

# **Econometrics**

Ph.D. Program in Economics and Management  
(Economics) Department of Economics and  
Management, University of Padova Academic year  
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## **Prerequisite**

Students should know the key econometric methods to estimate linear models (OLS, GLS and IV methods) and testing hypotheses (acceptance and rejection, type I error, t tests, F tests, type II error and power, statistical significance, p-values, diagnostics (reset test, heteroskedasticity tests, autocorrelation tests), etc.). Useful references are Ref. 3 and Ref. 4.

## **Course description**

The aim of the course is to provide a theoretical background that is useful for research in econometric methods and for applied research. Our focus will be the asymptotic properties of the most commonly used econometric estimators.

## Syllabus

1. Regression, Linear Projection, Marginal effects, causal effects. (Ref. 1 Ch. 1 and 2; Ref. 5 Ch. 2).
  - 1.a) Conditional density, mean and variance.
  - 1.b) Independence concepts (stochastic, in mean and linear).
  - 1.c) The best linear predictor (linear projection) and its error.
  - 1.d) Marginal effects and causal effects.
2. Finite sample properties of the estimators with application to the OLS and GLS estimators (Ref. 1 Ch. 3 and 4, Ref. 2 Ch. 1).
  - 2.a) The OLS and GLS estimators.
  - 2.b) Finite sample properties of the OLS and GLS estimators: unbiasedness under strict exogeneity; variance under several hypotheses; efficiency; normal sampling distribution.
3. Asymptotic theory (Ref. 1 Ch. 5, Ref. 7, Ref. 8 Ch. 3, Ref. 9 Chs. 59-69, Ref. 2 Ch. 2)
  - 3.a) Modes of stochastic convergence: almost sure convergence, convergence in probability, mean-squares convergence, convergence in distribution, Relations between different concepts of stochastic convergence.
  - 3.b) Theorems on stochastic convergence: the laws of large numbers, central limit theorems, the Continuous Mapping and Slutski's theorems, the  $\delta$  method.
4. Asymptotic properties of the OLS and GLS estimators (Ref. 1 Chs. 6, Ref. 6, Ref. 7, Ref. 2 Ch. 3).
  - 4.a) Asymptotic properties of estimators
  - 4.b) Consistency
  - 4.c) Asymptotic normality.
5. Topics on testing statistical hypothesis (Ref. 1 Ch. 8, Ref. 2

Ch. 3) 5.a) Wald tests and criterion-based tests

5.b) Asymptotic local power

6. Introduction to time series analysis: univariate and multivariate time series (Ref. 1 Ch. 16 and 17).

7. IV and GMM estimation of single equation linear model: definition asymptotic properties, test statistics (Sargan/Hansen test, weak instruments test; Hausman test). (Ref. 1 Ch. 15, Ref. 2 Ch. 3).

8. GMM estimator and other extremum estimators (Ref. 1 Ch. 13, Ref. 2 Ch. 3 and Ch. 7).
9. Linear panel data models (Ref. 1 Ch. 19)

## References

Main reference textbooks are Ref. 1 and Ref. 2.

- Ref. 1 Hansen, B. E.: Econometrics, <http://www.ssc.wisc.edu/bhansen/econometrics/>, free download, several editions.
- Ref. 2 Fumio Hayashi (2000): Econometrics, Princeton University Press.
- Ref. 3 Stock, J. H. & M. W. Watson (2006): Introduction to Econometrics, 2nd edition, Addison-Wesley / Prentice Hall.
- Ref. 4 Wooldridge, J. (2009): Introductory Econometrics: A Modern Approach, 4th Edition, South Western
- Ref. 5 Wooldridge, J. (2001): Econometric Analysis of Cross Section and Panel Data, MIT Press
- Ref. 6 Colin Cameron: Brief Asymptotic Theory, downloadable from <http://cameron.econ.ucdavis.edu/e240a/asymptoticsw07.pdf>
- Ref. 7 James L. Powell: Elements of Asymptotic Theory, downloadable from <http://personal.lse.ac.uk/PIFFER/powell.pdf>
- Ref. 8 Takeshi Amemiya (1985): Advanced Econometrics, Basil Blackwell, 1985
- Ref. 9 Marco Taboga (2012): Lectures on probability theory and mathematical statistics, 2th edition, Amazon CreateSpace
- Ref. 10 Lecture slides (<https://elearning.unipd.it/economia/>)