Syllabus for STAT 709 Mathematical Statistics

Yiqiao Zhong, Fall 2023

Course schedule

Part 1: Foundations of Statistical Theory

- Measure theory overview (2 lectures)
- Classical limit theorem (4 lectures)
- Concentration inequalities (3 lectures)
- Random matrix theory (1 lecture)

Part 2: Fundamentals of Statistics

- Basic notions, terminology, statistical decision theory (1 lecture)
- Sufficiency, completeness (1 lecture)
- Statistical from information-theoretical perspective (1 lecture)
- Asymptotics (1 lecture)

Part 3: Unbiased Estimation

- UMVUE (1 lecture)
- Fisher information (1 lecture)
- Estimation in linear models (1 lecture)
- U-statistics, sampling without replacement (1 lecture)
- Method of moments, generalized method of moments (1 lecture)

Part 4: Shrinkage Estimation and High-dimensional Phenomena

- Classical Stein's phenomenon (1 lecture)
- Wavelet denoising via shrinkage (1 lecture)
- From shrinkage to basis pursuit (1 lecture)
- LASSO (1 lecture)
- Low-rank matrix estimation and singular value estimation (1 lecture)

Part 5 (optional): Invited Guest Lectures

- TBD (1 lecture)

Books and References

Textbook: Jun Shao, Mathematical Statistics, Springer 2013

Other recommended books:

- Jun Shao, Mathematical Statistics: Exercises and Solutions, Springer 2005
- Rick Durrett, Probability: Theory and Examples, Cambridge 2010
- Roman Vershynin, High-dimensional Probability: An Introduction with Applications in Data Science, Cambridge 2018
- Terence Tao, Topics in Random Matrix Theory, AMS 2012
- Charles Bordenave, Lecture Notes on Random Matrix Theory, Lecture notes 2019
- Martin Wainwright, High-dimensional Statistics: A Non-Asymptotic Viewpoint, Cambridge 2019
- Iain Johnstone, Gaussian Estimation: Sequence and Wavelet Models, Book draft 2019
- Yihong Wu, Information-Theoretical Methods for High-Dimensional Statistics, Lecture notes 2020