Modern Sampling Methods: Design and Inference

Draft Syllabus (last updated: January 6, 2022)

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Course Description:

The way that data are collected can have important implications for their subsequent use in model estimation and evaluation, parameter inference, and policy choice. Complex experimental schemes are gaining increasing interest in economics and many other fields. In this course we examine the interplay between data design, and statistical inference and decisions. We will examine classic sampling and experimental designs, but also alternatives such as adaptive randomization designs and multi-armed bandits which raise the possibility of improving inference and decisions at lower cost. Some key themes we will examine include: the connection between design and identification; statistical efficiency considerations; and alternative objectives for data analysis beyond point estimation and classical statistical inference.

Outline of Topics:

1. Introduction: Examples and Key Issues; Random Samples for Population Inference
2. Randomized Experiments
3. Publication Bias and Preanalysis Plans
4. Treatment and Policy Choice
5. Multi-Wave Experiments
6. Covariate-Adaptive Randomization
7. Bandit Algorithms and Response-Adaptive Experiments
8. Applications of Bandits and Adaptive Designs
9. Statistical Inference with Adaptively Generated Data
10. Window Choice in Time Series

Topics and Readings:

Especially useful readings, recommended to read before the lecture, are marked with a "*". Additional references and readings will be added as this syllabus is revised.

1. Examples and Background

2. Randomized Experiments

   - Athey, S., and Imbens, G. W., (2017), "The Econometrics of Randomized Experiments," in *Handbook of Economic Field Experiments*, Volume 1, Elsevier.

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3. Publication Bias and Preanalysis Plans

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- Spiess, J., (2018), "Optimal Estimation when Researcher and Social Preferences are Misaligned," working paper.
https://gsb-faculty.stanford.edu/jann-spiess/files/2021/01/alignedestimation.pdf
- Sterling, T. (1959), "Publication Decisions and Their Possible Effects on Inferences Drawn from Tests of Significance — Or Vice Versa," *Journal of the American Statistical Association*, 54(285), 30-34.
- Tetenov, A., (2016), "An Economic Theory of Statistical Testing," working paper.
https://tetenov.com/Tetenov_hypothesis_testing.pdf
- Tullock, G. (1959), "Publication Decisions and Tests of Significance — A Comment," *Journal of the American Statistical Association*, 54(287), 593.
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4. Treatment and Policy Choice

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- Stoye, J., (2009), "Minimax Regret Treatment Choice with Finite Samples," *Journal of Econometrics* 151, 70-81.

5. Multi-Wave Experiments

* Hahn, J., Hirano, K., and Karlan, D., (2011), "Adaptive Experimental Design Using the Propensity Score," *Journal of Business and Economic Statistics* 29(1): 96-108.

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6. Covariate-Adaptive Randomization

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7-8. Response-Adaptive Experiments and Multi-Armed Bandits

- Adusumilli, K., (2021), "Risk and Optimal Policies in Bandit Experiments." https://arxiv.org/abs/2112.06363

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9. Statistical Inference with Data from Bandits

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10. Window Choice in Time Series (if time permits)

- Andrews, D. W. K., (1993), "Tests for Parameter Instability and Structural Change with Unknown Change Point," *Econometrica* 61(4): 821-856.

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* Hirano, K., and Wright, J., (2022), "Analyzing Cross-Validation for Forecasting with Structural Instability," *Journal of Econometrics* 226(1): 139-154.
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