

Statistical Inference



FALL 2025



TEACHING TEAM & HOURS

Instructor: Dr. Aboalghasemi Dehaqani

Head Teaching Assistants:

Kamand Mesbah

AmirReza Salamat

Teaching Assistants:

Check course page linked above.

Class Hours: 14-15:30 **Saturday & Monday**

Office Hours:

TA: 12-14 Sunday-Tuesday (Please message a day before)

Instructor: By Prior Arrangement



COURSE DESCRIPTION

Statistical Inference is a fundamental and a very important subject in the field of mathematics and statistics. It significantly informs and enhances disciplines such as Machine Learning, Neuroscience, Communications, Control Systems and much more. The course provides students with the necessary tools and techniques for analyzing collected data and utilizing statistics in real and practical decision-making. This course enables students to evaluate hypotheses and conduct hypothesis testing. It emphasizes generating valid estimates, understanding significance, effect sizes, and the power of tests to derive insightful conclusions from data, enhancing data-driven inference. Additionally, it also touches upon concepts of **experimental design** and Bayesian Inference. The course is designed to reduce the stress of grades, paving the way for a deep exploration of statistical inference. It encourages students to delve into its diverse aspects with the passion and curiosity of a data scientist, applicable in various components of social sciences, natural sciences, finance, engineering and many many other fields.



OVERVIEW OF THE TOPICS

For the presentation order & topics details see course page

1 Foundations of Engineering Statistics & Probability

Basic principles, Law of Large Numbers, Central Limit Theorem

2 Data Concepts and Sampling

Basics of data, visualization, data collection methods, **designing meaningful statistically analyzable experiments**, Parameter Estimation (MLE) . bootstrapping, ...

3 Statistical Testing

Neyman-Pearson Paradigm, mean-related tests (t-tests), variance tests, non-parametric tests (One-sample Sign Test, Paired Sign Test, Wilcoxon Signed Rank Test, Mann-Whitney test), Kolmogorov-Smirnov test, multiple hypothesis testing, ...

4 Analysis of Variance

ANOVA, MANOVA, Kruskal-Wallis test,...

5 Regression Analysis and Estimation

Linear regression, non-linear regression, parameter estimation, Cramer-Rao Lower Bound, Generalized Likelihood Ratio Tests, ...



PREREQUISITE

No prerequisite courses, but needs:

- Familiarity with Engineering Probability
- Basic Statistical Understanding
- Basic Programming Skills (R or Python Preferred)



MODES OF ASSESMENT**

Analytical and Computer Assignments + Quizzes

30%

Around 5 Assignments (Part Analytical Part Computational) . Each is handed out before the end of each chapter so students can start working as they learn. For each assignment we will have two evaluation processes. One, a personal hand-in session for the computational part and an analytical quiz designed straight from the analytical questions.

Midterm Exam

30%

Conceptual questions and or short problem solving. No need for memorization. 2 A4 Cheatsheets are allowed.

Final Exam

35%

Conceptual questions and or short problem solving. No need for memorization. 2 A4 Cheatsheets are allowed.

Final Project

12.5%

A Data Science project on a real dataset (12.5% of the total grade) with a possible bonus part (2.5-5% of the total grade), guiding the students on how they would use their new inference skills in the real world and then report and present their findings.

****Note 1:** In the spirit of reducing the stress of grades, the sum of grades is **21.5** instead of **20**.

****Note 2:** The structure of the course grading is subject to change. But it will always be in favour of the students.



RESOURCES

- **Class Slides**
- John A. Rice, **Mathematical Statistics and Data Analysis**, 3rd edition
- Larry Wasserman, **All of Statistics: A concise course in statistical inference**
- David Diez, Mine Çetinkaya-Rundel, Christopher D Barr - **OpenIntro Statistics**
- Some class videos might be available gradually

