JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

Syllabus
Probability and Statistics EN.550.310 Summer, 2017
(4 credits, EQ)

Description

An introduction to probability and statistics at the calculus level, intended for engineering and science students planning to take only one course on the topics. Combinatorial probability, independence, conditional probability, random variables, expectation and moments, limit theory, estimation, confidence intervals, hypothesis testing, tests of means and variances, goodness-of-fit. Recommended co-requisite: multivariable calculus.
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Students cannot receive credit for both EN.550.310 and EN.550.311. Students cannot receive credit for EN.550.310 after having received credit for EN.550.420 or EN.550.430.

Prerequisites

- Calculus I (AS.110.106 OR AS.110.108) AND Calculus II (AS.110.107 OR AS.110.109)
- Statistics Sequence restriction: students who have completed any of these courses may not register: EN.550.311 OR EN.560.435 OR EN.550.420 OR EN.550.430

Instructor

Prashant Athavale, pathava1@jhu.edu
Website: http://www.ams.jhu.edu/~prashant/index.html
Office: Whitehead 208-B, 410-516-7596
Office hours: Mondays, Tuesdays, Wednesdays, Thursdays at 11:00 am to 12:00 pm, or by appointment

Lecture Meetings

Mondays, Tuesdays, Wednesdays, and Thursdays 1:00 pm - 3:30 pm

Textbook

Sheldon Ross, *Introduction to Probability and Statistics for Scientists and Engineers*, 5^{th} edition, Academic Press (2014). 4^{th} edition is freely available electronically via our library.

Online Resources

Please log in to Blackboard for all materials related to this course.

Course Topics

- Experiments, elementary outcomes, Sample spaces, events, basic set theory related to events - union, intersection, complementation, Venn diagram representations, subsets/containment, mutual exclusivity (pair-wise disjointness)

- Axioms of probability, examples, sample spaces having equally-likely outcomes
- The notion of conditional probability, definitions, the multiplicative rule of conditional probability, the Bayes' rule.
- Independent events, intuitive meaning of independence, definition of two events being independent, definition of three or more events being independent.
- The notion of random variables, discrete versus continuous random variables and the associated (probability) distributions of individual random variables, probability mass functions (pmfs) and probability density functions (pdfs).
- Collections of random variables and their joint distributions, the notion of independence of random variables, joint distributions, conditional distributions.
- Expectation/expected value of random variables and functions of random variables, properties of expectation
- Variance of random variables, standard deviation of random variables, covariance between two random variables
- Moment-generating functions (mgfs) , properties of mgfs
  mgfs do not always exist, but when they do, they can uniquely identify probability distributions.
- Important probability mass functions : Bernoulli, Binomial, Poisson, Hypergeometric, discrete uniform
- Important pdfs : Uniform, Exponential, Gamma, Normal (Gaussian)
- Other important probability density functions : the Chi-square, the student's t-distribution, the F-distribution
- Random sampling from infinite populations, sampling statistics, examples are the sample mean and sample variance, distributions associated with certain random samples
- Large sample theory, the Central Limit Theorem (CLT), consequences of the CLT and the large sample distribution of the sample mean.
- Parameter estimation: random intervals and confidence intervals from large random samples; specific examples of normal random sampling, Bernoulli sampling, some two- sample inferences: difference in population means or population proportions in the case of independent random samples.
- Parameter estimation (continued): maximum likelihood estimation
- Statistical hypothesis testing, significance levels, critical/rejection regions, test statistics and their (conditional) distributions, p-values, drawing conclusions from hypothesis tests, testing for a normal population mean, or normal population variance, testing two population means in the case of normal random sampling, small sample t-tests, and paired t-tests.
- Analysis of variance (ANOVA), overview and meaning, underlying assumptions for standard ANOVA one-way classification, associated designs of experiments: completely randomized designs, randomized block designs: Sum of squares, Mean square error, associated F-test for testing for equality of treatment means.
- Other topics as time permits: Chi-square goodness-of-fit test.

Course Expectations & Grading
The final grade will be decided upon homework (20 %), quizzes (20%), midterm exam (30% each), and one cumulative final exam (30%). Quizzes will be given during the discussion meetings. There will be no make-up quizzes, homework, or exams. Three least quiz scores, and three least homework scores will be dropped. The letter-grades for the overall percentage will be as follows:

A- / A / A+ : 90 - 100 %
B-/ B / B+ : 80 - 89 %
C- / C / C+ : 70 - 79 %
D : 60 - 69 %
F : 0 - 59 %

Policy regarding the quizzes: There will be 13 quizzes. The quizzes will be given at the beginning of the class on Tuesdays, Wednesdays, and Thursdays. There will be no make-up quizzes under any circumstances. We will drop the least 3 scores from the quizzes.

Policy regarding the homework: Homework will be assigned on Thursdays. The homework will be due on Monday in the class. No late homework will be accepted. One least score on the homework will be dropped.

Midterm and final exam will be cumulative.

Attendance: I can not overemphasize the importance of attendance. It has been shown than even missing 2 lectures in a month significantly increases the risk of falling behind in a class. This is especially important for a fast-paced class such as this.

Calculators: You are allowed to use any calculator, during the quizzes, homework, and exams. For example, TI-83 and above is more than enough for this class.

Policy regarding cell-phones: Research shows that use of cell-phones in classroom is negatively related to classroom learning. Hence, any non-academic use of cell-phones, laptops, or any other electronic devices in the classroom is **strictly prohibited**.

Key Dates (Rooms to be announced)
Midterm : Thursday, June 15
Final Exam: Thursday, Jun 29

Assignments & Readings
Consult Blackboard on a regular basis.
Homework, notes, and recommended problems will be posted on Blackboard.

Ethics
The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition.
Report any violations you witness to the instructor.
You can find more information about university misconduct policies on the web at these sites:

- Undergraduates: e-catalog.jhu.edu/undergrad-students/student-life-policies/
- Graduate students: e-catalog.jhu.edu/grad-students/graduate-specific-policies/

Students with Disabilities
Any student with a disability who may need accommodations in this class must obtain an accommodation letter from Student Disability Services, 385 Garland, (410) 516–4720, studentdisabilityservices@jhu.edu.

ABET Outcomes

- Ability to apply mathematics, science and engineering principles (a).
- Ability to design and conduct experiments, analyze and interpret data (b).
- Ability to design a system, component, or process to meet desired needs (c).
- Ability to function on multidisciplinary teams (d).
- Ability to identify, formulate and solve engineering problems (e).
- Understanding of professional and ethical responsibility (f).

- Ability to communicate effectively (g).
- The broad education necessary to understand the impact of engineering solutions in a global and societal context (h).
- Recognition of the need for and an ability to engage in life-long learning (i).
- Knowledge of contemporary issues (j).
- Ability to use the techniques, skills and modern engineering tools necessary for engineering practice (k).