Harvard University, spring 2018
Syllabus for Economics 2140 - Econometrics

instructor	Maximilian Kasy,
	Elie Tamer
office	Littauer 121
	Littauer 125
office hours	after class, or by appointment
email	teachingmaxkasy@gmail.com
	elietamer@fas.harvard.edu
class time	Tue & Thur 1:30pm - 3:00pm
location	Sever 303
web page	https://canvas.harvard.edu/courses/37082
teaching fellow	Giselle Montamat
	gmontamat@g.harvard.edu

Overview and Objectives

This class continues the first year sequence in econometrics and covers various topics of relevance in particular in applied microeconomics. The first half of the class will be taught by Maximilian Kasy, the second half by Elie Tamer.

We start by discussing **Identification**. The focus will be on settings and assumptions that allow to recover causal relationships, including randomized experiments, conditional exogeneity, IV methods, difference in differences, and regression discontinuity. We then proceed to a discussion of **Estimation**. Statistical decision theory will be introduced as a general framework to think about estimation problems and the trade-off between bias and variance. Various examples of practical relevance will be covered, including machine learning methods such as Lasso, and "value added" estimation as popular in education, labor and related fields.

Continuing in the same spirit, the second half of class will start by a rigorous treatment of **M-estimators**. This includes GMM, likelihood, (nonlinear) least squares, and two step estimators. We will then highlight approaches for constructing standard errors. This includes clustering, and the use of **the bootstrap** and other methods. An overview of methods for **nonparametric** estimation of regression functions and probability density functions will be given. The class then concludes with some topics in **structural estimation**, in particular moment inequalities, demand analysis, and other models.

Assignments for part I

Your grade for Econ 2140 will be determined by both the first and second half of the class with equal weights. For the **first half** of the class, you are asked to complete two regular problem sets, and one computer-based problem set, as well as one in-class midterm. Please upload your problem set solutions via Canvas. These assignments contribute to your grade as follows.

1. Two **regular problem-sets**, posted on the class web page (8% of grade each). Due by Feb 8 and March 1.
2. One **Matlab problem-set**, posted on the class web page (8% of grade). Due by Feb 20.
3. An in-class **midterm** exam on **March 8** (26% of grade).

Remarks:

- All assignments except for exams are to be submitted online on the class homepage.
- Exams will be similar to the regular problem-sets. You should therefore make sure you understand these well.
- You are welcome, and in fact encouraged, to collaborate on any of these assignments (exams excluded). However, every one of you has to produce a separate write-up of your problem-set solutions and summaries. Identical write-ups will receive zero points.

To help me improve the course, I will ask you to give me anonymous feedback at some point, writing what you like about the class and what you think I should change.
I encourage you to come to my office hours with any questions. I will not answer emails with questions on the material.
If you need any special accommodations for physical or medical reasons, please see me after class or send me an email.

Assignments for part II

For this part, your grade will be divided equally between 1) a set of -more or less- weekly homework problems that are equally weighted, and 2) an in class exam to be held on Tuesday April 24th. There will not be an overall Final Exam. Also, you are all encouraged to work in groups on the homework but please submit your own solutions via the class website.

Course outline

We will cover the following topics in Econ 2140.

PART I

1. **Causality and identification**
   (a) Basic concepts
   (b) Historical origins: Linear systems of structural equations; selection models
   (c) Potential outcomes, randomization, and treatment effects
   (d) Instrumental variables, local average treatment effects
   (e) Conditional independence, reweighting and regression with controls
   (f) Difference in differences
   (g) Regression discontinuity
2. **Statistical decision theory and estimation**
   (a) Loss, risk function, Bayes risk
   (b) Admissible, minimax, and Bayes decision functions
   (c) Complete class theorem
   (d) Applications:
      i. Bayesian estimation
      ii. Value added estimation
      iii. Ridge and Lasso

PART II

3. **M-Estimation Approaches (4 Lectures)**
   (a) General Framework for inference on finite dimensional parameters defined as argmins of functions.
   (b) Identification, Consistency, and Normality
   (c) Examples: Likelihood, GMM, Least squares, minimum distance, and two step estimators.
   (d) Quantile regression.
4. **Standard Errors etc (2-3 Lectures)**
   (a) Clustered Data in linear models.
   (b) The bootstrap.
   (c) Subsampling.

5. **NonParametrics: Density and Regressions (2 Lectures)**

   (a) Nonparametric Density: Histograms, kernels, series, and high dimensions. Rates, risk and confidence bands.

   (b) Nonparametric Regression: Kernels, local linear regression, Series estimators, wavelets, etc. Rates, risk analysis and confidence bands.

   (c) Classification: Logit, Gaussian Discriminants, Support Vector Machines.

6. **Structural models and Moment Inequalities (2 Lectures)**

   (a) Discrete Choice with Applications to demand analysis. Simulation Methods.

   (b) Moment Inequalities: Examples

Readings, first half of class

There is no required textbook for this class. I have posted lecture slides as well as scanned copies of some textbook chapters and papers on the class website. You are required to know everything on the lecture slides for the exam. The textbook chapters and papers are more technical, and contain optional material, but are well worth your time. The empirical papers cover applications that we will briefly discuss as examples in class.

1. Causality and identification

   Angrist, J. D. and Pischke, J. S. (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton University Press, chapters 2, 4, 5, and 6.

   Manski, C. (2003). *Partial identification of probability distributions*. Springer Verlag, chapters 2 and 7

   Imbens, G. W. and Rubin, D. B. (2015). *Causal inference in statistics, social, and biomedical sciences*. Cambridge University Press

   Angrist, J., Imbens, G., and Rubin, D. (1996). Identification of causal effects using instrumental variables. *Journal of the American Statistical Association*, 91(434):444–455

   Hahn, J., Todd, P., and der Klaauw, W. (2001). Identification and estimation of treatment effects with a regression-discontinuity design. *Econometrica*, 69(1):201–209

2. Statistical decision theory and estimation

   Robert, C. (2007). *The Bayesian choice: from decision-theoretic foundations to computational implementation*. Springer Verlag, chapter 2.

   Lehmann, E. L. and Casella, G. (1998). *Theory of point estimation*, volume 31. Springer.

Stigler, S. M. (1990). The 1988 Neyman memorial lecture: a Galtonian perspective on shrinkage estimators. *Statistical Science*, pages 147–155.

Stein, C. M. (1981). Estimation of the mean of a multivariate normal distribution. *The Annals of Statistics*, 9(6):1135–1151.

Empirical papers

1. Randomized experiments

Finkelstein, A., Taubman, S., Wright, B., Bernstein, M., Gruber, J., Newhouse, J. P., Allen, H., Baicker, K., and Group, O. H. S. (2012). The Oregon health insurance experiment: Evidence from the first year. *The Quarterly Journal of Economics*, 127(3):1057–1106

Crépon, B., Duflo, E., Gurgand, M., Rathelot, R., and Zamora, P. (2013). Do labor market policies have displacement effects? Evidence from a clustered randomized experiment. *The Quarterly Journal of Economics*, 128(2):531–580

2. Difference-in-differences

Qian, N. (2008). Missing women and the price of tea in China: The effect of sex-specific earnings on sex imbalance. *The Quarterly Journal of Economics*, 123(3):1251–1285

Cascio, E. U. and Washington, E. (2014). Valuing the vote: The redistribution of voting rights and state funds following the voting rights act of 1965. *The Quarterly Journal of Economics*, 129(1):379–433

3. Instrumental variables

Aizer, A. and Doyle, J. J. (2015). Juvenile incarceration, human capital, and future crime: Evidence from randomly assigned judges. *The Quarterly Journal of Economics*, 130(2):759–803

Jackson, C. K., Johnson, R. C., and Persico, C. (2016). The effects of school spending on educational and economic outcomes: Evidence from school finance reforms. *The Quarterly Journal of Economics*, 131(1):157–218

4. Regression discontinuity

Saez, E., Matsaganis, M., and Tsakloglou, P. (2012). Earnings determination and taxes: Evidence from a cohort-based payroll tax reform in Greece. *The Quarterly Journal of Economics*, 127(1):493–533

Card, D., Dobkin, C., and Maestas, N. (2009). Does medicare save lives? *The Quarterly Journal of Economics*, 124(2):597–636