STAT 582/BIOST 584: Advanced Theory of Statistical Inference

Course Personnel
- Professor: Alex Luedtke. aluedtke@uw.edu
- Office hours (Alex): Mon 3 pm - 5 pm
- Teaching Assistant (TA): Zhen Miao. zhenn@uw.edu
- Office hours (Zhen): Thurs 10 am - 12 pm
- Quiz section (Zhen): Tues 3 pm - 4 pm starting on 1/11. Attending quiz section is optional.

Administrative Information
- Time(s): Mon/Wed/Fri 10:30 am - 11:20 am
- Location: Remote

Prerequisites
- Required: STAT 581/BIOST 583.
- Recommended: Mathematical analysis from a course at the level of either Math 426 or Stat 559.

Textbooks
Recommended:

Supplemental:

Grading
- **Midterm**: 25%. 1 hour take-home exam. May be taken any time between 10 am PT on 2/3 and 10 am PT on 2/5 (must be submitted on Canvas by 10 am PT on 2/5).
- **Final**: 35%. 2 hour take-home exam. May be taken any time between 10 am PT on 3/14 and 10 am PT on 3/15 (must be submitted on Canvas by 10 am PT on 3/15).

The midterm and final will be open note and open book. In particular, while taking each exam, you may make use of: course lecture notes, homeworks, homework solutions, course textbooks during exam. You may not make use of any other references, including the internet. You may not talk to your classmates about the content of an exam until after its due date (10 am PT on 2/5 for the midterm, 10 am PT on 3/15 for the final).

- **Homework**: 40%.
  - Homework 1: Assigned 1/5, Due 1/19
  - Homework 2: Assigned 1/19, Due 1/31
  - Homework 3: Assigned 2/4, Due 2/16
  - Homework 4: Assigned 2/16, Due 2/28
  - Homework 5: Assigned 2/28, Due 3/7

Homework assignments can be downloaded on Canvas.
Homeworks will be due on the start of class on the day that it is due. Assignments should be submitted on Canvas.

Assignments may be written by hand or in LaTeX. If the assignment is written by hand, please ensure that it is legible and that the scan/photograph of the assignment is as clear as possible.

Students are encouraged to seek help from the instructor, TA, or other students with the written homework problems. However, the work that is handed in should reflect only that student’s work. That is, obtaining help from other students in order to learn the methods of solution is allowed, but copying another student’s answer is not.

The best time to ask the instructor or the TA for help on the assignment is during office hours. However, if you do ask questions by electronically (either on Canvas Discussions or by email), please note that Alex and Zhen will not respond to electronic queries about assignments on weekends or within 24 hours of an assignment’s due date.

**Late policy:** While the official late policy is outlined below, please note that I will be flexible regarding deadlines for students who are experiencing illness or other challenges related to the current Covid-19 pandemic. Please contact me (Alex) **on or before the due date** if you think you may not be able to complete an assignment or take an exam on the designated schedule due to Covid-related hardships.

You may use up to three ‘grace days’ during the quarter. For each grace day used, a 24-hour extension will be given on an assignment without any deduction for lateness (Note: this may result in an electronic copy of your assignment being due at 10:30 am on a weekend). Multiple grace days may be used on one assignment. If you use grace days, clearly indicate this at the top of your assignment. **Once you have used all of your grace days, late assignments will receive no credit.**

**Outline**

**General theme:** nonparametric estimation of function-valued parameters.

- Minimax rates of convergence via the Le Cam and Fano methods.
- Kernel-based methods and the bias-variance trade-off.
- Concentration inequalities:
  - Moment inequalities.
  - Chernoff method.
  - Sub-Gaussian and sub-exponential random variables.
  - McDiarmid’s inequality.
- Empirical risk minimization.
- Empirical process theory for statistics:
  - Rademacher complexity.
  - Vapnik-Chervonenkis dimension.
  - Covering and bracketing numbers.
  - Glivenko-Cantelli and Donsker theorems.

**Learning Objectives**

By the end of this course, students will be able to:

- derive minimax rates of convergence in nonparametric estimation problems using the methods of Fano and Le Cam;
- define the bias-variance tradeoff for kernel estimators and explain its implications for bandwidth selection;
- define and employ concentration inequalities such as moment inequalities and exponential tail bounds;
- define and provide performance guarantees for empirical risk minimizers;
- understand core concepts in empirical process theory such as the Rademacher complexity, Vapnik-Chervonenkis dimension, and covering and bracketing numbers.
Access and Accommodations

Your experience in this class is important to me. If you have already established accommodations with Disability Resources for Students (DRS), please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course.

If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include, but not limited to: mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact DRS at 206-543-8924 or uw-drs@uw.edu or disability.uw.edu. DRS offers resources and coordinates reasonable accommodations for students with disabilities and/or temporary health conditions. Reasonable accommodations are established through an interactive process between you, your instructor(s) and DRS. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law.

Religious Accommodations

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW’s policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/).

Statement Against Discrimination and Harassment

Please follow the UW Student Conduct Code in your interactions with your fellow students and me in this course by respecting the many social and cultural differences among us, which may include, but are not limited to: age, cultural background, disability, ethnicity, family status, gender identity and presentation, citizenship and immigration status, national origin, race, religious and political beliefs, sex, sexual orientation, socioeconomic status, and veteran status.