Economics 5243

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Hours Tuesday, Thursday 9:00-10:30 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. I intend to follow it very carefully. 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 Verbeek; the two are highly complementary. Many will find Verbeek to be a little more accessible. He includes many empirical examples that may illuminate what you see in ETM.

Also, 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. It also has 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.

You can also check out the last two chapters in Stock and Watson's book listed below for very nice summaries of the linear model and general linear model. I'm using this book in the other econometrics class I am teaching this fall; it will be available for a while at the OSU bookstore.

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.

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

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.

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 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
- 4.5 Simulation-Based Tests

5 Computer Assignments

There are two types of assignments that I will make during the semester. The first type requires the use of a matrix programming language. Candidates include SAS IML, Gauss, or Matlab. You can use whichever you prefer. I will give you specific intructions for IML, but don't feel constrained to use it if you would prefer something else.

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

The advantage of using SAS is that you could do all of your homework in one program. SAS is industrial strength software and is widely used in industry and government. On the other hand, you can't really buy SAS, you only rent it. Also, it is rather hard to use compared to the others mentioned.

Stata

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

For those interested in what *Stata* can do, here is a link to a *Stata* brochure:

http://www.stata.com/products/overview

and to a brief list of *Stata*'s statistical capabilities

http://www.stata.com/capabilities

For a comparison to SAS, Stata, and SPSS visit:

http://www.ats.ucla.edu/stat/technicalreports/Number1/ucla_ATSstat_tr1_1.0.pdf

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 SAS IML examples in class and Gretl 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	27%
Exam 2	27%
Exam 3	27%
Homework	19%

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. Basically, you will receive a grade of 0 on any test or assignment you are caught cheating on. If the violation is especially egregious, 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).