University of Rome Tor Vergata; Department of Economics and Finance

Econometrics

Ph.D. in Economics and Finance

Syllabus, Fall 2024

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Office Hour: by appointment

Part I - The Linear Regression Model and GMM

Objectives: The aim of the course is to develop familiarity with a wide range of statistical and econometric techniques that have proved to be useful in applied contexts. Theoretical results will be developed as necessary in order to allow students to apply general principles to their own research problems. The material discussed is a reasonable definition of the minimal acquitance that a well-trained economics and finance Ph.D. should know.

Prerequisites: Familiarity with calculus, linear (matrix) algebra and basic mathematical statistics is expected.

Grading: Problem sets will account for 20% of the final grade. There will be a final exam that accounts for 80% of the final grade.

Textbooks and Notes: Lecture Notes will be provided for the first part of the course. The lecture slides will be provided. Good textbooks that can be useful for this course are:

Davidson, R. and J. G. MacKinnon (2004), *Econometric Theory and Methods*, Oxford University Press.

Hayashi, F. (2000), Econometrics, Princeton University Press.

Hamilton, J.D. (1994), Time Seies Analysis, Princeton University Press.

Perron, P. (forthcoming), Advanced Econometrics, Boston University.

Ruud, P.A. (2000), An Introduction to Classical Econometric Theory, Oxford University Press.

White, H. (2001), Asymptotic Theory for Econometricians, Academic Press.

Course Outline:

1. Geometric Interpretation of Least-squares: vector spaces and projections (motivation, vector spaces, matrices as linear maps, projections, generalized inverses, projection maps in the standard linear model).

2. Properties of the Least-squares Projection (fitted values, residuals, measure of fit, the Frish-Waugh-Lovell Theorem).
3. The Basic Linear Model; Finte-Sample Results (model and assumptions, properties of the least-squares estimator, the Gauss-Markov Theorem, Estimation of the variance of the errors, LUS residuals, recursive residuals.
4. Restricted Least-Squares (the restricted OLS estimate, consequence of misspecification, geometric interpretation).
5. Time Series Models (stationarity, autocovariance and autocorrelation, ARMA processes, maximul likelihood estimation, Granger cauality).
6. Nonstationary Time Series (unit roots, cointegration)
7. A Brief Review of Asymptotic Results (convergence in probability, order of magnitude, convergence in distribution, martingale differences, etc.).
8. The Basic Linear Model; Asymptotic Results (The Mann-Wald Theorem, consistency, asymptotic normality; the basic AR(1) model; test statistics and confidence intervals).
9. Instrumental Variables (instruments and estimators, the GIVE estimator, two-stage interpretation).
10. Non-Spherical Errors (properties of OLS, using OLS with corrected standard errors, heteroskedasticity and autocorrellation consistent (HAC) standard errors, GLS estimator, geometric interpretation of GLS, Feasible GLS).
11. Generalized Methods of Moments (GMM).

Selected Readings:

0. Review of Matrix Algebra: Ruud, Appendix C.

1. Geometric Interpretation of Least-squares. DM, ch. 2.1-2.3; Ruud, ch. 2.

2. Properties of the Least-squares Projection. DM, ch. 3.4-3.5, 3.6, 3.8.

3. The Basic Linear Model; Finte-Sample Results. DM, ch. 3.1-3.5; Ruud, ch. 6-9.

4. Restricted Least-Squares. DM, ch. 3.7. Ruud, ch. 4.

5-6. Time Series. DM, ch. 7.6-13.2; Ruud, 25; Hamilton, various chapters.

7. A Brief Review of Asymptotic Results. DM, ch. 4.5; Ruud, ch. 13.4.

8. The Basic Linear Model; Asymptotic Results. DM, ch. 4.5, 5.2.

9. Instrumental Variables. DM, ch. 8.1-8.4: Ruud, ch. 20.

10. Non-Spherical Errors. DM, ch. 7.1-7.6, Ruud ch. 18-19.

11. GMM. DM, ch. 9; Ruud, ch. 21-22.