Economics 308: Econometrics

Professor Moody

Text
Moody*, **Basic Econometrics with Stata*** (BES)

References:

Wooldridge, Jeffrey M., *Introductory Econometrics* (W)
Maddala, G.S. *Introduction to Econometrics*, Second Edition (M) HB139.M353.1992
Kennedy, Peter, *A Guide to Econometrics (K)* HB139 K45 2003
Stock and Watson, *Introduction to Econometrics* (SW)

Some journal articles are available electronically in the Course Documents section of Blackboard.

Grading:

Midterm	20%
Final Exam	40%
Project	40%

You must complete all homework assignments and turn them in on time. Questions based on the assignments may be on the midterm and the final exam. Each assignment will be given a check or a check+. A check is worth one point, a check+ is worth 2 points. At the end of the semester I will average the number of checks and add that to your grade. It could be the difference between a B+ and A-. (A=93-100, A-=90-92, B+=87-89, B=83-86, B-=80-82, etc.)

Attendance policy: I do not take attendance.

Some important dates:
Add/Drop deadline Friday September 10
Withdraw deadline Monday, November 1
Midterm exam Monday, October 11
Final exam: 9 am section (308-03): 9-12 Thursday December 16
10 am section (308-04): 2-5 Friday December 17

Office hours: MW 11-12 or by appointment, Chancellors 336.
I will respond to emails (cemood@wm.edu).

I will accept term papers up to the minute that the Registrar requires me to submit a grade (usually, the last day of final exams). If the paper is not received by that time, I will assign a grade of Incomplete. This will allow you to submit the paper in the spring semester (but it will ruin next semester for you, so try to get it in). The grade automatically turns to F if you do not turn in a paper by the end of classes next spring.

Review: Correlation and Regression.

Describing the relationship between two variables

Scatter diagrams
Correlation
Simple regression
Why is it called regression?
Reference: BES Ch. 7

Assignment 1

Theory of Least Squares

Properties of estimators

Small sample properties
- bias
- efficiency
- mean square error
- relative efficiency
- robustness

Large sample (asymptotic) properties
- consistency
- mean square error consistency
- asymptotic efficiency
- asymptotic unbiased

Note: consistency "carries over" transformations while unbiasedness does not

References: W 699-713, M Ch 2.6, PR 27-30, SW 56-60, BES Ch. 8, 58-60, W Ch. 19.

Assignment 2

Gauss-Markov Theorem

Gauss-Markov assumptions

$Y_i = \alpha + \beta X_i + U_i$

$U_i \sim iid(0, \sigma^2)$

Which implies that

$\hat{\beta}$ is a linear function of Y

$\hat{\beta}$ is random variable with a distribution (the sampling distribution of β)

$\hat{\beta}$ is an unbiased estimator of β

Deriving the variance of beta: $Var(\hat{\beta}) = \hat{\sigma}_u^2 / \Sigma x^2$

Gauss-Markov theorem: OLS is BLUE

OLS is also a maximum likelihood estimator

References: W Ch 1,2, SW 103-107, PR Ch.3, BES Ch. 8, 60-64.

Inference and Hypothesis Testing

Assume the error term is distributed normally, then the sampling distribution of betahat is also normal with

E($\hat{\beta}$)= β (the truth)

$Var(\hat{\beta}) = \hat{\sigma}_u^2 / \Sigma x^2$

however, we must estimate the variance of u: $\hat{\sigma}_u^2 = \Sigma e^2 / (n-2)$

A note on the Normal, Chi-square, t, and F distributions

References: SW 32-39, BES 65-71.

Testing hypotheses concerning β

References: PR Ch. 2; W 724-736, SW 108-117, BES Ch. 8, 65-75.

Maximum likelihood and the likelihood ratio test

References: M 118-129, K Ch. 4.4, BES Ch.8, 76-78.

Multiple Regression

Why? Because life is complicated: omitted variable bias

Three variable regression model

Interpretation of formulas

Goodness of fit: R^2
References: W Ch 3-6, M Ch 4, PR Ch 4-5, SW Ch 5, BES Ch 8, 79-83

Assignment 3

Omitted variable bias and modelling

Review: multiple regression formula determining the direction of bias.
There is only one way to be right and there are many ways to be wrong.
It is wrong to include an irrelevant variable (inefficiency)
and it is wrong to leave out a relevant variable (bias).
However, omitting a relevant variable whose value is less than its standard error
will decrease mean square errors.
Proxy variables
References: M Ch 11.6, W Ch 9.2, PR Ch 7.3, 7.5.1; W Ch 3, SW Ch 5, BES Ch 8, 83-90.

Digression: torturing the data until it tells you what you want to hear.
Leamer, "Let's take the con out of econometrics," *American Economic Review*, March 1983, 31-43 (Blackboard).

Dummy Variables
References: W Ch 7, PR 104-108, 121-123, M Ch 8.1-8.3, K Ch 13, SW 119-122, BES Ch 8 90-94.
Dey, Matthew S. "Racial Differences in National Basketball Association Players' Salaries: A New Look,"*The American Economist*, 41, Fall 1997, 84-90 (Blackboard)

Useful Tests

F-test
Chow test
Granger causality test
J-test for non-nested hypotheses
LM test

References: W Ch 4.5, 237-240; PR 110-112, 115-117, 216-219; M 393-394, 443-446; SW 165-70, 448-9, 468-9; BES Ch 8, 94-102.

Regression Diagnostics

Influential Observations
Multicollinearity
References: BKW, M Ch 7; BES Ch 9.

Digression: torturing the data until it tells you what you want to hear: Leamer, "Let's Take the Con out of Econometrics" A*merican Economic Review*, March, 1983, 31-43. (Blackboard)

Econometrics: What if the Gauss-Markov assumptions are violated?

Heteroskedasticity

Definition: nonconstant error variance, a common problem in cross sections.

Effects: (1) ols estimates remain unbiased, but
(2) inefficient,
(3) standard errors and t-scores are incorrect

Tests: Breusch-Pagan, White

Cure: weighted least squares
1.known variances: weighted least squares
2.unknown variances: assume that the error variance is a function of one or more observable variables

Why not just correct the standard errors? Heteroskedastic consistent (robust) standard errors

Modeling the variance: feasible generalized least squares (FGLS)

References: W Ch. 8-4, M Ch 5, PR Ch 6.1, K Ch 7, SW 124-129, 139-140, 591-596; BES Ch 10

Assignment 4

Specification Bias

Rule: if one or more of the explanatory variables in a regression are correlated with the error term,
the resulting OLS estimates are biased and inconsistent

Causes of correlation between X and u
- incorrect functional form
- omitted variables
- errors of measurement in the independent variables
- simultaneous equations

Errors in variables

Definition
Effects: ols is biased and inconsistent

Cure: instrumental variables (two stage least squares)
Problems:
(1) Choice between a biased but efficient estimator (ols)
and an unbiased but inefficient estimator (IV)
(2) Where are the instruments?
References: M Ch 11.1-11.3, 11.5-11.7, PR Ch 7; SW 248-250; BES Ch 11.

Simultaneous equations

When an equation is part of a simultaneous equation system, suCh that causation runs from Y to X as well as X to Y,
then X is correlated with the error term and OLS is biased and inconsistent.

Example: the consumption function
Example: supply and demand
Endogenous and exogenous variables, structural versus reduced form
Consistent parameter estimation: instrumental variables (2sls)
Indirect Least Squares
The identification problem
The order condition for identification
Types of equation systems: general, recursive, block recursive
Strategies: ols, ols with lags, reduced form, 2sls, VAR
Standard tests
Hausman test for mis-specification
Basmann test for over-identification restrictions
Bound-Jaeger-Baker test for weak instruments
System estimation methods: ZELS, 3SLS
References: M Ch 9, M Ch 12.10, PR Ch 11; KO Ch 7, K Ch 9; SW Ch 10; BES Ch 12.
Bound, Jaeger, and Baker, "Problems with Instrumental Variables Estimation When the Correlation Between the Instruments and the Endogenous Explanatory Variable is Weak." *Journal of the American Statistical Assocation* 90 (430) June 1995, pp. 443-450.

Assignment 5

Time Series Analysis

Time series data have advantage and disadvantages. The primary advantage is that we know time does not go backwards, so we can use lags to identify causal relationships (not possible in cross sections). The disadvantages are that we have to worry about certain problems that are unique to time series data, namely autocorrelation, unit roots, and cointegration.

Linear Dynamic Models

Autoregressive Distributed Lag (ADL) model.
The L (lag) operator.
The following models are special cases of the ADL.

- Static model
- AR model
- Leading Indicator model
- First Difference model
- Distributed Lag model
- Partial Adjustment model
- VAR model
- Common Factor model
- Error Correction model

Note: the Error Correction model is not really a special case, since we did not restrict any coefficients. It is just a re-statement of the ADL after some algebra.
References: SW 443-336, 485-486; BES Ch 13.

Autocorrelation

Definition: u(t) correlated with u(t-1) (and/or u(t-2), etc.)

Effects:

- OLS remains unbiased
- variance of betahat will not be minimum (loss of efficiency)
- standard errors will be underestimated and t-scores overestimated
  (second order bias)
- If regressors include a lagged dependent variable, then ols estimators will be
  biased and inconsistent as well as inefficient.

Tests: Durbin-Watson, Breush-Godfrey (LM).

There are two reasons for autocorrelation (1) serial correlation in the error term and (2) omitted variables with time components. If the autocorrelation is due to omitted lagged variables, then we can't fix it with Cochrane-Orcutt. We need to test to see if we have serial correlation or mis-specified dynamics.

Likelihood ratio test for mis-specified dynamics

Heteroskedasticity and autocorrelation consistent (HAC) standard errors (Newey-West)

References: M Ch 6,PR Ch 6.2, K Ch 7.4; SW 504-517, 530-531; BES Ch 14.

Analysis of non-stationary data

Random walks and unit roots
Spurious regressions
Unit root tests: ADF, DF-GLS
References: SW 457-467, 545-552; BES Ch 15.

Assignment 6

Cointegration and long run equilibrium

Short-run relationships: first differences
Cointegration and the long-run relationship
- Testing for cointegration
- Estimating the cointegrating regression
- Error correction model
- Dynamic Ordinary Least Squares

References: P&R Ch 15.3, 15.4; BES Ch 16
Granger "Introduction." (Blackboard)
Granger and Newbold, "Spurious Regressions in Econometrics, "*Journal of Econometrics* 2, (1974) 111-120. (Blackboard)

Panel Data

Motivation: cures one kind of omitted variable bias, efficient use of data, increases the number of observations

Fixed effects model
- Least squared dummy variables (LSDV)
- Absorb regression
- Xtreg

Time series issues
- Linear trends
- Individual state trends
- Unit roots and nonstationarity
- First difference model
- Autocorrelation
- Clustering
  - A problem with clustering panel data models
- Cointegration in panel data models
- Nickell bias in panel data models
- Other panel data models
  - Hausman-Wu again

References: PR Ch 9.4; W Ch 13, 14; SW Ch 8; BES Ch 17.