USC Viterbi
School of Engineering

EE364: Introduction to Probability and Statistics for EE/CS (Spring Dandelion)

This is a draft syllabus produced to post on the USC classes list. It will not be updated. The official syllabus will be available to enrolled students through piazza when the class starts.

Units:	4
Instructor:	Keith M. Chugg EEB 500A (5th floor main office) 213-740-7294 (Voice) zoom: https://usc.zoom.us/my/keithchugg chugg@usc.edu – Include 364 in subject
Office Hours:	TBD
TA:	TBD
Office:	TBD
Phone:	TBD
	foo@usc.edu – Include 364 in subject
Office Hours:	TBD
Grader:	TBD
	foo@usc.edu – Include 364 in subject
Office:	No office hours, email only for questions on grading. Grader is not a TA.
CARDINAL Lecture:	Tuesday, Thursday, 12:00 – 1:50 PM in VHE 217
GOLD Lecture:	Tuesday, Thursday, 3:30 – 5:20 PM in LVL 16
Discussion 1:	Monday, 3:00 – 3:50 PM in MHP B7B
Discussion 2:	Monday, 6:00 – 6:50 PM in GFS 207 – discussions are decoupled from lecture – attend whichever you prefer
Webpages:	– Piazza Class Page for most everything but grades and code – USC Blackboard Class Page for grades – Instructor's Teaching Page problem sets and handouts – Github for code examples – All HWs, handouts, solutions will be posted in PDF format – You can use whatever language you wish, instructor will use mostly Python – *Student has the responsibility to stay current with webpage material*
Prereq:	MATH 225 or MATH 245
Other Requirements:	Basic computer skills (e.g., plotting, Python or Matlab or other).
Grading:	20% Homework 23% Midterm Exam 1 (1 hour, 20 minutes) 23% Midterm Exam 2 (1 hour, 20 minutes) 34% Final Exam (2 hours)

Note on e-mail vs. Piazza: If you have a question about the material or logistics of the class and wish to ask it electronically, please post it on the piazza page (not e-mail). You may post it anonymously if you wish. Often times, if one student has a question/comment, other also have a similar question/comment. Use e-mail with the professor, TA, graders only for issues that are specific to your

individually (e.g., a scheduling issue or grade issue). You can post autonomously on piazza. Please do not us a private post on piazza.

Catalogue Description: Introduction to concepts of randomness and uncertainty: probability, random variables, statistics. Applications to digital communications, signal processing, automatic control, computer engineering and computer science.

Learning Objectives: Upon successful completion of this course a student will

- Understand probability as a model for uncertainty
- Be able to perform basic set probability relations including conditional probabilities and Bayes' Law
- Understand random variables as models for numerical measurements with uncertainty
- Use the complete statistical characterization of random variables (e.g., distribution and density functions) to compute probabilities
- Develop novel probability distributions given a description of a random experiment.
- Interpret the incomplete statistical characterization of random variables, such as mean and variance, to draw qualitative and quantitative conclusions.
- Be able to apply common distributions such as Gaussian, Poisson, Binomial, Exponential and uniform to solve problems as appropriate.
- Utilize joint distributions and joint moments to compute probabilities and make estimates of random variables.
- Understand the Law of Large Numbers and Central Limit Theorem and their relation to statistical analysis.
- Apply basic confidence interval formulas to characterize the accuracy of estimates from experimental data
- Make decisions between a finite set of hypotheses from experimental data
- Perform linear regression to estimate one variable from another using experimental data.

Exam Dates:

- **Midterm Exam 1:** Thursday, February 24 (TBR, finalized Lecture 1)
- **Midterm Exam 2:** Tuesday, April 5 (TBR, finalized Lecture 1)
- **CARDINAL Final Exam::** Wednesday, May 11, 2:00 – 4:00 PM as set by the university
- **GOLD Final Exam::** Tuesday, May 10, 2:00 – 4:00 PM as set by the university

Grading Policies:

- **Final grades** will be assigned by a combination of student score distribution (curve) and the discretion of the instructor. Final grades are nonnegotiable.
  - Final grades are non-negotiable and are assigned at the discretion of the instructor. If you cannot accept this condition, you should not enroll in this course.
- **Homework Policy**
  - **Late HW** will not be accepted. A late assignment results in a zero grade. Please have your homework turned in by the beginning of lecture on the date that it is due.
  - Homework will be assigned and collected weekly
  - Show your work in your homework solution; the correct answer alone is worth only partial credit.
  - Homework collaboration is encouraged. This is discussing problems and solution strategies with your classmates, the TA, and/or the instructor and is to be distinguished from copying solutions of others which is prohibited.
- **Exam Policy**
  - **Make-up Exams:** No make-up exams will be given. If you cannot make the above dates due to a class schedule conflict, you must notify me by the last day to add/drop. If I cannot accommodate your schedule, you must drop the class. In the case of a medical emergency, a signed letter from your doctor is required. This letter must include the telephone number of your doctor.
  - Exams will be closed book (possibly with a crib sheet allowed).
  - The weight of each exam in the course grade is proportional to the duration of the exam.
  - All exams are cumulative, but with an emphasis on material presented since the last exam.
- **Attendance:** Lecture attendance is encouraged but not mandatory. However, students are responsible for all material presented in lecture.

Textbooks:

- **Required Textbooks:** no textbook is required, but it is recommended that you have a text in probability for your reference.
- **Optional Textbooks:**

1. Charles Boncelet, Probability, Statistics, and Random Variables, Oxford University Press, 2016.
2. A. Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, 3rd Edition, Addison Wesley, 2008. (early editions are acceptable, just verify any problems assigned)
3. Bruce Hajek's Course Notes for ECE 313 at UIUC
4. Robert V. Hogg and Elliot A. Tanis, Probability and Statistical Inference, 8th Ed., Prentice-Hall.

- Bonocelet follows the same order of topics that I will cover. The level of presentation for many topics is more similar to that of Leon-Garcia or Hajek. Chapters and sections in the outline that follows are from Bonocelet.

Course Outline

1. Introduction and Motivation
   (a) Modeling, mathematics, measurements, and engineering pragmatism
   (b) Probability, statistics, and superstition
   (c) How EE/CS people use probability and statistics
2. Probability basics **[Ch. 1-3, 6.1-6.2]**
   (a) Mathematical formalisms
   (b) Set probability
   (c) Statistical Independence
   (d) Combinatorics (counting)
   (e) Introduction to Binomial Probability Distribution
   (f) Conditional Probability and Bayes' Law
   (g) Maximum Likelihood and Maximum A-Priori Decisions
3. Single, Discrete Random Variables **[Ch. 4]**
   (a) Complete Statistical Description (probability mass functions)
   (b) Common Discrete Random Variables
   (c) Incomplete Statistical Description (mean, variance, moments, tail bounds).

   MIDTERM 1
4. Multiple Discrete Random Variables **[Ch. 5]**
   (a) Joint, marginal, and conditional distributions
   (b) Independent random variables
   (c) Incomplete statistical descriptions (mean, variance, moments, covariance)
   (d) Example dsitrubtions
   (e) MMSE Estimation and Conditional Expectation
5. Continuous Random Variables **[Ch. 7-9]**
   (a) Cumulative Distribution Function
   (b) Probability Density Function
   (c) Joint, marginal, and conditional distributions
   (d) Independent random variables
   (e) Incomplete statistical descriptions (mean, variance, moments, covariance)
   (f) Example dsitrubtions
   (g) MMSE Estimation and Conditional Expectation
6. Introduction to Statistics **[Ch. 10-12]**
   (a) Random sampling

(b) Sample mean

(c) The Central Limit theorem and Law of Large Numbers
MIDTERM 2 approximately here

(d) Sample variance

(e) t-ditribution and F-distribution

(f) Confidence intervals on the mean

(g) Estimation of proportions and probability

(h) Linear Regression

(i) Hypothesis Testing as application of the sample mean confidence interval

Notes:

- My practice is to post lecture summaries after each lecture.
- We will not cover every section of every listed chapter. I will provide details as we progress through the book.
- I will extensively utilize spreadsheets and simple computer scripts (primarily Python) to build intuition. Homework assignments will typically involve at least one computational problem. Students are encouraged to become proficient in these methods during the course.
- Computational problems can be done in any language, but I will use Python primarily. If you do not know Python, you are encouraged to use this class to obtain basic knowledge of Python.
- The discussion material is determined by the students. Please provide suggestions and questions to the TA beforehand. If you show up to discussion and ask no questions, the TA will present summaries of the material and work example problems. The TA will not work the HW problems for you in discussion, although the TA will provide hints/help.

Statement on Academic Conduct and Support Systems

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 Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct.

Support Systems:

Student Health Counseling Services – (213) 740-7711, 24/7 on call. Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline – 1 (800) 273-8255, 24/7 on call suicidepreventionlifeline.org Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900, 24/7 on call Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) and Title IX – (213) 740-5086 Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support – (213) 740-2421 Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs – (213) 740-0776 Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy – (213) 821-4710 Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC – (213) 740-2101 Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000, 24/7 on call Emergency assistance and

avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120, 24/7 on call Non-emergency assistance or information.