

Econometrics

Yeshiva University, Stern College – Spring 2023

Econometrics is where theory meets data. Based on statistics and probability theory, econometrics is the branch of economics that uses economic data to test theoretical relationships, estimate their size and make predictions. As a first course in data analysis, this course will prepare the student for further study of econometrics and for other data analysis fields (e.g. machine learning).

Econometric education is a lot like learning to fly a plane; you learn more from actually doing it than you learn from reading about it. – A.H. Studenmund

One way to learn how to do it is to imitate other people. So I will first teach you to imitate me. I'll show you how I retrieve data, how I prepare it for analysis and how I analyze it, so that you can imitate me. Then I will ask you to prepare and analyze another data set, giving you a chance to "fly the plane."

textbook and course materials

- A.H. Studenmund. *Using Econometrics: A Practical Guide*. Pearson
- P. Kennedy. *A Guide to Econometrics*. Wiley-Blackwell
- E. Wdowiak. *Econometrics* (website). doviak.net/courses/metrics

The course revolves the website: doviak.net/courses/metrics, where you will find notes, homeworks, code, announcements and any additional readings that I may assign. Please check the website regularly.

The textbooks explain the materials at the website. Studenmund designed his textbook for beginners and it also serves as a good reference once you have a good knowledge of econometrics. Kennedy's *Guide* explores the assumptions of linear regression and emphasizes the intuition behind the models.

Kennedy's *Guide* and Studenmund's textbook will be the textbooks for this course. So please acquire a copy of Kennedy's *Guide* and Studenmund's textbook. Any edition is fine. Used copies are cheaper.

software

Please install R, wxMaxima and Gretl. I will use wxMaxima to show you the mathematical foundations of econometrics. For statistical analysis, I will also provide examples written in the R language, but Gretl is a better tool for beginners. Gretl's drop-down menus make it easy to learn econometrics.

course requirements

During the semester, there will be two midterm exams (25 percent each). The exams will consist of a set of short essays on econometric theory.

Solving the problems in the problem set will help you learn the theory, so we will review the solutions in class. Studying the mathematics in the problem set will help you write essays on the exams.

And participating in those discussions is one way to earn a good class participation grade (10 percent).

But the best way to learn econometrics is to do it. So for a final project (40 percent), I will ask you to perform an econometric analysis with a dataset of your choice.

course outline

Background – statistics and probability

Lecture 1 – ordinary least squares

- Studenmund, chaps. 1, 2 and 3
- problems #4 and #1

Lecture 2 – maximum likelihood

- Kennedy, chaps. 1, 2 and 3
- problem #2

Lecture 3 – hypothesis testing

- Studenmund, chaps. 4 and 5
- Kennedy, chap. 4
- problems #3 and #4

Lecture 4 – violations of the Gauss-Markov assumptions

- Studenmund, chaps. 6 and 7
- Kennedy, chaps. 5, 6 and 7

Lecture 5 – panel data

- Studenmund, chap. 16
- Kennedy, chaps. 15 and 18

Lecture 6 – heteroskedasticity

- Studenmund, chap. 10
- Kennedy, chap. 8

Lecture 7 – probability models

- Studenmund, chap. 13
- Kennedy, chaps. 16 and 17

Lecture 8 – time-series

- Studenmund, chaps. 9, 12 and 15
- Kennedy, chaps. 10, 19 and 20

Lecture 9 – simultaneous equations

- Studenmund, chap. 14
- Kennedy, chap. 11

review for first exam

1. What is Ordinary Least Squares? What is Maximum Likelihood Estimation?
2. What are the Gauss-Markov assumptions?
3. Why are the OLS estimates of regression coefficients equal to the MLE estimates?
4. Why doesn't OLS provide an estimate of the standard error?
5. What is the standard error of regression? What is the standard error of a regression coefficient?
6. Why do the MLE first-order conditions provide an estimate of the standard error of the regression?
7. Why do the MLE second-order conditions provide estimates of the standard error of the regression coefficients?
8. Why is the standard error of a parameter estimate smaller when the log-likelihood surface comes to a sharp peak along its dimension?

review for second exam

1. What are non-spherical disturbances?
2. What is panel data? How does it differ from cross-sectional data?
 - What are the fixed effects and random effects models? How are they similar? How do they differ?
 - How do we use the Hausman test to decide whether the fixed effects model or the random effects model is more appropriate?
3. What is time-series data? How does it differ from cross-sectional data? How does serial correlation affect our estimation strategy?
4. Describe the different types of probability models (i.e. probit, logit, Tobit). Under what conditions are they used? How do we interpret the results?
5. Why must we weight the residuals when analyzing proportions data (with the logit model)?

econometric analysis

Conducting an econometric analysis is your opportunity to learn econometrics by doing it. So that I can assist you, please first submit a proposal. Then the final project will be due at the end of the semester.

For the project proposal, please submit a written description of:

- the null hypothesis that you wish to test
- the dataset that you plan to test it with

For the final project, please submit a formal paper, in which you describe:

- the null hypothesis that you tested
- the dataset that you tested it with
- summary statistics
- how you manipulated the data
- the regressions that you ran
- your conclusion: should we accept or reject the null hypothesis?