, 4.7, 7.4

Week 15: Approximations to the binomial probability mass function.
Reading: pp. 282-285, §7.4

Final Exam on Wednesday, April 25 from 10:30 AM - 12:30 PM.