

# Syllabus for Econ 281 - Introduction to Econometrics

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We will meet three times a week: Mondays, Wednesdays and Fridays from 9-9.50am. The room is Tech LR2.

Office hours: these will be posted on Canvas.

My plan is for all the classes to be in person, and I do not intend to record any of them.

You are allowed to use a laptop or tablet in class, but to do so you must be sitting in one of the first two rows.

## 1 Course Overview

This is an introductory course in econometrics. The aim is to equip students with the basic tools needed to estimate and analyse empirical relationships between economic variables. It will be a mixture of theory and practice. The theory is essential if you are to understand why you're doing what you're doing. The practice will help you get a feel for the type of software used in empirical economics, and for the correct interpretation of the results such software generates. So, there will necessarily be a significant theoretical component to the course, but you will occasionally get your hands dirty with real data.

Prerequisites for the course are 201, 202, MATH 220, STAT 210 or equivalent. Of these STAT 210 is most important; I'll talk about this at the start of the class.

## 2 Evaluation

- Three assignments, due on Mondays of January 22<sup>nd</sup>, February 12<sup>th</sup> and March 4<sup>th</sup>. (10% each)
- Two midterms, in class on Fridays of January 26<sup>th</sup> and February 16<sup>th</sup>. (20% each)
- A final exam on Friday March 15<sup>th</sup> at 9am (30%).

I will be explicit about what is required on the exams closer to the times.

### 3 Sections

Each student will have registered for one of the following discussion sections (TAs are still to be assigned):

Section #	Day/time	Room	TA
21	Tuesday 5-5.50pm	TCH A110	??
22	Thursday 5-5.50pm	TCH M177	??
23/25	Tuesday 6-6.50pm	TCH A110	??
24/26	Thursday 6-6.50pm	TCH M177	??

I am often asked if the sections are mandatory. They are not, at least inasmuch as you will not be directly penalised for not attending. However, the sections will be very useful. There will be exercises for each section that I **strongly** advise you attempt beforehand. Econometrics is one of the subjects where practice is essential for understanding. You will get a lot more from the course, and find the midterms and final much easier, if you try the exercises before you see the answers.

There is no section in week 1. Sections begin in week 2, i.e. the week starting with Monday January 8<sup>th</sup>.

### 4 Course materials

The textbook will be the excellent *Introduction to Econometrics* [5<sup>th</sup> edition] by Christopher Dougherty. We will be following this book very closely, and it will serve as the blueprint for the course. It is absolutely essential that you get your hands on a copy.

You should also familiarise yourself with the supporting material available at Dougherty's website (<http://global.oup.com/uk/orc/busecon/economics/dougherty5e/>). There you will find a study guide which has an overview of what you should have learned from each chapter, answers to some of the textbook exercises and further exercises (with answers). If you ever want more practice than the questions I provide in sections, this is the place to go. Dougherty posts some Powerpoint slideshows, though you can probably ignore these. He also provides downloadable datasets to be used in some of the textbook exercises.

In general, refer to Canvas for administrative material/announcements. You should treat Dougherty's site as a supplement.

#### 4.1 STATA

In the three assignments you'll be asked to use STATA. You'll only need to do some pretty basic things with it, but this will nonetheless be a good introduction to one of the most widely-used econometric software packages.

STATA is available on campus at pretty much all the computers: <https://www.library.northwestern.edu/visit/technology/computers/index.html>. It's also available via NUworkspace: <https://nuworkspace.northwestern.edu/>.

#### 4.2 other materials

I will post on Canvas the slides I'll project in class. There will be three versions of the slides available: one identical to that I use in class; one in 'handout' form that omits the dynamic overlays but otherwise resembles

the version used in class; and one in ‘article’ form that’s even more compact.

I suggest you print out the handout version of the slides and bring them with you to class to annotate. **Note that reading the slides is not a perfect substitute for reading the book, which you must do.**

## 5 Lecture topics

We are not going to get through the whole book. The provisional plan is that we cover, in order, all the chapters up to and including Chapter 9 (simultaneous equations). If it seems we are falling behind schedule, my preference is to drop material from the syllabus rather than speed up. I will alert you as soon as this looks likely. We will typically spend a couple of classes on each chapter.

### **Review chapter: Random variables, sampling, estimation and inference**

Probability distribution of a random variable. Expected value of a random variable. Expected value of a function of a random variable. Population variance of a discrete random variable and alternative expression for it. Expected value rules. Independence of two random variables. Population covariance, covariance and variance rules, and correlation. Sampling and estimators. Unbiasedness. Efficiency. Loss functions and mean square error. Estimators of variance, covariance and correlation. Probability limits and their rules. Consistency. The central limit theorem. [Note that while the textbook reviews hypothesis testing in this chapter, I will defer this until Chapter 2.]

### **Chapter 1: Simple regression analysis**

Simple regression model. Derivation of linear regression coefficients. Interpretation of a regression equation. Goodness of fit.

### **Chapter 2: Properties of the regression coefficients**

Types of data and regression model. Assumptions for Model A. Regression coefficients as random variables. Unbiasedness of the regression coefficients. Precision of the regression coefficients. Gauss-Markov theorem.  $t$  test of a hypothesis relating to a regression coefficient. Type I error and Type II error. Confidence intervals. One-sided tests.  $F$  test of goodness of fit.

### **Chapter 3: Multiple regression analysis**

Multiple regression with two explanatory variables. Graphical representation of a relationship in a multiple regression model. Properties of the multiple regression coefficients. Population variance of the regression coefficients. Decomposition of their standard errors. Multicollinearity.  $F$  tests in a multiple regression model.

### **Chapter 4: Transformation of variables**

Linearity and nonlinearity. Elasticities and double-logarithmic models. Semilogarithmic models. The disturbance term in nonlinear models. Nonlinear regression. .

### **Chapter 5: Dummy variables**

Dummy variables. Dummy classification with more than two categories. The effects of changing the reference category. Multiple sets of dummy variables. Slope dummy variables.

### **Chapter 6: Specification of regression variables: a preliminary skirmish**

Omitted variable bias. Consequences of the inclusion of an irrelevant variable. Proxy variables.  $F$  test of a linear restriction. Reparameterization of a regression model.  $t$  test of a restriction. Tests of multiple restrictions. Tests of zero restrictions.

## **Chapter 7: Heteroscedasticity**

Meaning of heteroscedasticity. Consequences of heteroscedasticity. Goldfeld-Quandt and White tests for heteroscedasticity. Elimination of heteroscedasticity using weighted or logarithmic regressions. Use of heteroscedasticity-consistent standard errors.

## **Chapter 8: Stochastic regressors and measurement errors**

Stochastic regressors. Assumptions for models with stochastic regressors. Finite sample and asymptotic properties of the regression coefficients in models with stochastic regressors. Measurement error and its consequences. Friedman's Permanent Income Hypothesis. Instrumental variables.

## **Chapter 9: Simultaneous equations estimation**

Definitions of endogenous variables, exogenous variables, structural equations and reduced form. Inconsistency of OLS. Use of instrumental variables. Exact identification, underidentification, and overidentification. Two-stage least squares.

# **6 Various statements**

Here are some statements that instructors have been asked to include.

## **6.1 Academic Integrity Statement**

*Students in this course are required to comply with the policies found in the booklet, "Academic Integrity at Northwestern University: A Basic Guide". All papers submitted for credit in this course must be submitted electronically unless otherwise instructed by the professor. Your written work may be tested for plagiarized content. For details regarding academic integrity at Northwestern or to download the guide, visit: <https://www.northwestern.edu/provost/policies/academic-integrity/index.html>*

## **6.2 Accessibility Statement**

*Northwestern University is committed to providing the most accessible learning environment as possible for students with disabilities. Should you anticipate or experience disability-related barriers in the academic setting, please contact AccessibleNU to move forward with the university's established accommodation process (e: [accessiblenu@northwestern.edu](mailto:accessiblenu@northwestern.edu); p: 847-467-5530). If you already have established accommodations with AccessibleNU, please let me know as soon as possible, preferably within the first two weeks of the term, so we can work together to implement your disability accommodations. Disability information, including academic accommodations, is confidential under the Family Educational Rights and Privacy Act.*

### 6.3 Religious Observance Statement

*Northwestern is committed to fostering an academic community respectful and welcoming of persons from all backgrounds. To that end, the policy on academic accommodations for religious holidays stipulates that students will not be penalized for class absences to observe religious holidays. If you will observe a religious holiday during a class meeting, scheduled exam, or assignment deadline, please let me know as soon as possible, preferably within the first two week of class. If exams or assignment deadlines on the syllabus fall on religious holidays you observe, please reach out so that we can discuss that coursework.*

### 6.4 Course details subject to change

*Please note that the specifics of this course syllabus are subject to change in the case of unforeseen circumstances. Instructors will notify students of any changes as soon as possible. Students will be responsible for abiding by the changes.*

### 6.5 Exceptions to Class Modality

*Class sessions for this course will occur in person. Individual students will not be granted permission to attend remotely except as the result of an Americans with Disabilities Act (ADA) accommodation as determined by AccessibleNU.*

### 6.6 Guidance on Class Recordings

*This class or portions of this class will be recorded by the instructor for educational purpose and available to the class during the quarter. Your instructor will communicate how you can access the recordings. Portions of the course that contain images, questions or commentary/discussion by students will be edited out of any recordings that are saved beyond the current term.*

[Note from RW: I am not currently planning to record anything, but am including the above just in case that changes.]

### 6.7 Prohibition of Recording of Class Sessions by Students

*Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of University policy and state law. Students requesting the use of assistive technology as an accommodation should contact AccessibleNU. Unauthorized use of classroom recordings - including distributing or posting them - is also prohibited. Under the University's Copyright Policy, faculty own the copyright to instructional materials - including those resources created specifically for the purposes of instruction, such as syllabi, lectures and lecture notes, and presentations. Students cannot copy, reproduce, display, or distribute these materials. Students who engage in unauthorized recording, unauthorized use of a recording, or unauthorized distribution of instructional materials will be referred to the appropriate University office for follow-up.*

## 6.8 Support for Wellness and Mental Health

*Northwestern University is committed to supporting the wellness of our students. Student Affairs has multiple resources to support student wellness and mental health. If you are feeling distressed or overwhelmed, please reach out for help. Students can access confidential resources through the Counseling and Psychological Services (CAPS), Religious and Spiritual Life (RSL) and the Center for Awareness, Response and Education (CARE). All Northwestern students are also eligible to access support at no cost through TimelyCare, a virtual mental health platform that provides counseling, health coaching and 24/7 on-demand services. Additional information on all of the resources mentioned above can be found here:*

<https://www.northwestern.edu/counseling/>

<https://www.northwestern.edu/religious-life/>

<https://www.northwestern.edu/care/>

<https://www.northwestern.edu/studentaffairs/timelycare.html>