ECO 357: Econometrics

Instructor: Muzhe Yang

Fall 2025 (syllabus version: 07/20/2025)

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Course Overview

In most of economics we are interested in causal, rather than correlative, relationships among variables. For example, it is not the correlation between earnings and years of schooling that is of policy interest, but the effect of increasing a person's schooling by one year on that same person's earning. Econometrics focuses on such a causal relationship. This course aims to: 1) familiarize students with basic econometric methods; and 2) enable students to select appropriate econometric tools for basic empirical research.

This course emphasizes hands-on applications of econometric methods. Topics include ordinary least squares, instrumental variables, difference-in-differences, panel data methods, and causal inference using the potential outcomes framework (i.e., the counterfactual approach).

Course Objectives

By the end of the course, students should be able to do the following:

1. Understand the basic principles of econometric analysis;
2. Conduct estimation and hypothesis tests using the software *Stata*;
3. Use appropriate econometric tools to conduct basic empirical research.

Required Materials

- **Textbook**: Jeffrey M. Wooldridge (JW), *Introductory Econometrics: A Modern Approach, 7th Edition*. Please go over a separate document posted on Course Site for detailed information about the textbook.
- **MindTap**: Please go over these two documents posted on Course Site: 1) about access to MindTap; and 2) about MindTap and Cengage Unlimited.
- **Software**: *Stata*. Please go over the installation guide posted on Course Site to install this software. In addition to showing you how to use *Stata* within the software itself, I will show you how to use *Stata* together with *JupyterLab*; that is, how to use *Stata* from within *JupyterLab*, which makes it easy to combine code, outputs (e.g., estimates, figures and tables) with narrative texts and mathematical equations. *JupyterLab* is one popular choice among

Python users, and this way of using *Stata* together with *JupyterLab* is now possible because of the *Stata-Python* integration.

- Resources for learning *Stata*:
  - Please watch either (a) Ready. Set. Go Stata (a 45-minute-long tutorial) or (b) Introduction to Stata for students (a one-hour-long tutorial). Both videos were provided by StataCorp. They cover the same materials, with (b) giving a little more details. Please start your *Stata* learning process by watching either (a) or (b) as your first step.
    - In case the recording becomes unavailable online, you should be able to get back the access by filling out this form for accessing past webinar recordings made by StataCorp.
  - A lot of resources and support are listed here, especially video tutorials and short tutorials.
    - If you need help with, for example, importing EXCEL data (or data in other formats) into *Stata*, please see this 2-minute long video.
  - Tutorials for learning *Stata* are also available on the online platform of the textbook (i.e., MindTap).
- For the computing part of this course we will be focusing on the software *Stata*. It provides a comprehensive set of tools for econometric analyses, and it is significantly easier to grasp than *R* and *Python* (both of which are popular programming languages especially among data scientists). If time permits, I will go over some *R* and *Python* code that are related to our course materials. If you are interested in learning *R* and *Python* while taking this course, you may go over the following resources:
  - Tutorials for learning *R* that are available on the online platform of the textbook (i.e., MindTap);
  - *Using R for Introductory Econometrics, 2nd edition* by Florian Heiss. This book can be downloaded as a PDF copy for free, and it follows our textbook (*Introductory Econometrics* by Jeffrey M. Wooldridge) closely.
  - *Using Python for Introductory Econometrics, 2nd edition* by Florian Heiss and Daniel Brunner. This book can be downloaded as a PDF copy for free, and it follows our textbook (*Introductory Econometrics* by Jeffrey M. Wooldridge) closely.

Course Requirements

My responsibilities are to come to class prepared; respond to and encourage questions and other appropriate class participation; grade problem sets, exams and empirical projects; and hold regular office hours.

My regular office hours are Tuesdays and Thursdays 2:30–4:00 PM, during which I will be available on Zoom or in my office—Rauch Business Center 456. To join a Zoom session for office hours, please click this link. If you want to secure a 15-minute time slot for a meeting during office hours, please make a reservation by going to this website, where you can select the slot (and I will then be notified automatically). If my regular office hours do not work for you, please feel free to make additional appointments with me by e-mail.

Your responsibilities are to attend and participate in lectures; complete assigned readings in time; complete all problem sets on time; take one midterm exam and one final exam; and complete an empirical project.

Grading Components

Your course grade will be based on your work on problem sets, one empirical project, one midterm exam, and one final exam. Your letter grade for the course, with plus or minus marks possible, will be assigned after the final exam and the empirical project are both graded. The weights that will be used to compute the weighted average score, based on which the letter grade will be determined, are listed below.

Grade Components	Notes	Weights
Problem Sets (PS)	Posted on Course Site, 10 in total	40%
Empirical Project	Detail explained below, due ~~12/05~~	20%
Midterm Exam (1 hour)	~~10/10~~, in class, closed-book	20%
Final Exam (3 hours)	Date and location TBD, closed-book	20%

Each required grading component must be completed for a student to receive a passing grade. If you do not complete each required component, the weights will be adjusted.

Problem Sets

Problem sets include two types of exercises: 1) analytic exercises and 2) computer exercises using the software *Stata*. Please see the section titled "Lecture Topics and PS Due Dates" (at the end of the syllabus) for detailed information about the due dates of all problem sets. In order for me to post answer keys to Course Site in a timely manner, please remember that problem sets cannot be accepted after the due date.

Requirements for the problem sets:

- All problem sets should be submitted online through Course Site. The preferred file format is PDF.
- You may work together in a group on the problem sets. However, each person in the group must turn in his or her own set of solutions to the problem sets.

Grading of the problem sets:

- Grading uses a 0–5 scale: 5 = no major or minor errors; 4 = only a few minor errors; 3 = some major errors; 2 = many major errors; 1 = very few correct answers; 0 = not turned in or nothing correct.
- Copying of another student's work or other outright dishonesty can result in no credit, a reduced course grade or Disciplinary Committee action.

Empirical Project

Requirements for the empirical project:

- Each student is required to complete a written paper of his or her own empirical project and also required to give a five-minute-or-so in-class presentation of the estimation results of that empirical project.
  - The dates of the empirical project presentations are listed in the "Lecture Topics and PS Due Dates" section of the syllabus.

  - The completed paper is due 12/04 (Thursday), 11:59 PM.
- The format of the paper should follow the guidance given by Chapter 19 Section 5 ("Writing an Empirical Paper") of the textbook. The paper should be *about 10 pages* long with everything included (i.e., the main text, figures, tables, and references), double spaced, and using 12-pt font.
- In the paper it is important to point out potential limitations of the study, such as possible bias (i.e., any over- or under-estimation problems) in the estimation results.

Resources for the empirical project:

- For this empirical project, you may find your own data, or you can use data provided by the textbook (which have been posted on Course Site) or data that are available online, such as kaggle.
- The end of Chapter 19 of the textbook also provides information on data sources as well as possible topics for the empirical project.
- To prepare for the in-class presentation, you may also seek advice from the Philip Rauch Center for Business Communication, such as receiving feedback on your presentation slides.

Grading of the empirical project:

- Grading uses a 0–5 scale, with 5 representing the highest quality and 0 representing non-completion.
- The grading is focused on the *clarity* of the paper, as well as using *appropriate* econometric tools to answer well-defined research questions.
- The grading is *not* based on how *complex* the econometric analysis is.

Midterm Exam

One midterm exam will be given, using our class time and classroom. It will be a one-hour, closed-book exam. There will be no make-up exam if the midterm exam is missed. An absence from the midterm exam will only be allowed in the case of a medical or other emergency. In such situations a note from the Dean of Students Office is necessary. If the midterm exam is missed with valid reasons, the remaining graded work will have adjusted weights. An unexcused absence from the midterm exam will receive a zero score.

Final Exam

The final exam will be a three-hour, closed-book exam. The date and location of the exam will be determined by the Office of the Registrar (formerly named Registration & Academic Services). If you are unable to take the final exam, you must follow the procedures described in the "Definition of Grades":

"The grade X (grade) is used to indicate absence from the final examination when all other course requirements have been met. In such cases, the instructor calculates the parenthetical grade by assigning an F (or zero score) for the missing final exam. The X grade may be removed by a make-up examination if the absence was for good cause (e.g., illness or other emergency). *To be eligible for a make-up exam the student must submit a petition to the Dean of Students.* If the student fails to petition, or if the petition is not granted, or if the student fails to appear for the scheduled make-up examination, then the X grade will be converted into the parenthetical grade after the first scheduled make-up examination following the receipt of the X grade. If the petition is granted

and the final examination is taken, the X grade will be changed by the instructor using the make-up examination procedures and the parenthetical grade will be dropped from the transcript."

No make-up final exam will be given except on the official make-up day, which will be determined by the Office of the Registrar together with the instructor.

Attendance

It is important to attend all lectures. Each lecture covers a lot of materials and the materials are cumulative. Missing even one lecture can put you behind in a short time.

Tutoring Options

The College of Business Undergraduate Programs Office helps coordinate tutoring options for students. It is best to seek out tutoring early in the semester and to continue to use it regularly for best results. No matter the GPA, tutoring is a way for students to take proactive action to ensure their success. The Center for Academic Success offers tutoring in most College of Business first-year and sophomore-level core courses free of charge to students.

Tutoring begins the third week of classes and continues through the last week of classes every semester. Students have the option of participating in walk-in tutoring at the Center for Academic Success, located in 451 Williams Hall, where upperclass undergraduate students are available on a walk-in basis for specific courses. Weekly group tutoring is another option in which students sign up for a weekly tutoring session (usually no more than six students in a group) with an upperclass undergraduate student. The weekly group tutoring is also course-specific, and students may sign up for tutoring in more than one course.

Accommodations for Students with Disabilities

Lehigh University is committed to maintaining an equitable and inclusive community and welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact Disability Support Services (DSS), provide documentation, and participate in an interactive review process. If the documentation supports a request for reasonable accommodations, DSS will provide students with a Letter of Accommodations. Students who are approved for accommodations at Lehigh should share this letter and discuss their accommodations and learning needs with instructors as early in the semester as possible. For more information or to request services, please contact Disability Support Services in person in Williams Hall, Suite 301, via phone at 610-758-4152, via email at indss@lehigh.edu, or online at https://studentaffairs.lehigh.edu/disabilities.

Students who are approved for testing accommodations through Disability Support Services are strongly encouraged to meet with their instructor to discuss their testing needs as soon as possible, but *no later than seven (7) business days before an exam*. In the rare event that the instructor and the department are unable to accommodate the testing needs, students are able to submit a "Testing Services Request Form" to make arrangements through the Center for Academic Success' testing services. Request forms must be submitted *at least five (5) business days prior to the exam* and will be approved on a first-come, first-served basis. Students who do not communicate with their faculty and the Center for Academic Success in a timely manner risk the opportunity for taking their exam with testing services.

Use of Citation and Advice on Avoiding Plagiarism

Please visit this website to learn when and why to cite, paraphrasing, and constructing citations.

Use of Artificial Intelligence (AI) Tools

AI tools, such as ChatGPT, can be used for: (1) making tables and figures and checking answers when working on problem sets; (2) preparing presentations. When using AI tools in cases (1) and (2), please provide appropriate citations by following the examples given here.

For the writing of the paper of the empirical project, you can only use AI tools for checking grammar mistakes and improving sentence structures. In these cases, you do *not* need to provide citations for the AI tools used.

No AI tools will be allowed in any exam.

Lehigh University Undergraduate Student Senate Statement on Academic Integrity

"We, the Lehigh University Student Senate, as the standing representative body of all undergraduates, reaffirm the duty and obligation of students to meet and uphold the highest principles and values of personal, moral and ethical conduct. As partners in our educational community, both students and faculty share the responsibility for promoting and helping to ensure an environment of academic integrity. As such, each student is expected to complete all academic course work in accordance to the standards set forth by the faculty and in compliance with the University's Code of Conduct." (source: https://studentaffairs.lehigh.edu/content/academic-integrity-resources)

Lehigh University Policy on Harassment and Non-Discrimination

Lehigh University upholds The Principles of Our Equitable Community and is committed to providing an educational, working, co-curricular, social, and living environment for all students, staff, faculty, trustees, contract workers, and visitors that is free from harassment and discrimination on the basis of age, color, disability, gender identity or expression, genetic information, marital or familial status, national or ethnic origin, race, religion, sex, sexual orientation, or veteran status. Such harassment or discrimination is unacceptable behavior and will not be tolerated. The University strongly encourages (and, depending upon the circumstances, may require) students, faculty, staff or visitors who experience or witness harassment or discrimination, or have information about harassment or discrimination in University programs or activities, to immediately report such conduct.

If you have questions about Lehigh's Policy on Harassment and Non-Discrimination or need to report harassment or discrimination, contact the Equal Opportunity Compliance Coordinator (Alumni Memorial Building / 610.758.3535 / eocc@lehigh.edu).

The Principles of Our Equitable Community

Lehigh University is committed to being an institution that strives to enhance a sense of belonging for all members of our community (source: https://www2.lehigh.edu/diversity-inclusion-equity). Lehigh University endorses The Principles of Our Equitable Community. We expect each member

of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.

Lecture Topics and PS Due Dates

Week 01, 08/26 and 08/28: Overview (JW Chapter 1 and Math Refreshers A, B and C)

- JW 1.1–1.4
- Math Refreshers A, B and C

Week 02, 09/02 and 09/04: The Simple Regression Model (JW Chapter 2)

- JW 2.1–2.4
- JW 2.5–2.7
- PS#1 due 09/02, 11:59 PM

Week 03, 09/09 and 09/11: Multiple Regression Analysis: Estimation (JW Chapter 3)

- JW 3.1–3.3
- JW 3.3–3.7
- PS#2 due 09/09, 11:59 PM

Week 04, 09/16 and 09/18: Multiple Regression Analysis: Inference (JW Chapter 4)

- JW 4.1–4.3
- JW 4.4–4.7
- PS#3 due 09/16, 11:59 PM

Week 05, 09/23 and 09/25: Multiple Regression Analysis: OLS Asymptotics (JW Chapter 5)

- JW 5.1–5.3
- Homework review
- PS#4 due 09/23, 11:59 PM

Week 06, 09/30 and 10/02: Multiple Regression Analysis: Further Issues (JW Chapter 6)

- JW 6.2
- JW 6.2–6.3
- PS#5 due 09/30, 11:59 PM

Week 07, 10/07 and 10/09

- Review session for the midterm exam
- PS#6 due 10/07, 11:59 PM
- ***Midterm exam*** on 10/09

Week 08, 10/14 and 10/16: Multiple Regression Analysis with Qualitative Information (JW Chapter 7)

- JW 7.1–7.3
- JW 7.4–7.6

Week 09, 10/21 and 10/23: Multiple Regression Analysis: Other Topics (JW Chapters 8 and 9)

- JW 8.1, 8.2, 8.5, 9.2 and 9.4
- Carrying Out an Empirical Project (JW Chapter 19)
- PS#7 due 10/21, 11:59 PM

Week 10, 10/28 and 10/30: Instrumental Variable Estimation (JW Chapter 15)

- JW 15.1–15.3
- JW 15.3–15.6
- PS#8 due 10/28, 11:59 PM

Week 11, 11/04 and 11/06: Simple Panel Data Methods (JW Chapter 13)

- No classes on 11/04 (Civic Engagement Day)
- JW 13.1–13.2
- PS#9 due 11/06 (Thursday), 11:59 PM

Week 12, 11/11 and 11/13: Simple Panel Data Methods (JW Chapter 13)

- JW 13.3–13.4
- Empirical project result presentations (day 1) on 11/13

Week 13, 11/18 and 11/20

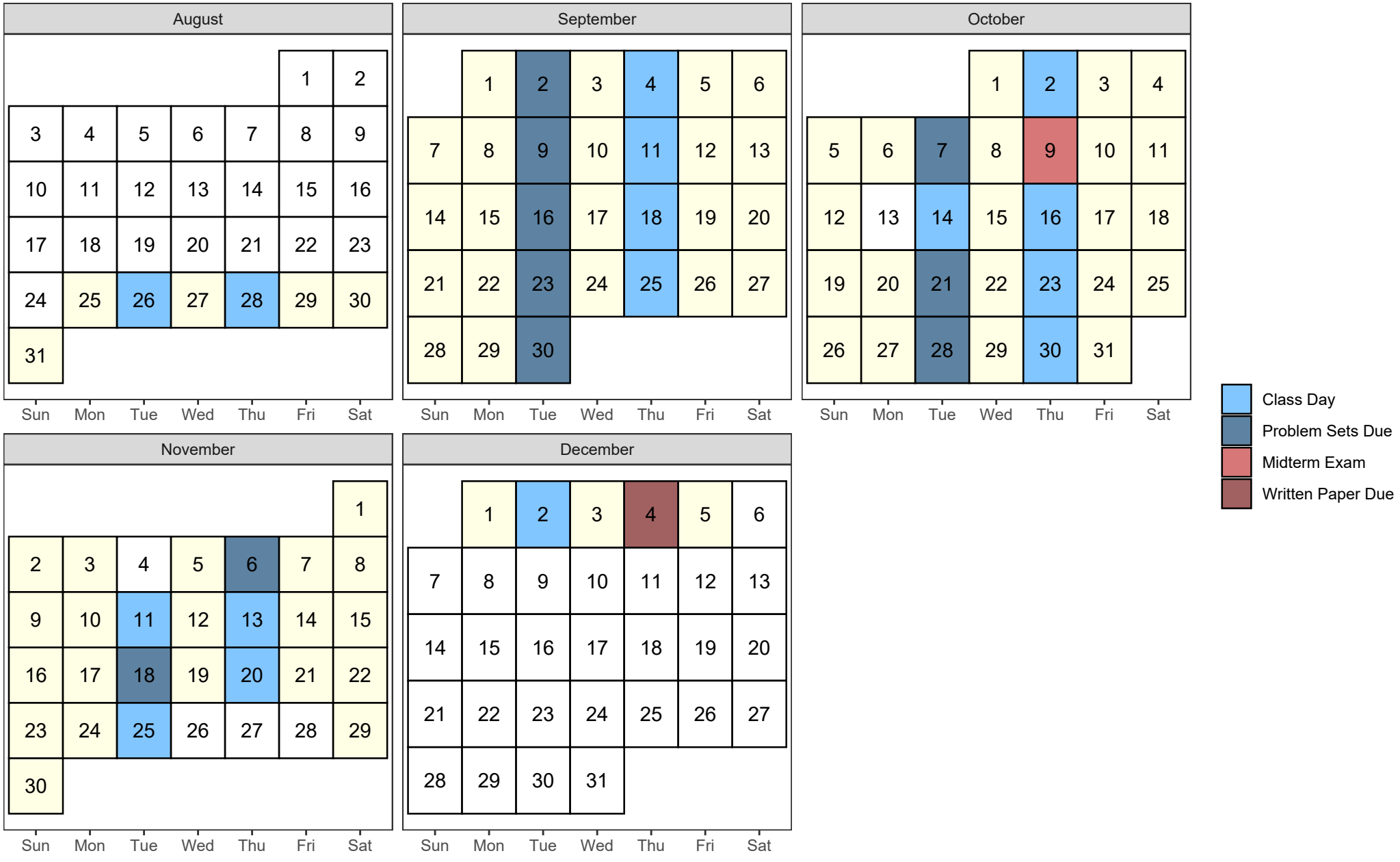
- Empirical project result presentations (day 2) on 11/18
- Empirical project result presentations (day 3) on 11/20
- PS#10 due 11/18, 11:59 PM

Week 14, 11/25 and 11/27

- Empirical project result presentations (day 4) on 11/25
- No classes on 11/27 (Thanksgiving Break)

Week 15, 12/02 and 12/04: Advanced Panel Data Methods (JW Chapter 14) and Review

- JW 14.1 and 14.5
- Discussion on Year of Learning (required by the College of Business)
- Review session for the final exam
- Empirical project written paper due 12/04 (Thursday), 11:59 PM



Notable dates: Midterm Exam (10/09), Written Paper Due (12/04)

AI AT WORK:
New Roles & Smarter Systems

Lehigh Business