Mathematical Statistics, Perugia 2022

With the recent advances in powerful computing and the availability of massive sets of data, the tools of statistics, data science, and analytics have become indispensable in the applied sciences and in industry. This course focuses on the mathematical underpinnings that provide the foundations to modern day statistical inference, uncertainty quantification and decision theory.

Course tentative program:

The exact content and course progression for each of the two weeks programs may depend in part on the background, preparation, and interest of the students.

The two parts of the course program are complementary, the first two weeks being devoted to inference and prediction via statistical learning techniques and the two last weeks focusing on uncertainty quantification and hypothesis testing.

Weeks 1 and 2 (Prof. Adrien Saumard): tentative program

1. Empirical Risk Minimization (ERM), with examples
2. Probably Approximately Correct (PAC) learning framework
3. A primer on concentration inequalities
4. PAC learning rates for ERM
5. Bias-Variance trade-off, overfitting phenomenon

Weeks 3 and 4 (Prof. Uwe Schmock): confidence intervals and testing

Course Prerequisite: Students should have at least one mathematically rigorous course in probability, and some basic statistics.

Instructors: Adrien Saumard and Uwe Schmock

Structure and Evaluation

Midterm 35%, Final Exam 35%, Course participation 30%

Course Texts

- Understanding machine learning, by Shai Shalev-Shwartz and Shai Ben-David, free downloadable version here. The course of Pr. Saumard corresponds to Section 1, chapters 1 to 5.
- Mathematical Statistics: Basic Ideas and Selected Topics, by Peter Bickel and Kjell Doksum

- Computer age statistical inference, by Bradley Efron and Trevor Hastie
- Statistical Inference, by Casella and Berger