

Concentration Inequalities, Oracles, and Applications

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Outline: Week 1

- 1) Bernstein-Chernoff inequality for random variables with a mgf.
- 2) Binomial example.
- 3) Okamoto's version; application to interval estimation of binomial proportion; accuracy.
- 4) Generalization to interval bounded random variables; Hoeffding's inequality.
- 5) Newer and better versions; Eaton, Pinsker, others.
- 6) Inefficiency of Bernstein-Chernoff inequality compared to moment inequalities; example(s).
- 7) Extension to convolutions; large deviation rate functions; first order accuracy of Chernoff's theorem; examples.
- 8) Generalization to higher dimensions.
- 9) Sample of other concentration inequalities:
 - a) maximum of a Gaussian vector; dimension independent versions as consequences of Talagrand's work; applications to false discovery;
 - b) Glivenko-Cantelli theorem and DKW inequality in \mathcal{R} ;
 - c) generalization to higher dimensions via *shattering coefficients*;
 - d) application to testing for goodness of fit in \mathcal{R}^d ; weak limits of test statistics; computing their critical values.