Fall 2023 STAT 6114

Advanced Topics in Statistical Inference

Instructor: Dr. Hongxiao Zhu
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Mode: In-person
Time: Tue/Thu 12:00 PM-1:45PM
Location: Hutcheson Hall 204
Office hour: Office meeting or zoom meeting by appointment.
Canvas site: Lecture notes, reference materials, homework, and solutions will be posted on the course's canvas site.

Course description: This course provides a rigorous overview of theoretical topics in statistical inference. The tentative content of this course is listed as follows.

Notation and Concepts:

1. σ-field, measurable functions, $\sigma(X)$, Law[X], absolute continuous, $\int f d\mu$ notation, Radon-Nikodym derivative.

Asymptotic Theory:

2. Stochastic order of convergence (notation of big O, small o, and big Op small op).
3. Tools for convergence in distribution.
4. Consistency and asymptotic distribution of an estimator.
5. M- and Z- estimators and their asymptotic properties.

Decision Theory:

6. Decision Theory: Loss, risk, decision rules, Bayesian decision theory.
7. Decision Theory Examples: Rao-blackwell theorem, theory of hypothesis testing.
8. Minimax rules.

Testing:

9. Asymptotic Tests.
10. Multiple testing.

Modern Inference:

11. Big Data inference.
12. TBD

Prerequisites: Statistical Inference (STAT5114). It is assumed that students are familiar with the following concepts: converge almost surely, in probability, and in distribution; sufficient/complete/ancillary statistics; Fisher-Neyman factorization Theorem; Basu's Theorem; Exponential family; Cramer-Rao Inequality; Fisher Information; Maximum Likelihood Estimator; Method of Moments; Neyman-Pearson Lemma; uniform most powerful test.

Reference:

[1] Unpublished lecture notes by Dennis D Cox.
[2] Theory of point estimation by Lehmann and Casella.
[3] Asymptotic statistics by A.W. Van der Vaart.

[4] Theory of statistics by Mark Schervish.
[5] Statistical decision theory by Jim Berger.

Grading: Homework: 36%, Midterm: 30%, Final: 30%. Additional credits: 2 credits = 4%

Homework: There will be 4-5 homework assignments. Students who volunteer to help grade homework will receive two additional credit points for each grading (added directly to the final grade).
Midterm exam: Midterm is take-home. Exam will involve proofs and derivations.
Final projects: final project involve two modules: presenting a paper (10%) and writing a review of that paper (20%). You need to hand in your report to canvas.
Submission policy: Homework will be submitted and graded on canvas. If you don't have a scanner, you may take pictures of the written part and merge them to PDF. This can be done by using cell phone apps such as Image to PDF converter. If the homework involves coding, you are required to submit the original code (e.g., .R script). Please make sure the submitted document is clear enough to be graded.

Course material: lecture notes and homework assignment will be provided through the canvas site.

Homework policy: A due date is shown on each homework assignment. Late homework is only accepted when it is submitted no later than three days after the deadline. Late homework is subject to an extra deduction of 20% per late day. Class attendance is required. If you have a medical condition or an obligation that will result in missing a class, let me know ahead of time.

Honor code: Graduate students enrolled in this course are responsible for abiding by the Graduate Honor Code. For additional information about the Honor Code, please visit: http://graduateschool.vt.edu/academics/expectations/graduate-honor-system.html.