

Econ 5280 Applied Econometrics (4 Credits)

Department of Economics, HKUST

Fall 2022

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Course Description

This course provides an introduction to econometric methods from ordinary least squares to cutting-edge deep-learning-based techniques for causal inference. Reasonably rigorous mathematical treatment will be given. Implementation (using R) and application of the methods will be covered.

Prerequisites. ISOM 2500, MATH 2411, MATH 3423 or equivalent. A brief review on matrix algebra and statistical inference will be provided, but a basic knowledge of them is needed.

Course Intended Learning Outcomes


On completion of the course, you will be expected to a) understand the potential outcome framework for causal inference and its relationship with econometric models, b) possess a reasonably solid theoretical foundation in econometrics and related machine learning methods, and c) use software to analyze a given economic data set and interpret the results.

Course Materials and Websites

- **Lecture notes.** Lecture notes are the main learning resources of this course.
 - Lecture notes in pdf will be posted on **Canvas** (<http://canvas.ust.hk>). All lecture notes with R code are Binder-enabled: You can run the R code on any device including your mobile phones or tablets with Internet connection without installing R.
 - Lecture notes in ipynb and data will be posted on **GitHub** (<https://github.com/junlong-feng/econ5280>).
 - A mirror in Shenzhen will be provided if access to GitHub is not available within the GFW.

- **References.** The course does not have a required textbook. Below is a list of useful references. You don't have to purchase any of them.
 - Hansen, Bruce. *Econometrics*, Princeton.
 - Stock, James and Mark Watson. *Introduction to Econometrics*, Pearson.
 - Angrist, Joshua and Jörn-Steffen Pischke. *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton.
 - Hanck, Christoph *et.al.* *Econometrics with R*, <https://www.econometrics-with-r.org/>.

Software

- R, free and open-source, will be taught and used. To get started, you will need to install two software:
 1. R: <https://www.r-project.org/>.
 2. RStudio (changing name to Posit): <https://rstudio.com/>. You have to install R first. RStudio is only an interface making it easier for you to interact with R.
 - You don't have to install R or RStudio to run the code in the lecture notes. Click the binder button  whenever it shows up, and you can run/modify code online. It may take long for the first time.
 - You do have to install R for homework.
- You may use other software/languages (Python, Stata, MATLAB, Julia, etc., though Python highly recommended), but they will not be taught in class.

Assessment

The course requirements include problem sets (20%), a final project (30%), and a final exam (50%). More details will be announced later.

Outline (Tentative)

September. Introduction. Review of matrix algebra, probability and statistical inference.

September - October.

- Framework of causal inference.
- Linear models under exogeneity: Least squares.
- Linear models under endogeneity: Instrumental variable (IV) methods and linear GMM.

October - November.

- Nonlinear models under exogeneity: Random tree, causal tree, and causal forest.
- Nonlinear models under endogeneity: Deep learning, neural networks, and DeepIV.
- Introduction to panel data (optional).