Economics 5243

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Hours Tuesday, Thursday 9:00-10:00 and by appointment

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1 Purpose

The objective of this course is for you to become knowledgeable users of the linear regression model. The topics include the estimation and specification of the linear regression model, imposition and testing of exact linear parameter restrictions, confidence intervals, estimation of nonlinear models, and an introduction to generalized least squares.

In order to become functionally literate in applied econometrics, it is also necessary for you to learn some of the basics of econometric theory. The basic tools of econometric theory will help to slow the rate of depreciation of your hard-earned econometric human capital. It is well worth your time to learn these tools now, especially if you intend to do any empirical work in the future.

2 Textbooks

Required

> Russell Davidson and James MacKinnon, *Econometric Theory and Methods*, Oxford, 2004.

Most of our lectures and class assignments will come from Davidson and MacKinnon's book. The major shortcoming of this book is that it doesn't contain many empirical examples. Also, it can be rather terse at times and you may need

to supplement your reading in ETM with other material. In particular, you may consider Wooldridge's *Introductory Econometrics: A Modern Approach*, which is a nice upper level undergraduate book, when trying to fill in the gaps. Or, Stock and Watson's *Introduction to Econometrics* is being used in the regression course this semester and is available at the bookstore. Both books have a number of very good data sets and empirical examples that we may use from time to time. The data sets and empirical examples from the book are available through links on our class website.

Christorpher Baum's Stata book should also be available at the bookstore. Obviously, it is useful for learning about Stata, but it is also useful for examples.

Recommended

Marno Verbeek *A Guide to Modern Econometrics*, Second edition, John Wiley and Sons, 2004.

Jeffrey Wooldridge, Introductory Econometrics: A Modern Approach, 2nd edition, Southwestern, 2003.

Peter Kennedy, *A Guide to Econometrics* 5th edition, MIT Press.

Christopher F. Baum, *An Introduction to Modern Econometrics Using Stata*, Stata Press, 2006.

Other Sources

James Stock and Mark Watson, *Introduction to Econometrics*, 2nd edition, Addison Wesley, 2007.

Fomby, Hill, and Johnson, *Advanced Econometric Methods*, Springer Verlag, 1984. Second Printing, 1988.

Jan Kmenta, *The Elements of Econometrics*.

Judge et al., *The Theory and Practice of Econometrics*, 2nd Edition, Wiley, 1985. (a.k.a., "Big Judge.")

Schmidt, Peter, *Econometrics*, Marcel Dekker, 1976.

Adkins and Hill, *Using Stata for Principles of Econometrics, 3rd edition*, forthcoming. (may be available for purchase at the copy center if Wiley permits it).

Adkins, *Using gretl for Principles of Econometrics, 3rd edition*, forthcoming. This one is not as far along as the Stata manual. It is available from my website, though.

3 Prerequisites

This course requires you to work with probability, statistics, calculus, matrix algebra, and to write computer programs (as well as learn econometrics). If you have any doubts about whether your experience is sufficient, please talk to me about it. At a minimum, I assume that you know the basics of differential calculus, matrix algebra, probability theory, and how to use a Windows based microcomputer. If you have any doubts about whether your experience is sufficient, please talk to me about it.

4 Course Outline

1 Review of Regression Models

- 1.1 Introduction
- 1.2 Distributions, Densities, and Moments
- 1.3 The Specification of Regression Models
- 1.4 Matrix Algebra
- 1.5 Method-of-Moments Estimation

2 The Geometry of Linear Regression

- 2.1 The Geometry of Vector Spaces
- 2.2 The Geometry of OLS Estimation
- 2.3 The Frisch-Waugh-Lovell Theorem
- 2.4 Applications of the FWL Theorem
- 2.5 Influential Observations and Leverage

3 The Statistical Properties of Ordinary Least Squares

- 3.1 Are OLS Parameter Estimators Unbiased?
- 3.2 Are OLS Parameter Estimators Consistent?
- 3.3 The Covariance Matrix of the OLS Parameter Estimates
- 3.4 Efficiency of the OLS Estimator
- 3.5 Residuals and Error Terms
- 3.6 Misspecification of Linear Regression Models
- 3.7 Measures of Goodness of Fit

4 Hypothesis Testing in Linear Regression Models

- 4.1 Basic Ideas

4.2 Some Common Distributions
4.3 Exact Tests in the Classical Normal Linear Model
4.4 Large-Sample Tests in Linear Regression Models

5 Confidence Intervals

5.1 Exact and Asymptotic Confidence Intervals
5.2 Confidence Regions
5.3 Heteroskedasticity-Consistent Covariance Matrices
5.4 The Delta Method

6 Nonlinear Regression

6.1 Method-of-Moments Estimators for Nonlinear Models
6.2 Nonlinear Least Squares
6.3 Computing NLS Estimates
6.4 The Gauss-Newton Regression
6.5 Hypothesis Testing
6.6 Heteroskedasticity-Robust Tests

7 Generalized Least Squares and Related Topics

7.1 The GLS Estimator
7.2 Computing GLS Estimates
7.3 Feasible Generalized Least Squares
7.4 Heteroskedasticity
7.5 Autoregressive and Moving-Average Processes
7.6 Testing for Serial Correlation
7.7 Estimating Models with Autoregressive Errors
7.8 Specification Testing and Serial Correlation

5 Computer Assignments and Homework

You can't expect to learn much without doing some homework. The problem is, my capacity to grade it is limited. So, the homework operates on the honor system for the most part. I expect you to do it and be ready to turn it in at the beginning of class on the due date. I will gather it, and we will discuss it if there are questions. In some instances, I will grade it. If I don't grade it, I will assume that it is correct for grading purposes. However, one way that I monitor who is doing the homework is by asking similar questions on the exams. If you

have homework questions, ask them in class. If I would prefer you to figure it out yourself, I'll tell you.

Some of the homework consists of algebraic puzzles, and for these I want to see how you do without my help (fairly common in statistics). This helps me to gauge your aptitude for further study in econometrics. Other assignments are purely empirical in nature and I am certainly willing to discuss these almost anytime. These are important for your progress as an applied social scientist.

Some assignments require the use of a matrix programming language. Candidates include IML, Gauss, Matlab, or Mata. If you have a strong preference for one of these then use it. If not, then use GAUSS. Aptech has made the Light version of Gauss 8.0 available for download. It's memory is pretty limited, but the price is right. Instructions for downloading Gauss are available at my website. I will give you specific instructions for GAUSS. The purposes of these assignments are to learn a little programming, to illustrate some of the matrix algebra we grind through, and to serve pedagogical needs. Do these exercises. You'll thank me later.

The other type of assignment will involve a small amount of applied regression analysis. For this you can use Stata or Gretl.

Stata

Stata is currently available in the CBA labs and on the CBA Trading Floor.

Gretl

Gretl is an acronym for Gnu Regression, Econometrics and Time-series Library. It is a software package for doing econometrics that is easy to use and reasonably powerful. Gretl is distributed as free software that can be downloaded from `http://gretl.sourceforge.net` and installed on your personal computer. Unlike software sold by commercial vendors (SAS, Eviews, Shazam to name a few) you can redistribute and/or modify Gretl under the terms of the GNU General Public License (GPL) as published by the Free Software Foundation.

Gretl comes with many sample data files and a database of US macroeconomic time series. From the Gretl web site, you have access to more sample data sets from many of the leading textbooks in econometrics, including ours *Introduction of Econometrics* by Stock and Watson. Gretl can be used to compute least-squares, weighted least squares, nonlinear least squares, instrumental variables least squares, logit, probit, tobit and a number of time series estimators. Gretl

uses a separate Gnu program called *gnuplot* to generate graphs and is capable of generating output in LaTeX format. Gretl is under development so you can probably expect some bugs, but in my experience it is pretty stable to use with my Windows XP systems.

So, why use Gretl? Well, its free, its fast, it will work on any platform, and it will do everything we are going to do in this class. If you want to use Gretl instead of Stata, then feel free to do so.

Why use Stata? Stata is a professional piece of software that has many more capabilities than Gretl. In the long-run, knowing how to use Stata could be beneficial. On the other hand, by the time you get around to using Stata, you may have forgotten it all and have to start from scratch anyway. As it turns out, knowing one package well (any package) is a pretty good introduction to other packages.

Early in the course you will begin to use the computer to do portions of your homework. You will be responsible for learning to use the software of your choosing, though I can help you as needed. I will probably use GAUSS examples in class and Stata for regression analysis.

6 Grades

Your grade in this class will be based on your performance on 3 exams and on homework assignments.

Grade Weights	
Exam 1	26%
Exam 2	27%
Exam 3	27%
Homework	20%

Grades will be assigned according to the following scale:

Grades	
90%–100%	A
76%–90%	B
60%–75%	C
50%–60%	D
$< 50\%$	F

All exams must be taken at the designated time. No make up exams will be given. If you miss an exam you will receive a grade of zero.

Unless you are specifically told otherwise by me, all homework must be turned in at the beginning of the class period on the date that it is due. Homework will not be accepted if late.

7 Attendance

Regular attendance is expected. You are responsible for any material you miss because of absence. In general, I do not permit students to copy my notes. If you miss class and need a copy of the notes, please obtain them from one of your classmates.

8 Cheating Policy

Cheating will not be tolerated. Any violation of the University's academic integrity policy will be prosecuted according to University regulations. If you are not sure what this is about, then visit the link at the bottom of my website. Basically, you will receive a grade of 0 on any test or assignment you are caught cheating on. If the violation is especially egregious or it threatens my ability to evaluate work for others in the course, then you could earn an F for the course and be suspended from the University. Remember, you are responsible for the security of your work (in other words, if someone copies your work, you will also receive a zero on the test or assignment).