



MATH 541: STATISTICAL METHODS

Spring 2022

Instructor:	Hadi Safari Katesari	Meeting:	Monday 12:00 - 2:30 PM
Email:	hsafarik@stevens.edu	Place:	Gateway North 204

Office Hours: Monday 2:45-4:30 PM.

Office: Kidde 229,

Main References:

- *Mathematical Statistics and Data Analysis*, 3rd Edition, by J. A. Rice.
- *An Introduction to Statistical Learning with Applications in R*, by G. James, D. Witten, T. Hastie, & R. Tibshirani.

Objectives:

- This course is primarily designed for graduate students. The objective of this course is to introduce the students to an extensive perspective of methods in statistics. Topics include data collection; descriptive statistics; relations between variables; confidence intervals; hypothesis testing for one and two samples; goodness of fit; simple and multiple linear regression; analysis of variance (ANOVA); design of experiments; parametric and nonparametric methods.
- After successful completion of this course, students will be able to select an appropriate statistical method for a given data set; perform parameter estimation using parametric and nonparametric methods; construct confidence interval for parameter(s), perform statistical hypothesis testing and correctly interpret the testing result; conduct comparison of two independent and paired samples; analysis of categorical data; apply different regression methods to datasets.

Prerequisite(s): MA 540 (Introduction to Probability Theory)





Grading Policy:

- Grades will be based on the following:
 - Homework (30%)
 - Midterm: (25%)
 - Final Exam (25%)
 - Research Project (20%)



- The letter-grade cutoffs are as below:

A: 85-100 A-: 81-84 B+: 77-80 B: 73-76 B-: 69-72 C: 60-68 F : 00-59

Programming:

Some of the homework questions and final project will involve basic programming, which you may select any of the following including , , , and .

Course Requirements:

- **Attendance:** Students are encouraged to attend each session and to participate in the discussion. Attendance will be taken into account in borderline cases.
- **Homework:** There will be periodic homework assignments during the semester, with due dates given in the course calendar. Homework should be submitted online in time, and no late homework will be accepted. The format of homework submissions should be only a pdf file.  code and output must be included. In this regard, you are encouraged to apply R Markdown. If you are using your handnotes, then you are encouraged to apply a scanner software such as .
- **Research Project:** You will be asked to work on a research project related to material in the course, which should result in a short ‘paper’. The detailed instruction of the research project will be added to the Canvas shell as a pdf file.
- **Exams:** Closed-book, one double-sided, letter size, cheat-sheet is allowed for the exam. Non-programmable calculators are allowed. Computers/tablets/cell phones/smart watches, and any other electronic devices, especially the ones with wireless communication, are not permitted. Students are not allowed to work with or talk to other students during the exam. The date of midterm exam will be announce at least one week before the date of the midterm exam. Moreover, details will be discussed one week before the exams. Students are needed to be present in the dates of the (midterm and final) exams. The (midterm and final) exams will not be repeated unless you have strong documentation (e.g., from health provider/hospital) which shows that you are not able to attend the exam (e.g., due to health problem).

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 by 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.

Learning Accommodations: 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/oce-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.

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. Students are expected to treat the 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.

Mental Health Resources: Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments are strongly encouraged and can be made by phone (201-216-5177) or in-person (on the 7th floor of the Howe Center). CAPS is open from 9:00 AM till 5:00 PM Mondays, Wednesdays, Thursdays and Fridays and from 9:00 AM till 7:00 PM on Tuesdays during the Fall and Spring semesters.

Emergency Information: In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. Other 24/7 resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text "Home" to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is not urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.






Refresh Links:

- http://www.mathwords.com/d/derivative_rules.htm
- http://www.mathwords.com/i/integral_rules.htm
- <https://homedir.jct.ac.il/~naiman/la1/>
- <https://homedir.jct.ac.il/~naiman/la2/>

Tentative Weekly Schedule:

[R] J. A. Rice. Mathematical Statistics and Data Analysis

[JWHT] G. James, D. Witten, T. Hastie, & R. Tibshirani. An Introduction to Statistical Learning with Applications in R.

- **Week 1-2:** [R] Chapter 8
Parameter Estimation, Method of Moments, Method of Maximum Likelihood, Efficiency, Cramer-Rao Lower Bound, Sufficiency, Bayesian Approach to Parameter Estimation
- **Week 3-4:** [R] Chapter 9
Neyman-Pearson Paradigm, Significance level, p-value, Uniformly Most Powerful Tests, Confidence Interval, Generalized Likelihood Ratio Tests, Likelihood Ratio Tests for Multinomial Distribution, Poisson Dispersion Test, Tests for Normality
- **Week 5:** [R] Chapter 10 and 7
Population, samples, stratified sampling, Cumulative Distribution Function, Density Curves, Measures of Location and Dispersion
- **Week 6-7:** [R] Chapter 11-12
Comparing Two Independent Samples, Comparing Paired Samples, Nonparametric methods, Experimental Design, One-way Analysis of Variance, Two-way Analysis of Variance
StatLab with 
- **Week 8:** Midterm exam; Chapters 7-12
- **Week 9-10:** [R] Chapter 13-14; [JWHT] 4.3
Analysis of Categorical Data, Relationships with Scatterplots, Logistic regression, Statistical Properties of Least Squares Estimates, Multiple Linear Regression
StatLab with 
- **Week 11-12:** [JWHT] Chapter 5-6
Resampling methods, Bootstrap, Model selection, LASSO, ridge regression
StatLab with 
- **Week 13:** [JWHT] Chapter 7.1–7.4
Basis functions, regression splines
StatLab with 
- **Week 14:** [JWHT] Chapter 10.2
PCA
StatLab with 
Final Exam Review.

GO DUCKS!

