36-789: Minimax Theory
Spring 2017

Instructor:

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Office: Baker Hall 229I
Office Hour: by appointment.

Lectures:

Monday and Wednesday, 9:30am - 10:50am, WH5304.

Class Website:

http://www.stat.cmu.edu/~arinaldo/Teaching/36789/S17/

Please check the website on a regular basis for the schedule, homework assignments, reading material, and references.

Prerequisites:

- 36-705: Intermediate Statistics or equivalent course

Topics:

Minimax theory provides a general framework for quantifying the inherent hardness of statistical inferential tasks, such as estimation, hypothesis testing and confidence set building, and for assessing the optimality of a given methodology. Minimax analysis is ultimately concerned with deriving sharp lower bounds on the risk of a statistical task. Such lower bounds will depend on the sample size and, possibly, other properties of the underlying distribution.

This mini will cover various techniques for computing minimax lower bounds and exemplify their usage in a variety of problems and applications borrowed from the current literature on high-dimensional statistics.

The intended audience for this class is Ph.d. students in Statistics and Machine Learning.

Class material:

Most of the course material will be taken from

1. Tsybakov, A.B. (2009). *Introduction to Nonparametric Estimation. Springer.*

2. Yu. B. (1997) Assuad, Fano, and Le Cam, Festschrift for Lucien Le Cam pdf.

Further reading material and notes will be posted on the webiste.

Course Grading:

Your assessment and grades will be determined as follows:

- Homework assignments.
- Scribe duties.
- Attendance and class participation.
- In-class presentation or project.

Any failure to turn in any assignment, to fulfill the scribe duties and to miss a significant number of lectures without informing me of your absence or without a reasonable excuse will result in a lower grade.

Scribe duties:
Each student will take turn in transcribing the notes of every lecture in electronic format using the latex template available at http://www.stat.cmu.edu/~arinaldo/Teaching/36789/S17/schedule.html. The scribe has to attend class, take good and accurate notes, check for mistakes and inconsistencies, write them up in latex, adding references and expanding the material if appropriate and after consulting with me. The resulting pdf and latex files have to be submitted for my approval within one week. The pdf files containing the lecture notes will be posted on the class website.

Homework:
Homework assignments will not be graded. I will only check if an honest effort has been made to solve the assigned problems. Homework problems will be assigned every 10-15 days. The problems will be mostly of theoretical nature and will essentially be proofs. There is a great value in discussing problems and sharing knowledge with your classmate, so you are encouraged to engage in group work. However, you should attempt to solve homework problems by yourself and only afterwards meet and compare with others.

Class presentations:
Each student will present one paper or an idea pertaining to minimax lower bounds in high-dimensional models. You are free to chose. But for a list of suggested papers, see here.

Class projects:
For the class project, each student will pick a minimax problem (for, e.g., estimation, testing, confidence set or model selection) and write a class report on it. The problem can be an old one, in which case the class project will be a summary of existing literature, or a new one, in which case the student is required to make an attempt to derive a minimax rate. The projects must to be chosen by February 15 and must be approved by the instructor. The report must contain at least three sections: introduction with literature review, problem formulation and minimax derivation and needs to be at least 5 pages long.

Attendance and Involvement:
It is important that you attend class, as the selection and organization of the topics will be on occasion different from the notes and textbooks. If you know you will be absent for few consecutive lectures, please let me know.
Come and see me any time you are confused or stuck and don't be shy in class: the more questions you ask and the more feedback I receive from you, the better I will be able to tailor the lectures to your specific needs.