STAT 7301 Advanced Statistical Theory I

lecture:	MWF 9:10–10:05 in Cockins Hall 228
instructor:	Vincent Q. Vu (vqv at stat osu edu)
office:	Cockins Hall 428B
office hours:	Thursdays 1:50–2:45, or by appointment
web:	Class schedule, assignments, and course announcements will be posted on Carmen (carmen.osu.edu)
prerequisites:	STAT 6802, or permission of the instructor

1 Overview

Statistics 7301 is a course on the fundamentals of statistical theory and is intended for second-year Ph.D. students in statistics. The course is based in part on chapters 2–4,8–9 of the required book *Theoretical Statistics: Topics for a Core Course*, chapters 2 and 6 of the required book *All of Nonparametric Statistics*, and notes provided by the instructor. The topics of the course include:

1. Fundamentals

   - Statistics, sufficiency, and completeness
   - Exponential families
   - Rao-Blackwell theorem
   - Fisher information

2. Methods of estimation

   - Unbiased estimation
   - Maximum likelihood
   - Minimum contrast estimation

3. Asymptotic approximations (a.k.a. large sample theory)

   - Consistency
   - Delta method
   - Asymptotic normality and efficiency

4. Nonparametric estimation

   - Estimating the CDF and statistical functionals
   - Influence functions and nonparametric Delta method
   - Density estimation

Although there will be overlap in the topics covered in STAT 7301 and STAT 6801/6802, some of the most important differences between this class and the 680x classes is that STAT 7301

- presents the theory in greater depth and detail;
- involves mathematically rigorous proofs;
- requires more sophisticated mathematical analysis.

2 Textbook

The in-class lectures and notes are the canonical source for the course. The following books are also required for supplemental reading:

- Keener, R.: *Theoretical Statistics: Topics for a Core Course.* Springer.

    - https://link.springer.com/book/10.1007%2F978-0-387-93839-4

- Wasserman, L.: *All of Nonparametric Statistics.* Springer.

    - https://link.springer.com/book/10.1007%2F0-387-30623-4

The notation and nomenclature used in lecture and the depth of coverage of material will occasionally deviate from these books. The instructor will try to alert students to these differences, but ultimately students are expected to pay attention to these differences themselves.

The follows books are optional references:

- Bickel, P. J. and Doksum, K. A.: *Mathematical Statistics: Basic Ideas and Selected Topics, Vol. 1.* CRC Press.
- van der Vaart, A. W.: *Asymptotic Statistics.* Cambridge University Press.
- Lehman, E. L. and Casella, G.: *Theory of Point Estimation*, second edition.

3 Prerequisites

Statistics 6802, or permission of the instructor. Mathematical analysis and probability theory are the primary tools of statistical theory. **Students are expected to be able to read and write rigorous mathematical proofs.**

4 Coursework & Grading

There will be eight homeworks, three in-class exams, a final exam, and scribing.

- 8% Homework
- 18% Exam 1 (September 23)
- 18% Exam 2 (October 18)
- 18% Exam 3 (November 13)
- 36% Final exam (December 9)
- 2% Scribing of two lectures

Inform the instructor of any scheduling conflicts at least three weeks in advance.

4.1 Homework

Homeworks will generally be assigned on a weekly basis and are due in class on the due date. If you cannot attend class on the due date of the homework, then either ask a classmate to submit the homework for you or place the homework under my office door in advance. Late homework will not be accepted and returned without grading.

4.2 Exams

All exams are closed book. No make-up exams will be given. The in-class exams are spaced apart by about two homeworks each, and will largely be based on the content of the two homeworks preceding them. In particular, a variation of a homework question may appear on the exam. The final exam will be cumulative but will emphasize more recent material.

4.3 Scribing

Students will be required to scribe two lectures using LaTeX and a template provided by the instructor. Additional instructions will be given by the instructor.

4.4 Fine print

4.4.1 Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

4.4.2 Accommodations for Students with Disabilities

Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614-292-3307, slds@osu.edu; slds.osu.edu.

4.4.3 Disclaimer

This syllabus is a approximate guide to the course content and dates, however the instructor reserves the right to deviate from the syllabus. An updated version of the syllabus will be maintained on the course webpage.