ECO 1421 – Tue/Thu 3:00 to 4:15pm – room Furst 317
office hours – half-hour before each class and via email

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Econometrics

Yeshiva College – Fall 2025

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

I have uploaded the syllabus and course materials to Canvas, yu.instructure.com. However, my teaching website, doviak.net/courses/metrics, provides a more comprehensive and convenient way to organize and distribute notes, homeworks, code, datasets and announcements. Please check the website regularly.

The textbooks explain the course materials. 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 *short* midterm exams (20 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 (50 percent), I will ask you to perform an econometric analysis on a topic of your choice with data *from the OECD*. I'll help you select the variables and assemble the dataset. Your task is to perform the analysis. Details and instructions below.

I encourage students to study together and help each other, but each student submits their own exam and each student submits their own analysis.

academic integrity

Below is the lead paragraph of Yeshiva University's Academic Integrity Policy:

"Yeshiva University strives to do much more than impart information and skills to undergraduate students. At the core of our educational goals include character development and preparation for graduate school and the workplace based on our Jewish tradition and values. Rabbi Moshe Feinstein zt"l ruled that if you get a job using a cheated grade, every dollar you earn from it is considered stolen. It is during college that students define who they are and who they will be after graduation. The academic integrity expectations and policies that follow are intended to help foster the traits of honesty and integrity that students will need throughout life."

artificial intelligence and academic integrity

The best reason not to use artificial intelligence in economic research is that it won't help you.

Large language models generate a fluent sequence of words similar to the sequences in their training data. And the newer reasoning models can solve math problems. But they cannot replace the human thought necessary to design and implement a comprehensive and cohesive plan.

For example, when preparing this policy, I asked one prominent reasoning model to create a lesson plan which relates econometrics to artifical intelligence. It wrongly advised me to teach you that: "machine learning algorithms can help econometricians select the most important variables from a vast dataset to include in their causal models." The model wrongly thought that this approach would help "prevent 'model misspecification."'

It is true that machine learning approaches can help identify correlates. But a simple correlation matrix does too. And, most importantly, correlation does not imply causation.

There should be a sound theoretic reason for including a variable in an econometric model. For example, even if a correlation exists between sunspots and economic fluctuations, that correlation does not imply a causal relationship. Unless the sun disappears from the sky, there's no reason to believe that changes in solar activity would affect GDP growth rates. Accordingly, we should not include sunspots in a model of economic growth. And we should not trust a reasoning model's reasoning.

That having been said, if *you* bring the mathematical reasoning that you learn in economics to a language model, the language model will help you write a fluent sequence of words with good mathematical reasoning. In other words, the critical ingredient is *you*. *You* must supply the good mathematical reasoning.

Accordingly, this course follows Yeshiva University's Academic Integrity Policy on Artificial Intelligence and allows students to use all forms of artificial intelligence without restriction. In following YU's policy, one must cite any content that a generative language model wrote. For example citations, YU's policy suggests the ones by the MLA and APA.

One must cite sources! So in cases where a student completely rewrote what a language model wrote, the student must still acknowledge use of a language model. For those cases, an acknowledgement with proper citation may be more appropriate than a standard citation.

students with disabilities

Students who will be requesting documented disability-related accommodations should make an appointment with the Office of Disability Services, wilfods@yu.edu, during the first week of class. The office is located in the Belz Building, suite 412. Once you have been approved for accommodations, please submit your accommodation letter and discuss any specifics with me to ensure the successful implementation of your accommodations.

course outline

Introductory Discussions

- Bender and Koller (2020). "Climbing towards NLU"
- Wdowiak. monopsonist and minimum wage
- Wdowiak (2017). minimum wage, employment and annual pay

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 – heteroskedascity

- 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 coefficents?
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. And the best topic to write about is the one that you want to write about, so we'll assemble data on a topic of your choice *from the OECD*. I'll help you select the variables and assemble the dataset. To make that task feasible, we'll use data *from the OECD*. Your task is to perform the analysis.

So that I can assist you, please first submit a proposal by mid-semester. 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?