Syllabus

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Course: *Econometrics II*
Professor:
Teaching Assistant:

2025 FIRST SEMESTER

PROGRAM

This course is the second part of a sequence of two courses that presents core topics in Econometrics. It covers topics about time series and general method of moments. Its main goal is to prepare the applied researcher to use econometric tools appropriately.

TOPICS

1) ARMA(p,q) models: Autoregressive Moving Average Model
2) Non-stationary time series
   a. Determinist Trends
   b. Unit Root models
3) ADL models: Autoregressive Distributed Lag Model
4) VAR models: Vector Autoregressive Model
5) Cointegration
6) GMM: Generalized Method of Moments
7) Dynamic Panel Data Model
8) Causality in Time Series and Panel Data Models

GRADING

Written Final Exam: 40% **[Date: TBD]**

- The final exam will contain **two** questions that will be very similar or equal to questions in the problem sets or lecture notes.
- The final exam will contain at least one theoretical question that is meant to be challenging. It may require lengthier mathematical proofs.
- The final exam will contain at least one empirical question.
- The final exam will last 3 hours and 50 minutes. I intend to create a final exam that is knowledge constrained instead of time constrained.

Problem Sets: 40%

- The problem sets will cover some theoretical questions from the lectures. It may include particular examples or lengthier proofs.
- They will also cover coding exercises. These exercises may include Monte Carlo simulations or specific empirical examples.

- The two lowest scores will be dropped from the final average score across problem sets. This policy is set as a "no-questions asked" excuse to help students who, for some reason, are unable to complete all problem sets.
- In each problem set, the teaching assistant will randomly choose one question to grade carefully. The other questions will be checked for completion only.
- For each problem set, you must submit a pdf file containing all your answers in a detailed way. Furthermore, for each problem set, you must submit one zip file containing all your R scripts and data sets. One easy way to do that is to use RMarkdown. The submission process will use our Teams platform (Assignment Section).

Short Research Project: 20% **[Deadline: TBD]**

- This project must contain a research question in any topic that can be answered using some of the techniques learned in Econometrics I and II or more advanced econometric tools.
- This project must also contain one paragraph explaining how to use a specific econometric technique to answer this question and one paragraph explaining the relevance of this research question with respect to the literature.
- This short research project must have at most one page (A4, 2-cm margins, 1.5 spacing). The reference list does not count for the page limit.

To pass the course, the student must achieve a final score greater than or equal to 60.

If the student's grade is greater than or equal to 40 and strictly less than 60, the student will take a re-evaluation exam. This exam will take place on July 8th. In this case, the final score will be 60 if the student scores 60 or more in the re-evaluation exam.

If the student scores strictly less than 40, the student will fail the course.

SELECTED BIBLIOGRAPHY

1) Stationary ARMA(p,q) models

- Hamilton: Chapter 3
- Optional reading about forecasting: Hamilton's Chapter 4
- Optional reading about estimation and inference: Hamilton's Chapter 5

2) Non-stationary time series

- Hamilton: Chapter 15
  - **a. Determinist Trends**
- Hamilton: Chapter 16
  - **b. Unit Root models**
- Hamilton: Chapter 17, Sections 1-4.

3) ADL models

- Hanck, Arnold, Gerber and Schmelzer: Chapter 14.5

4) VAR models

- Hamilton: Chapters 10.1, 10.2, 10.5 and 11.1, 11.4-11.6

- Light reading: Campante, Sturzenegger, Velasco, der Meguerditchian and Nicolas (2021, *Advanced Macroeconomics: An Easy Guide - Estimating VARs & SVARs*, in "Advanced Macro-Economics: An Easy Guide")

5) Cointegration
- Hamilton: Chapters 19.1, 19.2, 20.2 (pages 635 and 636), 20.3 (pages 645-648) and 20.4

6) GMM
- Hamilton: Chapter 14
- Soft reading: Chaussé (2021, *Computing Generalized Method of Moments and Generalized Empirical Likelihood with R*)
- Optional reading: Hayashi, Chapters 3 and 4

7) Dynamic Panel Data model
- Light reading: Bond (2002, *Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice*, Portuguese Economic Journal)

8) Causality in Time Series and Panel Data Models
- Optional reading: Rambachan and Shephard (2021, When Do Common Time Series Estimands Have Nonparametric Causal Meaning?)

CONTACT INFORMATION

Instructor:
Email:
Office:
Office Hours:

- Office hours are a pre-defined period of time that is entirely dedicated to students. During this period, feel free to drop by my office for any reason. You can ask me any questions related to the course, to academia, to your career, to Economics or to your life as a graduate student.
- Although not mandatory, you will make me happy if you schedule a meeting using this link: https://calendly.com/possebomvitor/officehour. Scheduling a meeting will also benefit you because I will prioritize scheduled meetings over walk-in meetings.

TA: TBD
Contact: TBD
Office Hours: TBD

Contact the TAs with your questions before going to their office hours.

ACCEPTABLE USE POLICY

You are free to use any published materials (e.g., a textbook), in preparing your assignments or for learning the material more generally. Similarly, you are free to use online resources such as Stackoverflow questions or R tutorials. You are also strongly encouraged to work with others in your class. This is particularly helpful for learning to code. Each person must turn in their own assignment.

We do not tolerate cheating and plagiarism. Cheating or plagiarism will result in a 0 on the assignment and will be reported to the department. You are welcome to work together in groups, but you are required to submit your own write-up and your own code.

Please take precautions to avoid putting us in a situation where we are forced to decide if two documents are "too similar". As future researchers, consultants, bankers, entrepreneurs etc, learning to do honest work in a timely manner is more important than getting everything correct.

If you are uncertain, please add proper citation. For example, if you relied heavily on a group-member's code for one part of an assignment, then you should make a footnote highlighting this fact. As long as proper credit is clearly given, it does not constitute cheating.

Moreover, note that the final exam will contain two questions from the problem sets. I believe that this policy institutes strong incentives for you to work hard in your own solutions.

TEXTBOOKS

There is one main textbook in this course.

- Hamilton: *Time Series Analysis*

This book is one of the standard references in any time series course and covers many topics that you will need during your graduate studies. I recommend reading many of their chapters during this course.

The standard textbook about cross-sectional and panel data is Wooldridge's *Econometric Analysis of Cross Section and Panel Data*. It has an excellent chapter on Generalized Method of Moments.

Another standard option that covers cross-section, panel data and time series topics is *Econometrics* by Hayashi.

I do not think that there is an optimal textbook. Some books work best for some students and other books work best for other students. Sometimes, you will need to read more than one reference to really understand a topic. Therefore, feel free to check any references that you find useful.

SOFTWARE

Much of the course work in this course will involve data analysis using *R*, an open-source implementation of the object-oriented programming language *S*. It is widely used by applied statisticians and its libraries implement a wide variety of statistical and graphical techniques with applications to a range of disciplines, such as the agricultural and biological sciences, genetics, neuroscience and economics.

R can be downloaded from https://cran.r-project.org. The program documentation is excellent. There are also many excellent and free *R* references available online, for example, *Econometrics in R* (https://cran.r-project.org/doc/contrib/Farnsworth-EconometricsInR.pdf) by G. Farnsworth and *Applied Econometrics with R* (https://link.springer.com/book/10.1007/978-0-387-77318-6) by Christian Kleiber and Achim Zeileis. If your time permits and you want to dig deeper, there are also more programming-oriented references such as *An Introduction to R* (https://cran.r-project.org/doc/manuals/R-intro.pdf) by W. N. Venables, D. M. Smith and the *R* Core Team, and *Hands-on Programming with R* (https://rstudio-education.github.io/hopr/) by Garrett Grolemund. However, I recommend learning by trial and error, as it is the most time efficient approach and sufficient for the type of coding problems that we will consider.

If you have never used *R* (and have never used another programming language), it might be helpful to check Chapter 1-12 in this free book (https://bookdown.org/ndphillips/YaRrr/) by Nathaniel D. Phillips. There are two more online tutorials that are very informative and quick. The first one is *Introduction to R* (https://hhsievertsen.github.io/applied_econ_with_r/) by Hans H. Sievertsen. Moreover, Kyle F. Butts, Nick C. Huntington-Klein and Grant McDermott developed an online tutorial focusing on data cleaning and regression analysis: https://stata2r.github.io/.

Although introductory, two of my favorite references combining *R* and Econometrics is *Introduction to Econometrics with R* (https://www.econometrics-with-r.org/) by Christoph Hanck, Martin Arnold, Alexander Gerber, and Martin Schmelzer, and *Using R for Introductory Econometrics* (http://urfie.net/read/index.html) by Florian Heiss. The theoretical depth of these books is surely not sufficient for a graduate course in Econometrics, but it covers most of the topics in this course and it brings many coding examples that may be helpful to you.

A deeper reference is *Causal Inference: The Mixtape* (https://mixtape.scunning.com/) by Scott Cunningham. It covers many recent econometric techniques and brings coding examples in *R* and *Stata*. However, it focuses exclusively on cross-section and panel data topics.

A similar resource is Vikjam's and Shusuke-Hori's GitHub repository (https://github.com/vikjam/mostly-harmless-replication) that replicates the book *Mostly Harmless Econometrics* by Joshua Angrist and Jörn-Steffen Pischke. In this repository, you can find R, Stata, Python and Julia codes.

Moreover, there is a new book by Martin Huber that focus on policy evaluation with causal machine learning: https://drive.switch.ch/index.php/s/tNhKQmkGB48bjfz. It includes many examples in R.

If you are interested in *Python*, you may want to check the following introductory books:

- *Causal Inference for the Brave and True* (https://matheusfacure.github.io/python-causality-handbook/landing-page.html) by Matheus Facure Alves.
- *The Effect* (https://www.theeffectbook.net/) by Nick Huntington-Klein.

Unfortunately, they also focus on cross-section and panel data topics.

For a book focusing on time series, I recently discovered *Forecasting: Principles and Practice* (https://otexts.com/fpp3/) by Rob J Hyndman and George Athanasopoulos. It covers advanced time series methods and brings many coding examples in *R*. Professor Childers also wrote excellent lecture notes with many coding examples that complement this book: https://donskerclass.github.io/Forecasting.html.

For a book focusing on finance, I recently discovered *Tidy Finance with R* (https://www.tidy-finance.org/index.html) by Christoph Scheuch, Stefan Voigt, and Patrick Weiss. It also covers some interesting topics related to Machine Learning.

For a time series chapter focusing on Python, you can check the *Coding for Economists* guide by Arthur Turrel (https://aeturrell.github.io/coding-for-economists/time-series.html).

CLASSROOMS POLICIES

This class is committed to an inclusive learning environment. All students, teaching staff, and the professor are expected to treat each other with respect and dignity at all times. All community members should enjoy an environment free of any form of harassment, sexual misconduct, discrimination, or intimate partner violence.

Mental Health issues are an extremely common problem among graduate students (https://scholar.harvard.edu/bolotnyy/publications/graduate-student-mental-health-lessons-american-economics-departments).

To help any students, FGV offers the Pró-Saúde Program: https://eesp.fgv.br/pro-saude-fgv. Feel free to contact them at any time.

Moreover, there are many affordable options outside FGV that may be helpful to you too, such as

- Clínica Psicológica Ana Maria Poppovic – PUC-SP: https://www.pucsp.br/clinica/index.html.
- Psicodrama Público no Centro Cultura São Paulo: http://centrocultural.sp.gov.br/2020/03/05/subjetividades-e-espaco-publico/ e https://spcultura.prefeitura.sp.gov.br/evento/26868/.

Furthermore, there are many mindfulness and meditation apps that you may find useful:

- Ten Percent Happier: https://www.tenpercent.com/
- Unwinding Anxiety: https://unwindinganxiety.com/
- Meditopia: https://meditopia.com/pt/ (em Português)