



SYS 501: Probability and Statistics for Systems Engineering

School of Systems and Enterprises
Spring 2019

Meeting Times: Thursdays, 3:30 – 6:00pm
Classroom Location: Edwin A. Stevens Hall 229
Instructor: A. Emrah Bayrak
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Email: ebayrak@stevens.edu
Office Hours: Tuesdays 1:00 – 3:00pm
Course Web Address: <https://sit.instructure.com/courses/31159>
Prerequisite(s): None

COURSE DESCRIPTION

This course is designed for students with a background in engineering, technology, or science that have not taken a class in statistics or need a refresher class. In this class we will apply probability and statistics throughout a system's life cycle. Topics include the roles of probability and statistics in Systems Engineering, the nature of uncertainty, axioms and properties of probability models and statistics, hypothesis testing, design of experiments, basic performance requirements, quality assurance specification, functional decomposition, technical performance measurements, statistical verification, and simulation.

LEARNING OBJECTIVES

The objective of this course is to enable the graduate engineer or systems engineer to properly use probability and statistics throughout a system's life cycle.

After successful completion of this course, students will be able to:

- Understand and apply probability distributions to a variety of data sets.
- Understand statistics associated with probability distributions.
- Understand concepts of confidence intervals.
- Apply hypothesis testing.
- Understand basic simulation steps.

FORMAT AND STRUCTURE

This is an on-campus course. Students are expected to attend lectures in person to participate in classroom activities and complete in weekly online discussion topics. Two exams will take place at regularly scheduled times.

COURSE MATERIALS

Textbook(s): Ross, S. (2012). *A First Course in Probability*, 9th Edition, Pearson. ISBN: 978-0-321-79477-2.
Black, K. (2016). *Business Statistics for Contemporary Decision Making*, 9th Edition, Wiley & Sons. ISBN: 978-1-119-32089-0.

Other Readings: Rausand, M. and A. Høyland (2004). *System Reliability Theory: Models, Statistical Methods, and Applications*, 2nd Edition, Wiley & Sons.
 Antony, J (2003). *Design of Experiments for Engineers and Scientists*, BH Press.
 Fenton, N. and M. Neil (2013). *Risk Assessment and Decision Analysis with Bayesian Networks*, CRC Press.

Materials: A computer with statistics software is required for classroom activities, assignments, and exams. Classroom examples will use Microsoft Excel, Python, and R.

COURSE REQUIREMENTS

Attendance Attendance is required for all students. Students shall contact the instructor in writing to be excused from lecture.

Participation Students earn up to 4 points per week for participation in online discussions on the course website.

Homework Homework assignments must be submitted on the course website by 11:59pm on the due date. Late assignments are penalized 10% per day and will not be accepted after solutions are posted (approximately 1 week after deadline). Extensions must be requested in writing at least 48 hours before the deadline. Collaboration is allowed on homework provided each student completes their own work. List any collaborators on your assignment cover sheet and submit all final source code and models. **Copying code, scripts, programs, saved models, or answers from others will not be tolerated and will result in a 0 for the assignment and referral to the Honor Board or Office of Graduate Academics.**

Exams Two exams will be held at scheduled times. Exams assess mastery of fundamental concepts developed in homework assignments. Exam 1 covers homework assignments 1-6 and Exam 2 emphasizes homework assignments 7-10.

GRADING PROCEDURES

This course will be graded on a points system with the following components:

Item	Quantity	Points	Total Points	% Final Grade
Participation*	10	4	40	8.0
Homework**	8	20	160	32.0
Exams	2	150	300	60.0

* Drop 2 lowest participation scores from 12 weeks

** Drop 2 lowest homework scores from 10 assignments

Grades will be assigned with the following criteria:

Final Points	Percent	Grade
450 - 500	90.0 - 100.0	A
425 - 449	85.0 - 89.9	A-
400 - 424	80.0 - 84.9	B+
375 - 399	75.0 - 79.9	B
350 - 374	70.0 - 74.9	B-
325 - 349	65.0 - 69.9	C+
300 - 324	60.0 - 64.9	C
275 - 299	55.0 - 59.9	C-*
250 - 274	50.0 - 54.9	D+*
225 - 249	45.0 - 49.9	D*
< 225	< 45.0	F

*Note: Graduate students are not eligible to receive a grade of C-, D+, or D and will instead receive a grade of F.

TENTATIVE COURSE SCHEDULE

The following schedule identifies tentative dates and topics for class sessions. The instructor reserves the right to modify any aspect of the schedule. Changes will be disseminated via announcements in class.

#	Date	Topic(s)	Readings	Assignment
1	01/24	Overview and Introduction Charts and Graphs Descriptive Statistics	Black Ch. 1-3	
2	01/31	Probability Theory Classical Probability Definition Probability Laws and Axioms	Ross Ch. 1-3; (Black Ch. 4)	
3	02/07	Discrete Random Variables Probability Mass Functions	Ross Ch. 4; (Black Ch. 5)	
4	02/14	Continuous Random Variables Probability Density Functions	Ross Ch. 5; (Black Ch. 6)	
5	02/21	Joint Probability Distributions Derived Random Variables Properties of Expectation	Ross Ch. 6-7	
6	02/28	Generating Simulated Data Discrete Process Generators Continuous Process Generators	Ross Ch. 10	
7	03/07	Exam 1 Review		
8	03/14	Exam 1 (In Class)		
--	03/21	Spring Break		
9	03/28	System Reliability Modeling Failure Models Reliability Block Diagrams	Rausand & Høyland Ch. 1-4	
10	04/04	Classical Statistical Analysis Estimates of Mean and Variance Statistical Quality Control	Black Ch. 7-8, 18; (Ross Ch. 8)	
11	04/11	Classical Hypothesis Testing One Population: z, t, χ^2 Two Populations: z, t, F	Black Ch. 9-10, 16	
12	04/18	Statistical Experiments Design of Experiments Analysis of Variance (ANOVA)	Black Ch. 11; (Antony Ch. 1-3)	
13	04/25	Bayesian Statistics and Risk Analysis Bayesian Probability and Inference Decision Trees	Black Ch. 19; (Fenton & Neil Ch. 1-5)	
14	05/02	Exam 2 Review		
15	TBD	Exam 2 (During Exam Period)		

ACADEMIC INTEGRITY

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the [Honor System Constitution](#). More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at <http://web.stevens.edu/honor/>

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at www.stevens.edu/provost/graduate-academics.

Special Provisions for Undergraduate Students in 500-level Courses

The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Dean of Graduate Academics or to the Honor Board, who will refer the report to the Dean. The Honor Board Chairman will give the Dean of Graduate Academics weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the [Bylaws of the Honor System](#) document, located on the Honor Board website.

EXAM ROOM CONDITIONS

The following procedures apply to quizzes and exams for this course. As instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Room Conditions on the quiz or exam.

1. Students may use the following devices during quizzes and exams. Any electronic devices that are not mentioned in the list below are not permitted.

Device	Permitted?	
	Yes	No
Laptops	X	
Cell Phones		X
Tablets		X
Smart Watches		X

2. Students may use the following materials during quizzes and exams. Any materials that are not mentioned in the list below are not permitted.

Material	Permitted?	
	Yes	No
Handwritten/Typed Notes	X	
Textbooks	X	
Readings	X	

3. Students are not allowed to work with or talk to other students during quizzes and/or exams.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

For more information about Disability Services and the process to receive accommodations, visit <https://www.stevens.edu/office-disability-services>. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone (201) 216-3748.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and in-class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.