

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 and estimate their size. In short, it's a course in data analysis.

As an economist working in a professional environment, you will spend 90 percent of your time preparing data and only 10 percent of your time conducting data analysis. But in the classroom, we will spend 90 percent of our time discussing data analysis and only 10 percent of our time preparing data.

Assume that good data preparation and good data analysis are equally important for us to obtain meaningful results. Even if they are equally important, we should still spend most of our class time discussing econometrics because the purpose of our data preparation is econometric analysis.

You will have to learn data preparation outside of the classroom, but I will help you learn the same way that I learned: by imitating other people. How does a child learn to speak? By imitating others. So I'm going to ask you to imitate me. I'm going to show you how I retrieve data, how I prepare it for analysis and how I analyze it. Then I'm going to ask you to imitate my work, by performing a similar statistical analysis with another data set.

textbooks

The following textbooks are required:

- J.H. Stock and M.W. Watson (2010). *Introduction to Econometrics*. ISBN: 978-0-1380-0900-7
- P. Kennedy (2008). *A Guide to Econometrics*. ISBN: 978-1-4051-8257-7

The following textbooks are optional:

- M.H. DeGroot and M.J. Schervish (2011). *Probability and Statistics*. ISBN: 978-0-3215-0046-5
- D.W. Pearce (1992), editor. *The MIT Dictionary of Modern Economics*. ISBN: 0-262-66078-4

Kennedy's *Guide* emphasizes the intuition behind the econometric models. It explains the Gauss-Markov assumptions, the properties of time-series and the importance of having exogenous regressors. Stock and Watson's textbook explains econometric techniques.

Kennedy's *Guide* and Stock and Watson's textbook will be the primary textbooks for this course. The DeGroot-Schervish textbook is a good reference on statistics and probability theory, while Pearce's *MIT Dictionary* will help you learn the language of economics and econometrics.

software

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

course requirements

The best way to learn econometrics is to do it, but to do it properly, you need to know the theory. Solving the problems in the problem set will help you learn the theory. Performing an econometric analysis will help you learn how to conduct a statistical analysis. And studying for the two exams will ensure that you learn the major themes of econometrics.

- (10 percent) class participation
- (20 percent) midterm exam
- (20 percent) final exam
- (50 percent) econometric analysis

course outline

Background – statistics and probability

- Stock and Watson, chaps. 1, 2, and 3

Lecture 1 – ordinary least squares

- Stock and Watson, chaps. 4 and 5
- problem #1

Lecture 2 – maximum likelihood

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

Lecture 3 – hypothesis testing

- Kennedy, chap. 4
- problems #3 and #4

Lecture 4 – violations of the Gauss-Markov assumptions

- Kennedy, chaps. 5, 6 and 7

Lecture 5 – panel data

- Stock and Watson, chap. 8
- Kennedy, chap. 18

Lecture 6 – heteroskedascity

- Kennedy, chap. 8

Lecture 7 – probability models

- Stock and Watson, chaps. 9
- Kennedy, chap. 16

Lecture 8 – time-series

- Stock and Watson, chaps. 12, 13 and 14
- Kennedy, chap. 19

Midterm Exam

Please answer the following questions and submit your handwritten answers in class.

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 us with an estimate of the standard error of the regression? Why do the MLE second-order conditions provide us with estimates of the standard error of the regression coefficients?
7. Why is the standard error of a parameter estimate smaller when the log-likelihood surface comes to a sharp peak along its dimension?



Final Exam

Please answer the following questions and submit your handwritten answers in class.

1. What are non-spherical disturbances?
2. What is panel data? How does it differ from cross-sectional data?
3. What is time-series data? How does it differ from cross-sectional data?
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, I would like you to submit a proposal by mid-semester. 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?