S Y L L A B U S: EE 503

PROBABILITY FOR ELECTRICAL AND COMPUTER ENGINEERS

Fall 2025   Professor Kosko
Lecture: Friday 2:00 – 6:00 pm   Office: EEB 438
email: kosko@usc.edu   Hours: Wed 5 - 6
voicemail: (213) 740 - 6242   Fri   6 - 7

Course Summary: The course focuses on _reasoning with probabilistic uncertainty_.
This involves developing _careful_ skills in logical reasoning and applying those skills to a
wide range of problems in probabilistic and statistical inference from signal processing to
machine learning. The course depends primarily on lecture material and handouts.
Attendance is **mandatory**. There are weekly exams and no make-ups. Unexcused
absences or departures result in an automatic exam score of zero.

COURSE OUTLINE

AUG 29:   Logic and sets. Proof technique. Sigma-algebras. Probability axioms.
SEP 5:   Uncountability. Borel sigma-algebra. Independence. Total probability.
SEP 12:   Combinatorics. Limits of sequences and sets. Borel-Cantelli Lemmas.
SEP 19:   Discrete densities. Probabilistic _until_. Poisson law. Approximations.
SEP 26:   Random variables. Continuous densities. Bayesian conjugate inference.
OCT 3:   Expectations and higher moments of random variables.
OCT 8:   Covariance. Correlation. Uncertainty principles. NOTE: _Wednesday_ at 6
OCT 10:   No class: Fall Recess. (Class rescheduled to October 9th at 6 pm.)
OCT 17:   Stochastic convergence of random sequences. Laws of large numbers.
OCT 24:   Conditional expectations. S.I.T. Technique. Maximum likelihood.
OCT 31:   Transformed densities. Monte Carlo. Entropy and information. Mixtures.
NOV 7:   Central limit theorem. Confidence and credible intervals. _R_ simulations.
NOV 14:   Financial engineering: probabilistic highlights. Martingales. Queues.
NOV 21:   Markov processes and queues. Optimal estimation. Multiple regression.
NOV 28:   No class: Thanksgiving holiday.
DEC 5:   Markov chains. Bayesian regression. Advanced applications. Review.
DEC 12:   FINAL EXAM: 2 – 4 pm.

Required text: Gubner, J. A., _Probability and Random Processes for Electrical and
   Computer Engineers_, Cambridge University Press, 2006.
Recommended texts: Leon-Garcia, A., _Probability, Statistics, and Random Processes for
   Electrical Engineering_, Prentice Hall, 2008.
   Efron, B., Hastie, T., _Computer Age Statistical Inference: Algorithms, Evidence, and
Data Science_, Cambridge University Press, 2016.
   Harchol-Balter, M., _Probability for Computing_, Cambridge University Press, 2024.

Note: **The texts are a _distant second_ to in-class lecture material and homework sets**.

GRADING PROCEDURE

Summary: Class grade depends on weekly exams and the final exam. Homework problems are optional. Homework problems from the text do not count. Homework handouts count as extra credit.

1. **Weekly Exams**. 13 weekly exams. **Closed book**. 10 minutes per exam. No make-up exams. Each weekly exam is worth 6 points. Missed exams earn 0 points. The total weekly-exam score counts as 60 points or 60% of the final grade. The total weekly-exam score sums your 10 best midterm exam scores. We ignore your three worst scores. Algorithm: Label your weekly exam scores from lowest to highest: $w_1 \leq \ldots \leq w_{13}$. Then $w_4 + \ldots + w_{13}$ is your total weekly-exam score. Class attendance is *mandatory*. **<u>Unexcused absences get an automatic exam score of zero for that session's exam grade.</u>**

2. **Final Exam**. Worth 40 points. Cumulative. **Closed book**.

3. **Homework Problems**. Textbook problems are checked but not graded. Homework handout problems are graded but count only as optional points. They count at most as 10 points if *all* homework sets turned in and accurately worked. Grade remains as is if only some homework turned in. How much homework affects which cases is at the discretion of the instructor and the teaching assistant. Students may discuss homework problems among themselves but each student must do his or her own work. Cheating warrants an F in the course. Turning in identical homework sets counts as cheating.

4. **Course Grade**. 100 points possible in course.
A if 90 - 100 points
B if 80 - 89 points
C if 70 - 79 points
D if 60 - 69 points
F if   0 - 59 points .

5. **Cheating**. Not tolerated on homework or exams. Penalty ranges from F on exam to F in course to recommended expulsion.

6. Statement for Students with Disabilities. Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

7. Statement on 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 located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

8. Academic Conduct
Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

9. Support Systems
A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the

American Language Institute http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* http://emergency.usc.edu will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.