# NATIONAL TAIWAN UNIVERSITY

**Department of Finance**

# ECONOMETRIC THEORY I

and

**Departments of Economics and International Business**

# ECONOMETRIC THEORY III

**Prof. C.-M. Kuan** **Fall 2012**
**Room 716, Bldg. 2** **ckuan@ntu.edu.tw**

---

This is the first course in econometric theory for Ph.D. students; well prepared Master students are also welcome to take this course. This course requires knowledge of probability theory, multivariate statistics, and linear (matrix) algebra. Some econometrics knowledge at master level is a plus but *not* required. In this course, I will follow my own lecture notes and cover the least-squares theory and quasi-maximum likelihood theory. Unlike most econometrics textbooks that are organized according to *models*, my notes are arranged by *theories* (*methods*), with applications to various models. Some textbooks (R2 and R3 below) provide more thorough treatment of these topics. By introducing econometric theory in this way, I hope students will learn *how* an econometric method is derived and *why* it works. In addition, commonly used computational methods in econometrics, such as Monte Carlo simulation and bootstrap, will also be introduced.

The lectures will be in *English*; classroom discussion may be in Mandrin. To conduct simulations and bootstraps, students are required to learn at least one programming language, such as R (a free software) or Matlab. A senior student will introduce basic programming in R in the beginning lectures; some basic materials about R installation and introduction can be found in the class website (see below).

## Required Reading

[R1] Kuan, C.-M., *Introduction to Econometric Theory*, Lecture Notes and Slides.
https://ceiba.ntu.edu.tw/1011metrics_fin (for finance students)
https://ceiba.ntu.edu.tw/1011metrics_ib (for economics and IB students)
homepage.ntu.edu.tw/~ckuan

[R2] White, H., *Asymptotic Theory for Econometricians*, revised ed., Academic Press, 1999.

[R3] White, H., *Estimation, Inference and Specification Analysis*, Cambridge University Press, 1994.

## Supplemental Reading

[S1] Davidson, R. and J. G. MacKinnon, *Estimation and Inference in Econometrics*, Oxford University Press, 1993.

[S2] Greene, W. H., *Econometric Analysis*, 6th ed., Pearson Prentice Hall, 2008.

[S3] Hamilton, J., *Time Series Analysis*, Princeton University Press, 1994.

[S4] Kuan, C.-M., *Elements of Matrix Algebra*, Lecture Notes.

**Office Hours:** Tuesday 4–6 or by appointment (3366.1072)

**Course Outline**

**Part I:** Classical Least Squares Theory (Chapters 3–4 of R1; S2; S4)

- I.1 The Method of Ordinary Least Squares (OLS)
- I.2 Properties of the OLS Estimator
- I.3 Hypothesis Testing
- I.4 Limitation of the Classical Conditions
- I.5 The Method of Generalized Least Squares (GLS)

**Part II:** Asymptotic Least Squares Theory (Chapters 5–7 of R1; R2; R3; S1)

- II.1 Elements of Probability Theory
- II.2 Asymptotic Properties of the OLS Estimator
- II.3 Consistent Estimation of Asymptotic Covariance Matrix
- II.4 Large Sample Tests
- II.5 Digress: Bootstrap

**Part III:** Nonlinear Least Squares (NLS) Theory (Chapter 8 of R1; S1)

- III.1 Nonlinear Specifications
- III.2 NLS Estimator

**Part IV:** Quasi-Maximum Likelihood (QML) Theory (Chapters 9–10 of R1; R3; S3)

- IV.1 Kullback-Leibler Information Criterion
- IV.2 Asymptotic Properties of the QML Estimator
- IV.3 Information Matrix Equality
- IV.4 Large Sample Tests – Nested Models
- IV.5 Large Sample Tests – Non-Nested Models
- IV.7 Applications: ARMA Models
- IV.8 Applications: Volatility Models

**Grading:** One midterm (40%), one final (45%), Homework (15%).