ECON4274 Programing Econometrics with R

Hong Kong University of Science and Technology
Department of Economics

Course Information

Instructor: Yangguang (Sunny) HUANG
Email: huangyg@ust.hk
Lecture time: Monday 15:00-16:20; Friday 10:30-11:50 at LSK1001
(I may occasionally use LA1 Wednesday 9:00-10:20 at LSK1001 for makeup lecture. Unless I ask you to attend in Canvas announcement, you do not need to attend LA1 section.)
Please bring your laptop with R program to all lectures and exams.
Office hours: Wednesday 10:30-11:30; Friday 9:15-10:15.
- Face-to-face at LSK6075
- Zoom meeting (2067854429, https://hkust.zoom.us/j/2067854429)

Teaching assistant: Jeremy TO
Email: ecjeremy@ust.hk
Tutorial time: Thu 18:00-18:50 at LSK1033
Office hours and Zoom information will be posted on Canvas.

Course:

1. Five problem sets, each counts 8%, total 40%
   Can be submitted by individual student or by group with maximum two members. (Grouping can be changed across problem sets.) Submission will be through Canvas. Please submit both your answer (as word document or PDF) and your code.
2. Two exams, each counts 20%, total 40%
   Exams will be conducted during lecture time. Absence in an exam without a prior notification and a reasonable and verifiable justification will result in zero point.
3. Final project, 20%
   See detail in the final project requirement.

The final course grade will be given by the University guideline (http://qa.ust.hk/aos/distribution.html).
Student conduct and academic integrity (http://acadreg.ust.hk/generalreg.html).

Learning Goal

This course puts statistical theory and econometric method into practice by working with data and cases. ECON3334 is the prerequisite. Students are required to write their own program with R for summary statistics, data visualization, estimation, and hypothesis testing. The students are also trained to produce table and write report for empirical studies. The main objective is to help students develop skills in working with data to support a better business decision or analysis.

Warning: This is an advanced level course and require significant amount of time and commitment. The learning curve of programming is very steep. Students are assumed to have reasonable knowledge of

Econometrics, Calculus, Probability, Statistics, and Linear Algebra. TA and instructor are not responsible to help line-by-line debugging of student's code.

Based on the Program Intended Learning Objective (PILO) for BSc in Economics and Finance, after completing this course, students will
1. Understand the logic, scientific basis, and critical thinking of economic analyses. Solve business problems using appropriate quantitative and analytical techniques. (PILO 1)
2. Analyze qualitatively and quantitatively basic economic and financial problems. Apply economic knowledge to practical situations and make sound economic and finance decisions. Have a solid foundation for postgraduate studies. (PILO 4)
3. Work with others effectively and responsibly. (PILO 5)
4. Graduates will be effective users of information technology in business applications. Demonstrate proficiency in using IT applications in business and management. Use econometric or statistical software to deal with databases and conduct empirical analysis. (PILO 7)
5. Be lifelong users of economic analysis and econometric or statistical software. (PILO 9)

Course Materials

Books:

1. *Econometrics* (2019) by Bruce Hanse (Hansen) (http://www.ssc.wisc.edu/~bhansen/econometrics/)
2. *Mostly Harmless Econometrics* (2008) by Joshua Angrist and Jorn-Steffen Pischke (Harmless)
3. *Discrete Choice Methods with Simulation* (2003) by Kenneth Train (Train) (https://eml.berkeley.edu/books/choice2.html)
4. *Data Analysis and Graphics Using R* (2010), by John Maindonald and John Braun. (http://maths-people.anu.edu.au/~johnm/r-book/daagur3.html)
5. *Applied Econometrics with R* (2008) by Achim Zeileis and Christian Kleiber.

Papers:

1. David, H., Alan Manning, and Christopher L. Smith. "The Contribution of the Minimum Wage to US Wage Inequality Over Three Decades: a Reassessment." *American Economic Journal: Applied Economics* (2016).
2. Card, David, and Alan B. Krueger. "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania." *American Economic Review* (1994).
3. Angrist, Joshua D., and Alan B. Krueger. "Does Compulsory School Attendance Affect Schooling and Earnings?" *Quarterly Journal of Economics* (1991).
4. Acemoglu, Daron, Simon Johnson, and James A. Robinson. "The Colonial Origins of Comparative Development: An Empirical Investigation." *American Economic Review* (2001).
5. Islam, Nazrul. "Growth Empirics: A Panel Data Approach." *Quarterly Journal of Economics* (1995).
6. Acemoglu, Daron, et al. "Democracy Does Cause Growth." *Journal of Political Economy* (2019).
7. Jaffee, Adam B. "Building Program Evaluation into the Design of Public Research Support Programs." *Oxford Review of Economic Policy* 18 (2002).
8. Wallsten, Scott J. "The Effects of Government-industry R&D Programs on Private R&D: the Case of the Small Business Innovation Research program." *RAND Journal of Economics* (2000).
9. Chemmanur, Thomas J., Elena Loutskina, and Xuan Tian. "Corporate Venture Capital, Value Creation, and Innovation." *Review of Financial Studies* (2014): 2434-2473.

10. *Howell, Sabrina T. "Financing Innovation: Evidence from R&D Grants." *American Economic Review* (2017)
11. *Branstetter, Lee G., and Mariko Sakakibara. "When do Research Consortia Work Well and Why? Evidence from Japanese Panel Data." *American Economic Review* 92.1 (2002).
12. Shum, Matthew. "Estimating Demand in Discrete-Choice Differentiated Product Markets". (http://people.hss.caltech.edu/~mshum/gradio/china1.pdf)
13. Petrin, Amil. "Quantifying the Benefits of New Products: The Case of the Minivan." *Journal of Political Economy* (2002).

Outline and Schedule

Module 1. Programming boot camp (6 lectures)

- Introduction to R Programming
  - Basic commands
  - Matrix algebra
  - Function
  - Loop
  - Plot
  - Solving mathematical problem by computer programming

  Readings: Hansen Appendix A

- Ordinary least square (OLS)
  - Linear regression and OLS
  - Unbiasedness and consistency
  - Monte-Carlo simulation

  Readings: Hansen 3, 4

Problem set 1

Module 2. Linear regression (5 lectures)

- Data
  - Importing/exporting data
  - Organizing and visualizing data
  - Summary statistic table

  Readings: paper 1, 2, 3

- Linear Regression
  - Coefficient estimation and standard error
  - Hypothesis tests

- Model specification and diagnostic
- Reporting estimation results in tables

Readings: Hansen 5, 7; paper 4, 9

Problem set 2

Exam 1 (1 lectures)

Module 3. Causal inference (5 lectures)

- Causal inference
  - Endogeneity and causality
  - Treatment effect
  - Difference-in-difference (DID)
  - Instrumental variable (IV) and two-stage least square (TSLS)
  - *Regression discontinuity (paper 10)
  - *Propensity score matching (paper 11)

  Readings: Harmless 1, 2, 3, 4, 5; Hansen 12; paper 2, 3, 4, 7, 8, 9

- Panel data
  - Structure of panel data
  - Fixed effect estimation
  - Random effect and Hausman test

  Readings: Hansen 16; paper 5, 6, 9

Problem set 3

Start final project!!

Module 4. Non-linear models (4 lecture)

- Extremum estimators
  - Use of "optim" function
  - Non-linear least square (NLS)
  - Maximum likelihood estimation (MLE)

  Readings: Hansen 5, 20

- Limited dependent variable and discrete choice
  - Limited dependent variable
  - Binary outcome: Logit and Probit
  - Discrete choice and multinomial logit

- Demand estimation

Readings: Train 1, 2, 3, 4, 13; paper 12, 13

Problem set 4

Exam 2 (1 lectures)

Module 5. Selected topics (3 lecture)

- Writing training
  - Quotation and reference
  - Tables and figures
  - Clarity and grammar

- Bootstrap method
  - Find critical value of test statistic
  - Find standard error of estimator

  Readings: Hansen 10

- Nonparametric estimation
  - Estimate CDF and PDF
  - Nonparametric regression

  Reading: Hansen 18.

- Big data
  - High-dimensional data and Lasso
  - Tree-based classification
  - Clustering

Problem set 5

Final project is due at the end of the final exam period.