Concentration Inequalities (L16)

Dr V. Jog

The topic of this course is the study of concentration inequalities and their applications. Concentration inequalities quantify the random fluctuations of functions of independent random variables and find applications in many domains including statistics, learning theory, discrete mathematics, random matrix theory, information theory, and high-dimensional geometry.

The course will cover a selection of topics including:

- Markov's inequality and Chebyshev's inequality; inequalities for sub-Gaussian random variables; Hoeffding's inequality and related inequalities
- Efron-Stein inequality and Poincaré inequality; basic information-theoretic inequalities; log-Sobolev inequalities; the entropy method
- Talagrand's inequality; the transport method; Marton's transport cost inequalities

Applications of the above inequalities to dimensionality reduction, random matrices, Boolean analysis, combinatorics, and learning theory will be considered throughout the course.

Prerequisites

The only pre-requisite is knowledge of basic probability, although a certain level of maturity and familiarity with the use of probabilistic techniques will be helpful. Knowledge of advanced (including measure-theoretic) probability is not necessary.

Literature

1. S. Boucheron, G. Lugosi and P. Massart, *Concentration Inequalities: A Non-Asymptotic Theory of Independence*, Oxford University Press, 2013.
2. M. Raginsky and I. Sason, *Concentration of Measure Inequalities in Information Theory, Communications and Coding*, Foundations and Trends in Communications and Information Theory, 2013.
3. M. Ledoux, *The Concentration of Measure Phenomenon*, Mathematical Surveys and Monographs, 2001.

Additional support

Three examples sheets will be provided and three associated examples classes will be given. There will be a one-hour revision class in the Easter Term.