ECONOMETRICS III
Master-Ph.D. FAll 2016
UC3M

Professors:
Jesús M. Carro (Office: 15.2.28, jcarro@eco.uc3m.es) &
Jesús Gonzalo (Office: 15.1.15, http://www.eco.uc3m.es/jgonzalo)

Description

The course contains two parts: Micro-Econometrics and Time Series Econometrics.

The objective of the first part of the course is to deal with some important topics in the empirical analysis of micro data (households, firms, etc.). We will study issues in the specification, estimation and testing of different models with cross-sectional and with panel data. The econometric techniques covered here will be useful in the economic applications from wide range of fields: labour economics, health economics, economics of education, Industrial Organization, demand estimation, evaluation of public policies, etc. This part of the course will take the first four weeks of lectures, and will be complemented by the Applied Economics course that you can also take this term.

The second part examines the models and statistical techniques used to study time series data in economics. A central message is that THEORETICAL time series analysis is useful because it helps us understand patterns in actual economic data, as well as dynamic CAUSAL relationships.

The course has two specific objectives. The first is to equip students with the tools necessary for state-of-the-art empirical research with economic time series data. This is designed for those students who are likely to use time series data in their Ph.D. theses (macro-economics, finance, marketing, accounting,...etc). The second objective is to lay out the econometric theory of time series analysis, with an emphasis on recent developments during the past 10-20 years.

The first block of the second part presents the theory of univariate stationary and non-stationary time series variables. The second block focus on the multivariate level covering the different aspects of the VAR modelling that have been relevant in the recent macroeconomic time series literature. The last block consists of some further topics that have become recently very popular in time series econometrics (some of these topics are excellent candidates to write a dissertation on).

Some of the the materials of this second part will be complemented by other Advanced Econometrics courses offered in this PhD program. Particularly we encouraged all of you to take courese like the Topic Courses on Introduction to Empirical Processes (by W. Stute and or Juan Carlos Escanciano), Introduction to Bootstrap (by E. Paparoditis), Stochastic Calculus (by D.Nualart) or similars. These courses are NOT only designed for those students thinking on writing a dissertation on Econometrics. The courses will be useful for anyone aiming to write a good dissertation in Economics.

Grading

The course work consists of a final exam, a midterm exam, eight problem sets that will require theoretical and computationally work, and a FIVE-pages project. The project can be theoretical or applied (see Prof. Gonzalo's web page). For the applied project this year we will focus on the causal relationship between interest rates and seasonally adjusted GNP (or IPI). The question to analyze is how effective is the monetary policy.

Grades for this course will be based on the final exam (47%), the midterm (33%) and the project (20%). The problem sets are a necessary condition in order to get a final grade. I encourage individuals to work together on the problem sets. You will undoubtedly teach each other more about time series and microeconometrics while working in a problem set than we will in class. Each individual is, however, required to turn in a separate problem set answer sheet for the last five problem sets.

Software

Econometrics and Time Series software: E-views, Matlab, STATA, R, etc. We recommend the students to become familiar as soon as possible with at least two of the packages (E-views or STATA and R or Matlab). One menu-driven (good to analyze empirical data) and the other better designed for programming (good for simulations).

COURSE OUTLINE

PART I: MICROECONOMETRICS

1. LINEAR MODELS FOR PANEL DATA
   Introduction and motivation. Review of Static models and control for unobserved heterogeneity: Within-groups, between-groups and Random Effects Methods.
   Dynamic models. Models with strictly exogenous and predetermined variables. The bias of the within-groups estimator. GMM estimation of dynamic panel data models. Specification tests.

2. DISCRETE CHOICE MODELS
   Introduction and motivation. Review of binary choice models for cross sectional data: linear probability models, probit and logit models. Maximum likelihood, semi-parametric, and non-parametric estimation. Interpretation.
   Multiple choice models: multinomial probit and multinomial logit. Simulated method of moments estimation. Ordered probit.
   Binary choice models for panel data. Fixed-T solutions: static and dynamic models, random effects and fixed effects approaches to account for unobserved heterogeneity, identification problems and set identified parameters of interest. General solutions to fixed effects estimation (T is not fixed).
   Limitations of the linear index specification.

3. SAMPLE SELECTION MODELS AND SELECTION MODELS WITH MICRO-DATA
   Applications. Truncated Regression Models. Tobit: Censored Regression Models. Sample selection models: maximum likelihood estimation and two-stage estimation. Unbalanced panels. Missing observations and missing information.

PART II: TIME SERIES ECONOMETRICS

BLOCK 0: INTRODUCTION

4. BASIC CONCEPTS OF STOCHASTIC PROCESSES
   Definitions and examples of stochastic processes and time series. Stationarity and ergodicity. The mean. The autocovariance and autocorrelation function. One of the goals of time series analysis: Forecasts based on conditional expectation and Forecasts based on linear projection (least squares)

BLOCK I: MODELS BASED ON UNIVARIATE INFORMATION

5. STATIONARY LINEAR MODELS I: CHARACTERIZATION AND PROPERTIES
   Wold's decomposition. Causal and Invertible ARMA processes. The Partial autocorrelation function. The Autocovariance generating function. Identification of ARMA processes.

6. STATIONARY LINEAR MODELS I': SPECTRAL ANALYSIS
   Spectral Densities. The Periodogram. Time-Invariant Linear Filters. The Spectral density of an ARMA process.

7. STATIONARY LINEAR MODELS II: ESTIMATION AND INFERENCE
   Estimation: The maximum likelihood method (the likelihood function for a gaussian AR(1) and a gaussian MA(1)) and Least squares. Asymptotic behavior of the sample mean and autocovariance function. Estimation of the Long-Run Variance. Inference on the parameters of ARMA models.
   Appendix: Asymptotics for linear processes (LLN and CLT). Martingale Theory.

8. MODEL SELECTION
   Box-Jenkins Methodology. Information Criteria: AIC, BIC, HQ and LCIC. Consistency of the IC. Inference on models selected by the IC. Testing versus IC.

9. FORECASTING
   Forecasts from ARMA and ARIMA models. The prediction function and its economic interpretation. Combination of forecasts. Evaluation of forecasts. Forecast comparisons of trend-stationary and unit root processes.

10. NON-STATIONARY LINEAR MODELS: THE CASE OF AN AR WITH A UNIT ROOT
    Deterministic trends versus stochastic trends. Processes with unit roots: Testing and Estimation. Decompositions in trend and cycle: Beveridge-Nelson decomposition and orthogonal decompositions.
    Appendix: The functional central limit theorem and the continuous mapping theorem.

11. NON-STATIONARY MODELS: THE CASE OF STRUCTURAL BREAKS
    Testing for a Single Break. Testing for Multiple Breaks. Unit Roots versus Breaks.

BLOCK II: MODELS BASED ON MULTIVARIATE INFORMATION

12. STATIONARY MULTIVARIATE LINEAR MODELS: VARs
    Structural VAR models. Identication of Shocks: Short-run conditions; Long-run conditions (example: Blanchard and Quah); Via Sign restrictions; Via Heterokedasticity. Stability, Estimation and inference in VAR models. Lag selection. Transfer functions derived from VAR models. Bivariate Granger causality tests. Impulse-response function. Variance decomposition. Standard errors for impulse-response functions.

13. NON-STATIONARY MULTIVARIATE LINEAR MODELS I: VAR MODELS WITH UNIT ROOTS- COINTEGRATION
    Spurious regression. Cointegration. Implications of cointegration for the VAR representation: the Error correction model (Granger's representation theorem). Testing for cointegration and estimation of the cointegrating vector: A single equation approach (OLS and DOLS). Testing for the rank of cointegration and estimation of the cointegrating vectors: A simultaneous equation approach (Reduced Rank Regression). Consequences of misspecification of the trend components on testing for cointegration.
    Appendix: Asymptotic results for non-stationary vector processes.

14. NON-STATIONARY MULTIVARIATE LINEAR MODELS II: VAR MODELS WITH UNIT ROOTS- COINTEGRATION
    Common trends representations. Permanent and Transitory Decompositions: Stock-Watson and Gonzalo-Granger representations. Identification of the shocks of a cointegrated VAR: Gonzalo-Ng approach.

15. MODEL SELECTION
    Consequences of lag or/and rank misspecification in VARs. Information criteria approach to select the number of lags and the rank of cointegration. Consistency of the IC; Testing versus IC.

BLOCK III: FURTHER TOPICS

16. LONG MEMORY
    Definition. How long-memory appears in Economics. Modelling. Estimation and inference. Testing I(1) versus I(d). Testing I(d) versus I(0)+ Breaks.

17. THRESHOLD MODELS
    Threshold autoregressive models. Conditions for Stationarity. Estimation, Inference and Model Identification. Testing linearity. The Case of Threshold Unit Root (TARUR and TARSUR Models).

18. DYNAMIC FACTOR MODELS
    Standard Factor Models. Determination of the number of Factors. Inferential Theory for Factor Models.

TEXTBOOKS

Part I: **Wooldridge** or **Cameron and Trivedi** cover many of the topics, but no textbook covers all aspects. **Arellano** covers in depth the first topic.

Arellano, M. (2002), *Panel Data Econometrics*. Oxford University Press.

Cameron, C. and P. Trivedi, (2005) *Microeconometrics*, Cambridge University Press.

For doing applied work, it is also useful the companion book: Cameron, C. and P. Trivedi (2009), *Microeconometrics Using Stata*, Stata Press.

Wooldridge, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data*. The MIT Press.

Part II: The primary texts are **Brockwell and Davis** (1991), **Hamilton** (1994), and **Hayashi** (2000). The other texts provide treatments of various subtopics.

Hamilton, J., *Time Series Analysis*. Princeton University Press, 1994.

Hayashi, F., *Econometrics*. Princeton University Press, 2000.

Brockwell, P.J. and R.A. Davis, *Time Series: Theory and Methods*. New York. Springer-Verlag, second edition, second printing 2009.

FOR BOTH PARTS: LECTURE NOTES PLUS OTHER REFERENCES AND FURTHER READINGS FOR EACH TOPIC THAT WILL BE GIVEN DURING THE LECTURES

We hope you enjoy the course. GOOD LUCK