

Unusual circumstances may result in the need to cancel a class. In such cases, this class will be OFFICIALLY CANCELED ONLY when the Department of Economics letterhead "CANCELED CLASS" form is posted and the DEPARTMENT OF ECONOMICS DATE STAMP is used. Any other form of notification should be ignored.

Office: BAC 677
Phone: 480-965-6574

Office Hours:
3:00- 5:00 TTh
And by appointment

1. GENERAL DESCRIPTION

This course presumes that students have completed ECN 525 and ECN 526 or equivalent. The goal of this course is to acquaint students with techniques they may wish to apply in thesis research.

2. TEXTBOOKS

1) Required

Baltagi, ECONOMETRIC ANALYSIS OF PANEL DATA (Wiley)
Hamilton, TIME SERIES ANALYSIS (Princeton)

2) Optional

Greene, ECONOMETRIC ANALYSIS, 3rd ed (Prentice)
Banerjee, Dolado, Galbraith and Hendry, COINTEGRATION, ERROR CORRECTION
AND ECONOMETRIC ANALYSIS OF NONSTATIONARY DATA (Oxford)
Maddala, LIMITED DEPENDENT AND QUALITATIVE VARIABLES IN
ECONOMETRICS (Cambridge)
Amemiya, T (1985), ADVANCED ECONOMETRICS (Harvard Press)

3. COURSE OUTLINE

The schedule listed below is just an estimate. Adjustments, if necessary, may happen during the term.

(1) Review of MLE

1. Review of MLE
2. Testing hypothesis

(2) Limited Dependent Variables Models

1. Binary choice models (Review)
2. Ordered probit model
3. Unordered choice models
4. Bivariate probit models
5. Double selection models
6. Switching models

(3) Generalized Method of Moments (GMM) Estimation

1. The principle of GMM
2. Properties of GMM estimators
3. Three ways to obtain optimal GMM
4. Estimation of covariance matrices of moment functions
5. Testing hypothesis
6. Specification tests
7. Application to simultaneous equation models
8. Problems in GMM applications
9. Bootstrapping

(4) Panel Data

1. Introduction to panel data models
2. Fixed effects vs. random effects
3. Heteroskedasticity and autocorrelation
4. Instrumental-variables and GMM estimators
5. Probit/logit models
6. Dynamic Panel Data Models
7. Rational Expectations Models
8. Intertemporal Substitution Models

(5) Univariate Time Series Analysis

1. Stationarity
2. AR and MA
3. MLE
4. Spectral analysis

(6) Vector Autoregression (VAR)

1. Estimation and testing hypothesis
2. Impulse-response function
3. Structural VAR

(7) Autoregressive Conditional Heteroskedasticity (ARCH) in Time Series Models

1. Basic model
2. ARCH
3. GARCH
4. ARCH-M
5. EGARCH
6. TGARCH
7. Multivariate GARCH
8. Quasi-MLE

(8) Nonstationary Time Series Data

1. Trend stationary and unit root
2. Testing unit root

(9) Cointegration

1. Definitions
2. Testing cointegration
3. Estimation in cointegration systems

(10) Panel Data with Large T

1. Testing unit root
2. Properties of panel data estimators

4. REFERENCES

(1) Review of MLE

Greene, Ch. 3 - 5.

Amemiya, Ch. 3.

Engle, R (1984), "Wald, Likelihood Ratio, and Lagrangean Multiplier Tests in Econometrics," Handbook of Econometrics, Vol. II, edited by Z. Griliches and Intriligator, Ch. 13.

(2) Limited Dependent Variables Models

1. Greene, Ch. 19.1 - 19.5.

Maddala, Ch. 2.

Amemiya, Ch. 9.6.

Judge, G., et al (1985), The Theory and Practice of Econometrics, John Wiley & Son Inc.,

- Ch. 18.2.
- Manski, C. (1975), "The Maximum Score Estimation of the Stochastic Utility Model of Choice," Journal of Econometrics, 205-228.
- Manski, C. (1985), "Semiparametric Analysis of Discrete Response: Asymptotic Properties of the Maximum Score Estimator," Journal of Econometrics, 25, 313-333.
- Cosslett, S. (1983), "Distribution-Free Maximum Likelihood Estimator of the Binary Choice Model," Econometrica, 765-798.
2. Greene, Ch. 19.8.
- Zanoina, R. and McElvey, W. (1975), "A Statistical Model for the Analysis of Ordinal Level Dependent Variables," Journal of Mathematical Sociology, 103-120
- Hausman, J., A. Lo and C. Mackinlay. (1992), "An Ordered Probit Analysis of Transaction Stock Prices," Journal of Financial Economics, 31, 319-379.
3. Greene, Ch. 19.7.
- Maddala, Ch. 2.12, 3.1 - 3.3.
4. Greene, Ch. 19.6.
- Maddala, Ch. 11.6.
- Poirier, D.J. (1980), "Partial Observability in Bivariate Probit Models," Journal of Econometrics, 209-217.
- Abowd, J.M, and H. Farber (1982), "Job Queues and the Union Status of Workers," Industrial and Labor Relations Review, 354-368.
- Farber, H.S. (1983), "Worker Preference for Union Representation," Research in Labor Economics, 171-205.
- Meng, C., and P. Schmidt (1985), "On the Cost of Partial Observability in the Bivariate Probit Model," International Economic Review, 71-85.
5. Maddala, Ch. 1, 6.
- Greene, Ch. 20.1 - 20.3.
- Amemiya, Ch. 4, 9, 10.
- Cragg, J. (1971), "Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods," Econometrica, 829-844
- Amemiya, T (1973), "Regression Analysis When the Dependent Variable Is Truncated Normal," Econometrica, 997-1016.
- Hausman, J. and A. Wise (1977), "Social Experimentation, Truncated Distributions and Efficient Estimation," Econometrica, 919-939
- Lin, T-F and P. Schmidt (1984), "A Test of the Tobit Specification Against an Alternative Suggested by Cragg," Review of Economics and Statistics, 174-177.
- Chamberlain, G. (1986), "Asymptotic Efficiency in Semi-Parametric Models with Censoring," Journal of Econometrics, 189-218.
- Heckman, J. (1979), "Sample Selection Bias as a Specification Error," Econometrica, 153-161.

- Heckman, J. (1974), "Shadow Prices, Market wages, and Labor Supply," Econometrica, 670-694.
- Greene, W. (1981), "Sample Selection Bias as a Specification Error: Comment," Econometrica, 795-799.
- Melino, A. (1982), "Testing for Sample Selection Bias," Review of Economic Studies, 151-153.
- Fishe, R., R. Trost and P. Lurie (1981), "Labor Force Earnings and College Choice of Young Women: An Examination of Selectivity Bias and Comparative Advantage," Economics of Education Review, 169-191.
- Ham, J.C. (1982), "Estimation of a Labour Supply Model with Censoring Due to Unemployment and Underemployment," Review of Economic Studies, 335-354.
- Blundell, R., J. Ham and C. Meghir (1987), "Unemployment and Female Labor Supply," The Economic Journal, 44-64.
- Johnson, N.L. and S. Kotz (1972), Distributions in Statistics: Continuous Multivariate Distributions, Vol. 4, John Wiley and Sons.
- Maddala, appendix.
- Ahn, S.C. (1992), "The Lagrangean Multiplier Test for a Model with Two Selectivity Criteria," Economics Letters, 9-15.
6. Lee, L. (1978), "Unionism and Wage Rates: A Simultaneous Equation Model with Qualitative Limited Dependent Variables," Internatinal Economic Review, 19, 415-433.

(2) Generalized Method of Moments (GMM) Estimation

Basic references:

- Greene, Ch. 11.5.
- Hamilton, Ch. 10, 14.

1. Hansen, L. (1982), "Large Sample Properties of Generalized Method of Moments Estimators," Econometrica, 50, 1029-1054.
 2. Hansen, L. (1982), "Large Sample Properties of Generalized Method of Moments Estimators," Econometrica, 50, 1029-1054.
- Chamberlain, G. (1987), "Asymptotic Efficiency in Estimation with Conditional Moment Restrictions," Journal of Econometrics, 34, 305-334.
3. Hansen, L.P., J. Heaton and A. Yaron, 1996, Finite-sample properties of some alternative GMM estimators, Journal of Business & Economic Statistics, 14, 262-280.
- Kitamura, Y. and M. Stutzer, 1997, An information-theoretic alternative to generalized method of moments estimation, Econometrica, 65, 861-874.
- Andrews, D.W.K., A stopping rule for the computation of generalized method of moments estimators, Econometrica, 65, 913-932.

4. Newey, W. K. and K. West (1987), "A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix," Econometrica, 55, 703-708.
 Andrews, D.W.K. (1991), "Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimation," Econometrica, 59, 817-58.
 Andrews, D. W. K. and J. C. Monahan (1992), "An Improved Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimator," Econometrica, 60, 953-966.
 Newey, W.K. and K. West (1994), "Automatic Lag Selection in Covariance Matrix Estimation," Review of Economic Studies, 61, 631-654.
 West, K.D. (1997), "Another Heteroskedasticity- and Autocorrelation-consistent Covariance Matrix Estimator," Journal of Econometrics, 76, 171-191.

5. Newey, W. and K. West (1987), "Hypothesis Testing with Efficient Method of Moments Estimation," International Economic Review, 28, 777-787.

6. White, H. (1994), Estimation, Inference and Specification Analysis (Cambridge University Press, New York, NY).
 Newey, W (1985), "Generalized Method of Moments Specification Testing," Journal of Econometrics, 29, 229-256.
 Newey, W. (1985), "Maximum Likelihood Specification Testing and Conditional Moment Tests," Econometrica, 53, 1047-1070.
 Tauchen, G. (1985), "Diagnostic Testing and Evaluation of Maximum Likelihood Models," Journal of Econometrics, 30, 415-443.
 Eichenbaum, M. S., L. Hansen and K. Singleton (1988), "A Time Series Analysis of Representative Agent Models of Consumption and Leisure Choice under Uncertainty," The Quarterly Journal of Economics, 103, 51-78.
 Gallant, A. R. and D. Jorgenson (1979), "Statistical Inference for a System of Simultaneous, Non-linear, Implicit Equations in the Context of Instrumental Variable Estimation," Journal of Econometrics, 11, 275-302.
 Wooldridge, J. M. (1990), "A Unified Approach to Robust, Regression-based Specification Tests," Econometric Theory, 6, 17-43.
 Wooldridge, J. M. (1991), "On the Application of Robust, Regression-based Diagnostics to Models of Conditional Means and Conditional Variances," Journal of Econometrics, 47, 5-46.
 Ahn, S.C. and P. Schmidt (1995), "A Separability Result for GMM Estimation, with Applications to GLS Prediction and Conditional Moment Tests," Econometric Reviews, 14, 19-34.
 Ahn, S.C. (1995), "Robust GMM Tests for Model Specification, with Applications to Conditional Moments Testing and Structural Instability Testing," unpublished manuscript at Arizona State University.

7. White, H. (1980), "A Heteroskedasticity-Consistent Covariance Matrix Estimator and A Direct Test for Heteroskedasticity," Econometrica, 48, 817-838.
 White, H. (1982), "Instrumental Variables Regression with Independent Observations."

- Econometrica, 50, 483-499.
- Chamberlain, G. (1984), "Panel Data," In Handbook of Econometrics, Volume II, edited by Z. Griliches and M. Intriligator. New York, N.Y.: Elsevier Science Publishers BV.
- O'Brien, P. and R. Bhushan (1990), "Analyst Following and Institutional Ownership," Journal of Accounting Research, 28, 55-76.
- Ahn, S.C., D.M. Kim and P. Regier (1996), "Evidence of Structural Changes in Relations Involving Analyst Following and Institutional Ownership," mimeo, Arizona State University.
8. Journal of Business & Economic Statistics, Volume 14, 1996: Special section on small-sample properties of GMM.
9. Horowitz, J. (1998), "Bootstrap Methods for Covariance Structures," Journal of Human Resources, 33, 39-61.
- Hall, P. and J. Horowitz (1996), "Bootstrap Critical Values for Tests Based on Generalized Method of Moments Estimators," Econometrica, 64, 891-916.
- Brown, B., W. Newey and S. May, "Efficient Bootstrapping for GMM," mimeo, MIT.
- (3) Panel Data
1. Baltagi, Ch. 1.
2. Baltagi, Ch. 2 - 4.
Greene, Ch. 14.
Chamberlain, G. (1984), "Panel Data," Chapter 22 in Handbook of Econometrics, Vol. 46, Z. Griliches and M. Intriligator, eds., North-Holland.
Hsiao, C. (1986), Analysis of Panel Data, Cambridge University Press.
Balestra, P. and M. Nerlove (1966), "Pooling Cross Section and Time Series Data in the Estimation of a Dynamic Model: The Demand for Natural Gas," Econometrica, 585-612.
Mundlak, Y. (1978), "On the Pooling of Time-Series and Cross Section Data," Econometrica, 69-85.
Hausman, J. (1978), "Specification Tests in Econometrics," Econometrica, 1251-1271.
Arellano, M. (1993), "On the Testing of Correlated Effects with Panel Data," Journal of Econometrics, 59, 87-97.
Ahn, S.C. and S. Low (1996), "A Reformulation of the Hausman Test for Regression Models with Pooled Cross-Section-Time-Series Data," Journal of Econometrics, 71, 291-307.
3. Baltagi, Ch. 5.
Kiefer, N. (1980), "Estimation of Fixed Effects Models for Time Series of Cross-Sections with Arbitrary Intertemporal Covariance," Journal of Econometrics, 195-202

4. Baltagi, Ch. 7.
 Hausman, J. and W. Taylor (1981), "Panel Data and Unobservable Individual Effects," Econometrica, 1377-1399.
 Amemiya, T. and T. MaCurdy (1986), "Instrumental-variable Estimation of An Error-components Model," Econometrica, 869-880.
 Breusch, T. G. Mizon and P. Schmidt (1989), "Efficient Estimation Using Panel Data," Econometrica, 695-701.
 Baltagi, B. and S. Khanti-Akom (1990), "On Efficient Estimation with Panel Data: An Empirical Comparison of Instrumental Variables Estimators," Journal of Applied Econometrics, 5, 401-406.
 Cornwell, C. and P. Rupert (1988), "Efficient Estimation with Panel Data: An Empirical Comparison of Instrumental Variables Estimators," Journal of Applied Econometrics, 3, 149-155.
 Arellano, M. and O. Bover (1995), "Another Look at the Instrumental Variable Estimation of Error-component Models," Journal of Econometrics, 68, 29-51.
 Ahn, S. and P. Schmidt (2000), "Estimation of Linear Panel Data Models Using GMM," Chapter 8 in Generalised Method of Moments Estimation (1999), edited by Laszlo Matyas: Forthcoming.
 Im, K.S., S. Ahn, P. Schmidt and J. Wooldridge (1999), "Efficient Estimation of Panel Data Models with Strictly Exogenous Explanatory Variables," Journal of Econometrics, 93, 177-201.
 Ahn, S. and P. Schmidt (1999), "Modified Generalized Instrumental Variables Estimation of Panel Data Models with Strictly Exogenous Instrumental Variables," in Analysis of Panels and Limited Dependent Variables: A Volume in Honour of G S Maddala, edited by Cheng Hsiao, Kajal Lahiri, Lung-fei Lee and M. Hashem Pesaran: Cambridge University Press, Cambridge, U.K.

5. Baltagi, Ch. 10.4 - 10.5.
 Greene, Ch. 19.5.
 Maddala, Ch. 2.17.
 Chamberlain, G. (1980), "Analysis of Covariance with Qualitative Data," Review of Economic Studies, 225-238.
 Honore, B. (1993), "Orthogonality Conditions for Tobit Models with Fixed Effects and Lagged Dependent Variables," Journal of Econometrics, 59, 35-62.
 Verbeek, M. and T. Nijman (1992), "Testing for Selectivity Bias in Panel Data Models," International Economic Reviews, 33, 681-703.
 Wooldridge, J. (1995), "Selection Corrections for Panel Data Models under Conditional Mean Independence Assumptions," Journal of Econometrics, 68, 115-132.
 Gourieroux, C. and A. Monfort (1993), "Simulation-Based Inference," Journal of Econometrics, 59, 5-33.

6. Baltagi, Ch. 8.
 Chamberlain, G. (1984), "Panel Data," Chapter 22 in Handbook of Econometrics, Volume 46, Z. Griliches and M. Intriligator, eds., North-Holland.

- Anderson, T., and C. Hsiao (1981), "Estimation of Dynamic Model with Error Components," Journal of the American Statistical Association, 76, 598-606.
- Hsiao, C. (1982), "Formulation and Estimation of Dynamic Models Using Panel Data," Journal of Econometrics, 47-82
- Bhargava, A. and Sargan, J. (1983), "Estimating Dynamic Random Effects Models from Panel Data Covering Short Time Periods," Econometrica, 695-701.
- Bhargava, A. (1987), "Wald Tests and Systems of Stochastic Equations," International Economic Review, 789-808.
- Holtz-Eakin, D. (1988), "Testing for Individual Effects in Autoregressive Models," Journal of Econometrics, 297-307.
- Holtz-Eakin, D., W. Newey and H. Rosen (1988), "Estimating Vector Autoregressions with Panel Data," Econometrica, 1371-1396.
- Arellano, M., and S. Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and Application to Employment Equation," Review of Economic Studies, 277-297.
- Ahn, S. and P. Schmidt (1995), "Efficient Estimation of Models for Dynamic Panel Data," Journal of Econometrics, 68, 5- 27.
- Ahn, S. and P. Schmidt (1997), "Efficient Estimation of Dynamic Panel Data Models: Alternative Assumptions and Simplified Estimation," Journal of Econometrics, 76, 309-321.
7. Baltagi, Ch. 8.5.
- Keane, M. and D. Runkle (1992), "On the Estimation of Panel-Data Models with Serial Correlation When Instruments Are Not Strictly Exogenous," Journal of Business & Economic Statistics, 10, 1-9.
- Schmidt, P., S. Ahn and D. Wyhowski (1992), "Comment," Journal of Business and Economic Statistics, 10-14.
- Chamberlain, G. (1992), "Comment: Sequential Moment Restrictions in Panel Data," Journal of Business & Economic Statistics, 10, 20-26.
8. MaCurdy, T.E., 1983, A simple scheme for estimating an intertemporal model of labor supply and consumption in the presence of taxes and uncertainty, International Economic Review, 24, 265-89.
- Hall, R. E., 1988, Intertemporal substitution in consumption, Journal of Political Economy, 96, 339-57.
- Ham, J. C., 1986, Testing whether unemployment represents intertemporal labor supply behavior, Review of Economic Studies, 53, 559-578.
- Heckman, J. J. and T. E. MaCurdy, 1980, A life cycle model of female Labor supply, Review of Economic Studies, 47, 47-74.
- Hayashi, F., 1992, Comment, Journal of Business & Economic Statistics, 10, 15-17.
- Altug, S. and R. A. Miller, 1990, Household choices in equilibrium, Econometrica, 58, 543-570.
- Blundell, R., C. Meghir and P. Neves, 1993, Labor supply and intertemporal substitution, Journal of Econometrics, 59, 137-60.

- Townsend, R. M., 1994, Risk and insurance in village India, *Econometrica*, 62, 539-591.
- Hayashi, F., J. Altonji, and L. Kotlikoff, 1996, Risk-sharing between and within families, 64, 261-294.
- (5) Univariate Time Series Analysis
- Hamilton, Ch. 1 - 6.
- (6) Vector Autoregression (VAR)
- Hamilton, Ch. 10 - 11.
- Sims, C., 1980, Macroeconomics and reality, *Econometrica*, 1-48.
- (7) Autoregressive Conditional Heteroskedasticity (ARCH) in Time Series Models
- Basic references:
- Greene, Ch. 18.5.
- Hamilton, Ch. 21.
- Engle, R., 1982, Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation, *Econometrica*, 50, 987-1006.
- Bollerslev, T., 1986, Generalized autoregressive conditional heteroskedasticity, *Journal of Econometrics*, 31, 307-327.
- Engle, R. and T. Bollerslev, 1986, Modeling the persistence of conditional variances, *Econometric Reviews*, 5, 1-50.
- Engle, R., D. Lilien and R. Robins, 1987, Estimating time-varying risk premia in the term structure: The ARCH-M Model, *Econometrica*, 55, 391-407
- Nelson, D., 1991, Conditional heteroskedasticity in asset returns: A new approach, *Econometrica*, 59, 347-370.
- Gourieroux, C. and M. Monfort, 1992, Qualitative threshold ARCH models, *Journal of Econometrics*, 52, 159-200.
- Bollerslev, T. and J. Wooldridge, 1988, Quasi-maximum likelihood estimation of dynamic models with time-varying covariances, *Econometric Reviews*, 11, 143-72.
- Engle, R. and G. Gonzalez-Rivera, 1991, Semiparametric ARCH models, *Journal of Business and Economic Statistics*, 9, 345-59.
- Nelson, D., 1992, Filtering and forecasting with misspecified ARCH models I: Getting the right variance with the wrong models, *Journal of Econometrics*, 52, 61-90.
- Nelson, D. and D. Foster, 1994, Asymptotic filtering theory for univariate ARCH models," *Econometrica*, 62, 1-41.
- Nelson, D. and D. Foster, 1995, Filtering and forecasting with misspecified ARCH models I: Making the right forecast with the wrong model, *Journal of Econometrics*, 67, 303 - 335.

Nelson, D., 1994, Asymptotic filtering theory for multivariate ARCH models, *Journal of Econometrics*, 71, 1-17.

Lumsdaine, R., 1996, Consistency and asymptotic normality of the quasi-maximum likelihood estimator in IGARCH(1,1) and covariance stationary GARCH(1,1) Models, *Econometrica*, 64, 575-596.

(8) Nonstationary Time Series Data

Hamilton, Ch. 15 - 18.

Banerjee, *et al*, Ch. 3 - 4.

Fuller, W.A., 1985, Nonstationary autoregressive time series, in *Handbook of Statistics*, 5.

Phillips, P.C.B., 1987, Time series regression with a unit root, *Econometrica*, 55, 277-301.

Phillips, P.C.B. and P. Perron, 1988, Testing for a unit root in time series regression," *Biometrika*, 75, 335-346.

Schwert, G.W., Effects of model specification on tests for unit roots in macroeconomic data, *Journal of Monetary Economics*, 20, 73-103.

Nelson, C.R. and C. Plosser, 1982, Trends and random walks in macroeconomic time series: Some evidence and implications, *Journal of Monetary Economics*, 10, 139-162.

Cochrane, J., 1988, How big is the random walk in GNP?, *Journal of Political Economy*, 96, 893-920.

Dickey, D.A. and Fuller, 1979, Distribution of estimators for autoregressive time series with a unit root, *Journal of American Statistical Association*, 74, 427-31.

Perron, P., 1989, The Great Crash, the oil price shock and the unit root hypothesis, *Econometrica*, 57, 1362-1401.

Kwiatkowski, D., P. Phillips, P. Schmidt and Y. Shin, 1992, Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root?" *Journal of Econometrics*, 54, 159-78.

(9) Cointegration

Hamilton, Ch. 19 - 20.

Banerjee, *et al*, Ch. 5 - 8.

Engle, R.F. and C.W. Granger, 1987, Co-integration and error correction: Representation, estimation, and testing, *Econometrica*, 55, 251-276.

Davidson, J., D. Hendry, F. Srba and Y. Yeo, 1987, Econometric modeling of the aggregated time series relationship between consumer's expenditure and income in the UK, *Economic Journal*, 88, 661 - 92.

Stock, J.H., 1987, Asymptotic properties of least squares estimators of cointegrating vectors, *Econometrica*, 55, 1035-1056.

Stock, J.H. and M. Watson, 1988, Testing for common trends, *Journal of the American Statistical Association*, 83, 1097-1107.

- Phillips, P.C.B., 1991, Optimal inference in cointegrating systems, *Econometrica*, 59, 282-306.
- Johansen, S., 1988, Statistical analysis of cointegrating vectors, *Journal of Economic Dynamics and Control*, 12, 231-254.
- Johansen, S. and K. Juselius, 1990, Maximum likelihood estimation and inference on cointegration - with applications to the demand for money, *Oxford Economic Bulletin of Economics and Statistics*, 52, 169-210.
- Johansen, S., 1991, Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models, *Econometrica*, 59, 1551-1580.
- Stock, J. and M. Watson, 1993, A simple estimator of cointegration vectors in higher order systems, *Econometrica*, 61, 783-820.
- King, R.G., C. Plosser, J. Stock and Watson, M.W., 1991, Stochastic trends and economic fluctuations, *American Economic Review*, 1991, 819-839.

(10) Panel Data with Large T

1. Levin, A. and C-F Lin, 1992, Unit root tests in panel data: Asymptotic and finite-sample properties, mimeo, University of California at San Diego.
 - Levin, A. and C-F Lin, 1993, Unit root tests in panel data: New results, mimeo, University of California at San Diego.
 - Im, K.S., M.H. Pesaran and Y.C. Shin, 1997, Testing for unit roots in Heterogeneous panels, mimeo, University of Cambridge.
 - Higgins, M. and E. Zakrajsek, 1999, Purchasing power parity: Three stakes through the heart of the unit root null, mimeo, Federal Reserve Bank of New York.
2. Phillips, P.C.B. and H.R. Moon, 1999, Linear regression limit theorem for nonstationary panel data, *Econometrica*, 67, 1057-1111.
 - Choi, I., 1999, Asymptotic analysis of a nonstationary error component model, mimeo, Kookmin University, South Korea
 - Alvarez, J. and M. Arellano, 1998, The time series and cross-section asymptotics of dynamic panel data estimators, mimeo, CEMFI, Madrid.

4. GRADE

(1) Four Assignments:

These assignments count 40 % of your final grade. The assignments will require knowledge of computer software. A maximum grade of “C” will be awarded to those who choose **NOT** to complete homework assignments.

(2) Proposal for the Term Paper:

You should write a proposal for your independent research, and it is due no later than Monday, April 17. Your proposal counts 10% of your final grade. Your proposal should indicate the importance of your independent study and a brief discussion of methodology you will use. The proposal **should not be more than 5 pages**. Before you

decide on a topic, contact Dr. Ahn.

(2) A Term Paper:

You should write a paper, which counts 50% of final grade. The font sizes are limited to minimum 12 pt. Margins must be all 1 inches for top, bottom, left and right. The paper **should not be more than 25 pages** (including tables and bibliographical lists.) Note that the number of pages is not necessarily correlated with grade. Concise and compact papers are strongly encouraged. A final draft of the paper is due no later than Monday, May 8, 12:00 pm.

You may choose one of following categories:

1. Empirical Paper: You have to collect your own data set and apply advanced econometric techniques. The paper should describe (i) motivation; (ii) relevance of econometric techniques applied; (iii) and correct interpretation of empirical results.
2. Survey Paper: You can survey the literature regarding an econometric topic. The paper should refer to as many references as possible, and summarizes the references in a unique way. It is also important to point out the limitations of the studies in the literature, and introduce some constructive suggestion on future studies.
3. Theory Paper: You can prove some econometric theorems which are not proven in the literature, or provide alternative proofs for existing econometric theorems.