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**


2. **Statistical decision theory and estimation**


**Empirical papers**

1. Randomized experiments


2. Difference-in-differences


3. Instrumental variables


4. Regression discontinuity
