Princeton University **Spring 2022**
Department of Economics **ECO 312**

Econometrics: A Mathematical Approach

Syllabus: Version 2 (February 16, 2022)

Instructor:	Mikkel Plagborg-Moller (mikkelpm@princeton.edu)
Lectures:	Mon/Wed 1.30–2.50pm, JRR A17
Office hours:	Mon 3.00–4.00 pm, JRR 282
Assistant-in-Instruction:	Rachel Fung (ylfung@princeton.edu)
Undergrad Course Assistants:	Lindsay Li, Emiri Morita, Anlin Zhang
Web page:	https://princeton.instructure.com/courses/6051

Description. This course is an introduction to econometrics. Econometrics is a subdiscipline of statistics that provides methods for inferring economic structure from data. This course has two goals. The first goal is to give you means to evaluate an econometric analysis critically and logically. Second, you should be able to analyze a data set methodically and comprehensively using the tools of econometrics.

Prerequisites. ECO 100, ECO 101, ECO 202 (or ORF 245), MAT 175 + elementary matrix algebra such as matrix addition, subtraction, multiplication and inversion. MAT 201 and 202 recommended, but not required.

Lecture format. The course will be taught in-person. If necessary due to Covid-19 quarantine protocols, a Zoom link to the live lectures and precepts will be provided on the course website; however, in-person attendance is strongly encouraged if possible.

Readings. Optional textbook:

- Stock and Watson, *Introduction to Econometrics*, Pearson, 4th edition. We will cover most of the first 13 chapters, as well as chapters 15, 18, and 19. If time permits, we will also cover parts of chapter 14.

Lecture slides will be posted on the course website. The slides are self-contained if supported by attendance at the lectures. However, you are strongly encouraged to read along in the Stock & Watson textbook as well. It is especially useful to read the empirical examples in the book.

Requirements/grading.

In-class tests: 25%.

- There will be two 80-minute, closed-book in-class tests. The tests are required. If you miss any of these tests, then the final will be reweighted appropriately, provided that this is endorsed by the relevant dean.

Final exam: 50%.

- There will be a 3-hour in-person, closed-book final exam.

Problem sets: 25%.

- There will be a number of problem sets (approximately one per week, except in weeks with a test). The problem sets are challenging and sometimes require you to think beyond what is on the lecture slides. You are encouraged to discuss problem sets with your classmates, but problem sets should be written and submitted individually.

  We will only accept late submission of problem sets due to (i) a documented illness or distressing experience, or (ii) a major event that cannot be rescheduled and that you let us know about well before the deadline. However, we will ignore the two lowest problem set grades.

We reserve the right to subtract points for sloppy exposition, including unreadable code or poor document structure. If you find a grading error, please resubmit your problem set or test along with a one-paragraph explanation. Re-grading will be done by the Instructor or Assistant-in-Instruction. We reserve the right to re-grade the entire problem set.

Computer work. Computer work is an integral part of econometrics, and the problems that will be assigned assume general computer literacy. Lectures, precepts, and problem sets will emphasize use of the software package Stata, but you may use other equivalent software packages for problem sets if you wish. You are expected to spend time during the first weeks to familiarize yourself with the necessary software.

Timing of events.

- Problem sets will generally be posted on Mondays and due the following Tuesday morning.
- Precepts will start the first week. The first precept will introduce Stata and review basic matrix algebra.
- The two in-class tests are scheduled for Feb 23 and Apr 13.
- The final exam is scheduled by the registrar for May 6 at 9 a.m. in JRR A17.

Code of conduct. All course activities, including class meetings and homework assignments, are subject to the university's academic code and code of conduct as detailed in the "Rights, Rules, Responsibilities" publication.

Accommodations for students with disabilities. Students must register with the Office of Disability Services (ODS) (ods@princeton.edu; 258-8840) for disability verification and determination of eligibility for reasonable academic accommodations. Requests for academic accommodations for this course need to be made at the beginning of the semester, or as soon as possible for newly approved students, and again at least two weeks in advance of any needed accommodations in order to make arrangements to implement the accommodations. Please make an appointment to meet with the instructor in order to maintain confidentiality in addressing your needs. No accommodations will be given without authorization from ODS, or without advance notice.

Course outline. The following outline is preliminary and may change without warning.

1. What is econometrics and why is it useful? (Stock and Watson, chapter 1).
2. Linear regression.
   i) Regression with one regressor (Stock and Watson, chapters 4–5 and 18).
   ii) General case (Stock and Watson, chapters 6–8 and 19.1–19.6).
   iii) Assessing studies based on regression (chapter 9).
3. Panel data (Stock and Watson, chapter 10).

4. Binary choice (Stock and Watson, chapter 11).

5. Instrumental variables (Stock and Watson, chapters 12 and 19.7).

6. Experiments and quasi-experiments (Stock and Watson, chapter 13).

7. Introduction to time series (Stock and Watson, chapter 15).

8. Time permitting: Prediction with many regressors (Stock and Watson, chapter 14).

We will review probability and statistics (Stock and Watson, chapters 2–3) as needed along the way. The relevant topics include:

- Random variables, probability distributions, and densities. Expectations. Multivariate distributions, conditional distributions, and independence. Special distributions: Bernoulli, normal, chi-squared, F, and T.
- Large sample theory.
- Estimators and their properties. Confidence intervals and hypothesis testing.