Northeastern University

ECON 2560
Applied Econometrics
Summer 2023

Basic Information:

Instructor: Dr. Richeng Piao
Email: r.piao@northeastern.edu
Class Meetings: Monday to Thursday 3:20 pm to 5:00 pm
Class Location: FR 235
Zoom Office Hours: Tue - Wed 1:30 pm - 3:00 pm
Personal Zoom Meeting Link: https://northeastern.zoom.us/my/richeng.zoom.office

Course Description:

The Applied Econometrics course is designed to provide students with a solid foundation in the application of statistical and econometric methods to analyze economic data. This course equips students with the tools necessary to conduct empirical research, make informed policy decisions, and contribute to the field of economics.

Course Objectives:

1. Develop a deep understanding of the key concepts and techniques used in econometrics.
2. Gain proficiency in the application of statistical software for data analysis.
3. Acquire the skills to critically evaluate empirical research and identify potential limitations or sources of bias.
4. Learn to formulate and test hypotheses using various econometric models.
5. Develop the ability to interpret and communicate econometric results effectively.
6. Guide students through the process of formulating research questions, collecting data, and designing empirical studies, fostering their critical thinking and research skills.

Course Topics:

1. Introduction to Econometrics:
    - The role of econometrics in economic analysis.
    - Review in Probability and Statistics
2. Regression Analysis
    - Simple linear regression model.
    - Multiple regression model.
    - Assumptions and diagnostic tests.
    - Hypothesis testing and inference.
    - Extensions and robustness checks.
3. Career Skill Development:
    - Panel Data: Fixed and Random effects models
    - Binary Dependent Variable: Logit and Probit Model
    - Instrumental Variable Analysis
    - Difference-in-differences, Regression Discontinuity Estimators
    - Big Data: Lasso and Ridge Model

Text(s):

The course is largely self-contained and there is no one particular textbook that I follow perfectly. However, our primary required text is **Stock and Watson's Introduction to Econometrics, 4TH Edition** (ISBN: 978-0134461991).

Link to Pearson: Link (You don't need MyLab access, just the Textbook, you can also get from Amazon)

- Additional material such as data sets, will be provided on Canvas.

Canvas, Cocalc, and Internet Access:

Students are expected to have a computing device (a working Browser) with functioning internet access to Northeaster's Wi-Fi network and bring it to the classroom every lesson. You must know how to access Canvas and that your account remains in good standing throughout the semester. Failure to maintain Canvas access is NOT considered an excuse for not completing assignments as required. You will also need access to Cocalc (you can use your GitHub/Google/ Meta/Twitter account to log in).

Calculators:

Please bring a calculator to class (a simple calculator should suffice). You may use a calculator in exams. Cell phones are not allowed to be used as calculators (and used altogether) during exams.

Course Grading

Each student's grade will be based on the performance on four components:

- Career Skills Development
  - Textbook Replication (15%)
  - Empirical Exercises (15%)
- Weekly Assignment (10%)
- Online Tests (Lowest = 5% | non-Cumulative | 35%)
  - Test 1(Chapter 1-5)
  - Test 2(Chapter 6-9)
  - Test 3(Chapter 10-13)
- Online Final Exam (Chapter 4-14 | 25%)

Career Skills Development:

You get to develop a range of data analytic skills by utilizing provided empirical data with detailed instructions.

- By the end of each chapter, we will try to replicate some tables or figures from each chapter by using Python via Juypter Notebook as classroom practice. This part will be graded on a completion basis only.
- You will be also assigned empirical exercises, I encourage you to work together on empirical exercises, however, each student must upload their "Empirical Exercises" results to Canvas by the due dates. This part will be graded on a completion basis only.

Weekly Assignment:
Multiple choices question assignments will be assigned through the Canvas system for each topic during the term. No assignment will be accepted late. Assignments not submitted will be given a score of 0.

Tests:
There are 4 tests scheduled for this course, including a comprehensive final exam. Of the first 3 tests (Test 1 to 3), the lowest score will be worth 5% and the remaining 2 will be worth 30% of your grade. The final exam will be worth 25%. As such, **there will be no makeup tests**.

- ✯ Grades will be kept up-to-date in the Canvas course shell. Students are expected to monitor their progress by reviewing the online grade book.
- ✯ Please ensure that your grades are accurately posted on Canvas, as it is your responsibility to do so. If there are any errors in grading or data entry, please bring them to my attention within one week of the posting of grades. Late disputes concerning grades will not be addressed.

Classroom Policies:

- As regards teaching and lectures
  - I aim to offer students a chance to engage in economic analysis and apply it to a diverse range of issues. During my lectures, I will present pertinent economic analysis and philosophical reflections on each topic. Additionally, I will make my lecture notes available on Canvas for students to access.
  - I consider homework assignments to be an extension of my lectures. While I may occasionally assign problems that are not directly related to the lecture material, I will always provide you with the necessary tools to solve them. These tools will either be presented during the lectures or will be provided on the homework assignment itself.
  - Attendance will be taken officially, and it is imperative that you attend class regularly. Please note that class participation points will be challenging to obtain if you are absent, and this can negatively affect your grade. Since the subject matter is analytical, it is essential to stay on track with the course material.
- General:
  - I will make announcements either during class or post them on Canvas.
  - Recording any classroom activity, either video or audio, is not permitted without my express written consent. If required, I will provide a copy of the recorded lecture.
  - Punctuality is crucial. Late arrivals create a disturbance for other students.
  - To minimize distractions to your fellow classmates, we have implemented a silent-electronics policy. Laptops, cell phones, and other mobile devices must be silenced during class.
  - Additionally, food is not allowed in the classroom.

Contacting Me:

I am frequently present in my office when on campus, although there may be occasions when I am not available. It is recommended to meet during my scheduled office hours. However, if my

door is open, feel free to drop by. If I am unavailable at that moment, I will suggest an alternative time to meet.
Email is the most effective way to contact me. I usually respond to emails within 24 hours on weekdays and within 48 hours on weekends.

Course Policies:

- **Email Correspondence and Course Announcements:** It is crucial to note that your official northeastern.edu email address is the primary mode for receiving course and college-related communications. Additionally, any course-related announcements may be communicated via your course's Canvas site. As a student, it is your responsibility to regularly monitor both your email account and your course's Canvas site for any updates or announcements.
- **Email Response Policy:** Please note that I typically check my email once in the morning and once in the evening during weekdays and make every effort to respond within 24 hours. However, I may not be able to check my email over the weekend, and therefore the response time may be longer.
- **Code of Conduct:** It is essential for all students to conduct themselves in a manner that is respectful of their peers and instructors. Students are expected to contribute to a class atmosphere that fosters open communication, diverse opinions, and values.

- **Academic Integrity:** All students must comply with the Northeastern University Academic Integrity Policy. The Student Handbook outlines the Academic Integrity Policy in detail. Please note that all assignments are considered open resources, which implies that you are permitted to utilize any available resources. Nevertheless, you are responsible for submitting original work. If you have any queries or concerns about the policy, please do not hesitate to discuss them with me.

- **Copyright Notice:** Please be aware that course materials may be protected by copyright laws. Unauthorized duplication or retransmission of course materials is prohibited by United States copyright law, 17 USC section 101, et seq., as well as by University policy and procedures. To learn more about copyright laws, you may refer to the Library of Congress Copyright Office and the University Copyright Policy.

- **No Make-Up Policies:**
  - Exams: There will be NO make-up examinations for any reason.
  - Homework Assignments: Late homework will NOT be accepted – NO EXCEPTIONS. **The schedule of homework assignments is shown on the Canvas class calendar and in Canvas Assignments Tab.**

- **Grading Scale:** The following grading scale (see Table 1) is used to determine your course grade after considering any dropped low scores and weights for the different elements of your grade. However, it is subject to change. Overall, students with relatively good performance will receive A's, students with average performance will receive B's, and students with below-average performance will receive C's. Students with unsatisfactory performance will receive D's or in some extreme cases F's. Additionally, there is no possibility of doing "extra credit" to improve your grade in the course.

Table 1. Grading Scale

Letter	Score
A	>= 93
A–	90 - <93
B+	87 - <90
B	83 - <87
B–	80 - <83
C+	77 - <80
C	73 - <77
C–	70 - <73
D+	67 - <70
D	63 - <67
D–	60 - <63
F	<60

Additional Supports:

- **Tutoring**:
  - The University provides one-on-one tutoring service to those interested.
    - This service is located in Room 1 of Meserve Hall
    - https://undergraduate.northeastern.edu/peer-tutoring/
  - The economics department also maintains a tutoring service,
    - This service is located in Room 301 of Lake Hall
    - https://cssh.northeastern.edu/economics/resources/undergraduate-tutoring/
- **Accommodations and disabilities**
  - Any student who feels he or she may need an accommodation based on the impact of a disability should provide me with a letter from Northeastern University's Disability Resource Center. I will then proceed to coordinate reasonable academic accommodations.
  - http://www.northeastern.edu/drc/
- **Religious observances**
  - Any student who faces a conflict between the requirements of the course and the observance of his or her religious faith should contact the instructor as early in the semester as possible. In such event, the instructor will provide reasonable accommodations that do not unduly disadvantage the student.

Tentative Course Outline:

Please be aware that there is a high probability that we may modify the schedule of topics as we move forward in the class. I will notify you of any changes through class announcements and on the Canvas course site.

	Content	Recommended	
		Reading	Exercises
Week 1-2	• Chapter 1 introduces econometrics and stresses the importance of providing quantitative answers to quantitative questions. It discusses the concept of causality in statistical studies and surveys and the different types of data encountered in econometrics. • Material from probability and statistics will be reviewed in Chapters 2 and 3, respectively. **07/04 Independence Day**, No Class.	Chapter 1, 2, 3	
Week 2	• Chapter 4 introduces regression with a single regressor and ordinary least squares (OLS) estimation, and • Chapter 5 discusses hypothesis tests and confidence intervals in the regression model with a single regressor. **Test 1** (Thursday, 07/14/2023, Chapter 1-4)	Chapter 4,5	
Week 3	• In Chapter 6, we will learn how to address omitted variable bias using multiple regression, thereby estimating the effect of one independent variable while holding other independent variables constant. • Chapter 7 covers hypothesis tests, including F-tests, and confidence intervals in multiple regression.	Chapter 6,7	
Week 4	• In Chapter 8, the linear regression model is extended to models with nonlinear population regression functions, with a focus on regression functions that are linear in the parameters (so that the parameters can be estimated by OLS). • In Chapter 9, students step back and learn how to identify the strengths and limitations of regression studies, seeing in the process how to apply the concepts of internal and external validity. **Test 2** (Thursday, 07/28/2023, Chapter 5-8)	Chapter 8,9	
Week 5	• In Chapter 10, we learn how to use panel data to control for unobserved variables that are constant over time. Panel Data Analysis: Panel data sets contain observations on multiple individuals or entities over time, allowing for the analysis of both individual and time effects. Students learn about fixed effects and random effects models, and how to account for unobserved heterogeneity and dynamic panel data issues. • Chapter 11 covers regression with a binary dependent variable. Limited Dependent Variable Models: Many economic phenomena involve outcomes that are limited or discrete, such as binary choices (e.g., yes or no) or counts. Students learn about econometric models suitable for analyzing such data, including logit and probit models for	Chapter 10, 11	

	binary outcomes, and Poisson and negative binomial models for count data.		
Week 6	• Chapter 12 shows how instrumental variables regression can be used to address a variety of problems that produce correlation between the error term and the regressor, and examines how one might find and evaluate valid instruments. • Instrumental Variable (IV) Analysis: IV analysis is used when there is endogeneity, i.e., a correlation between the independent variable(s) and the error term in a regression model. Students learn about the identification conditions for IV estimation, two-stage least squares (2SLS) estimation, and techniques for testing the validity of instruments. **Test 3** (Thursday, 08/03/2023, Chapter 9-12)	Chapter 12	
Week 7	• Chapter 13 introduces students to the analysis of data from experiments and quasi-, or natural, experiments, topics often referred to as "program evaluation." • Causal Inference and Program Evaluation: This section covers methods for estimating causal effects in observational data, where randomized controlled experiments may not be feasible or ethical. Students learn about difference-in-differences (DID) estimators, regression discontinuity Estimators, and instrumental variable approaches to address endogeneity and selection bias. • Chapter 14 turns to econometric issues that arise with large data sets (AKA Big Data) and focuses on prediction when there are very many predictors.	Chapter 13,14	
Final Exam Week	**Final Exam** (You can take anytime between 08/17 to 08/22, Chapter 4-14)		