Empirical Processes: Fall 2010.

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1 Instructor information.

Instructor: Moulinath Banerjee.

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Office Hours: By appointment.

2 Course information.

Coursework: Solving homework problems assigned by instructor.

Topics :

- Introduction And Overview: Classical Glivenko Cantelli and Donsker Theorems; General Empirical Processes; Motivating Statistical Examples
- Extended Weak Convergence Theorems: Handling nonmeasurability; Representation Theorems; Characterizing weak convergence in function spaces.
- Maximal Inequalities, Chaining, Symmetrization: Dealing with suprema of collections of random variables; Symmetrized Processes using Rademacher multipliers; Hoeffding's inequality
- Glivenko-Cantelli Theorems: Characterizing classes of functions satisfying the law of large numbers uniformly; preservation of such properties; Uniformity in the underlying distribution.

- Donsker Theorems: Uniform Central Limit Theorems in terms of conditions on entropy and bracketing numbers.
- Entropy Considerations: Bounds on entropy and bracketing numbers for 'well-behaved' classes; VC (Vapnik-Chervonenkis) and BUEI (bounded uniform entropy integral) classes; preservation of Donsker properties.
- Central Limit Theorems for Processes.
- Applications: Maximum Likelihood Estimation.
- Applications: M estimation (estimators characterized as maximizers of random criterion functions) – argmax continuous mapping theorem, rate of convergence theorems, applications of continuous mapping.
- Applications: Z estimation (estimators characterized as zeores of estimating equations)
- Functional Delta Method: Extension of the usual delta method for dealing with appropriately differentiable functionals of stochastic processes.
- Time permitting, some discussion on the bootstrap.

3 References

Major References:

- 1. Weak Convergence and Empirical Processes (1996) by van der Vaart and Wellner. Springer Series in Statistics.
- 2. Jon Wellner's Lecture Notes for the Summer School at Torgnon (2003).
  Available at http://www.stat.washington.edu/jaw/RESEARCH/TALKS/talks.html – you will need to scroll down the page.
  Also check out http://www.stat.washington.edu/jaw/COURSES/EPWG/sp09.html
- 3. Introduction to Empirical Processes and Semiparametric Inference (2008) by Michael Kosorok. Springer Series in Statistics.
- 4. Convergence of Probability Measures (1999) by Patrick Billingsley. Wiley Series in Probability and Statistics.
- 5. Asymptotics via Empirical Processes (1989) by David Pollard. Statistical Science, Vol 4, No. 4, 341–366.
- 6. Empirical Processes: Theory and Applications (1990) by David Pollard. NSF-CBMS Regional Conference Series in Probability and Statistics, Volume 2. Institute of Mathematical Statistics (IMS).

- 7. Cube Root Asymptotics (1990) by Kim and Pollard. Annals of Statistics, Vol. 18, No. 1, 191–219.

Other References:

- 1. Empirical Processes in Action: A Review (1992) by Jon Wellner. International Statistical Review, Vol. 60, No. 3, 247–269.
- 2. Empirical Processes and Applications: an overview (1996) by Evarist Gine. Bernoulli, Vol. 2, No. 1, 1–28.
- 3. Asymptotic Statistics (1998) by Aad van der Vaart. Cambridge Series in Statistical and Probabilistic Mathematics.
- 4. Uniform Central Limit Theorems (1999) by R.M. Dudley. Cambridge Studies in Advanced Mathematics.