ADVANCED ECONOMETRICS

Spring Term, 2011

(Instructors: Matteo Ciccarelli, Jan Kiviet and Juan Mora)

OBJECTIVE OF THE COURSE

The aim of the course is to introduce the students into some modern techniques in Econometrics and show how they work in practice. The first part of the course deals with nonparametric and semiparametric methods, Monte Carlo and bootstrap inference, and quantile regression. The second part of the course is an introduction on Bayesian inference, starting from first principles and covering topics of interest for applied econometricians.

TEACHING METHODOLOGY

The topics will be presented in lectures by the instructors. Since all the topics that are covered in the course are computer-intensive techniques, next to the necessary theoretical background substantial attention will be paid in the lectures to actual illustrations on the computer. All theoretical material is also discussed in practice, with several examples of computer calculations and problem sets to complement the learning process.

SCHEDULE OF LECTURES

Monday, April 4,16-18 (Juan Mora)
Monday, April 11,16-18 (Juan Mora)

Monday, May 9, 16-18 (Jan Kiviet)
Wednesday, May 11, 16-18 (Jan Kiviet)
Monday, May 16, 16-18 (Jan Kiviet)
Wednesday, May 18, 16-18 (Jan Kiviet)

Monday, May 23, 16-18 (Juan Mora)
Monday, May 30, 16-18 (Juan Mora)

Monday, June 6, 11-13 and 14-16 (Matteo Ciccarelli)
Tuesday, June 7, 17.30-20.30 (Matteo Ciccarelli)
Wednesday, June 8, 10-12 and 16.30-18.30 (Matteo Ciccarelli)
Thursday, June 9, 16-19 (Matteo Ciccarelli)

GRADING

There will be an exam at the end of the course (50%). In addition, there will be three short assignments in the first part of the course (25%) and a computer assignment in the second part of the course (25%).

FIRST PART OF THE COURSE (April, May)

I) Background

In the first two sessions the nonparametric techniques for estimation of densities and conditional functions are introduced, and various classical econometric problems are discussed from a semiparametric point of view.

The next four lectures are aimed to demonstrate how computer simulation can be used for two distinct purposes: (a) assessment of the actual finite sample properties of standard asymptotic econometric inference methods (parameter estimation, hypothesis testing, construction of confidence sets) when applied to fully specified and known synthetic data generating processes, and (b) the conversion of standard econometric inference methods by resampling techniques such that they may yield more accurate inference from finite samples on actual empirical data generating processes. Each session will provide EViews computer programs on concrete specific cases. Students will have to run (and slightly alter) these programs and in assignments will have to demonstrate their skills in interpreting the output. The students will get a full set of detailed lecture notes, but may find it useful to consult some additional material from the list of references given below.

The last two sessions provide an overview of quantile regression techniques, and discuss fields where they have proved to be especially fruitful.

II) Syllabus

1. Foundations of Nonparametric Statistics
   a. Nonparametric density estimation
   b. Nonparametric estimation of conditional functions
   c. Topics in Semiparametric Econometrics

2. Fundamentals of Classic Monte Carlo Simulation
   a. pseudo random numbers
   b. Monte Carlo estimation of moments and of probabilities (relevance of central limit theorem, choosing the sample size)
   c. Monte Carlo analysis of asymptotic tests (quantile estimation, size correction, power comparison)
   d. Monte Carlo design and methodology

3. Monte Carlo Tests
   a. exact inference, similar and nonsimilar tests
   b. tests based on pivots
   c. implementing Monte Carlo tests

4. Parametric and Nonparametric Bootstrap
   a. bootstrap bias correction and variance estimation
   b. bootstrap hypothesis testing and confidence set construction
   c. alternative resampling plans (paired, residual, recursive, block, sieve, wild, double)

5. Quantile Regression
   a. Fundamentals of quantile regression
   b. Economic applications of quantile regressions

III) Bibliography

Books:

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

Fitzenberger, B., Koenker, R. and Machado, J.A. (Eds.), 2002. Economic Applications of Quantile Regression, Physica-Verlag.

Koenker, R., 2005. Quantile Regression, Econometric Society Monographs, Cambridge University Press.

Li, Q. and Racine, J.L., 2007. Nonparametric Econometrics: Theory and Practice, Princeton University Press.

Papers/Chapters in Books:

Davidson, R., MacKinnon, J.G., 1993. *Estimation and Inference in Econometrics*. New York, Oxford University Press (see in particular Chapter 21).

Davidson, R., MacKinnon, J.G., 2006. Bootstrap Methods in Econometrics. Chapter 23 (pp. 812-838) in: Mills, T.C., Patterson, K. (eds.). *Palgrave Handbook of Econometrics* (Volume 1, Econometric Theory). Basingstoke, Palgrave Macmillan.

Doornik, J.A., 2006. The Role of Simulation in Econometrics. Chapter 22 (pp. 787-811) in: Mills, T.C., Patterson, K. (eds.). *Palgrave Handbooks of Econometrics* (Volume 1, Econometric Theory). Basingstoke, Palgrave MacMillan,

Hendry, D.F., 1984. Monte Carlo experimentation in econometrics. Chapter 16 in: Griliches, Z., Intriligator, M.D. (eds.). *Handbook of Econometrics*, Vol. II. Amsterdam, Elsevier.

Horowitz, J.L., 2003. The bootstrap in econometrics. *Statistical Science* 18, 211-218.

Johnson, R.W., 2001. An introduction to the bootstrap. *Teaching Statistics* 23, 49-54.

Kiviet, J.F., 2007. Judging contending estimators by simulation: Tournaments in dynamic panel data models. Chapter 11 (pp.282-318) in Phillips, G.D.A., Tzavalis, E. (Eds.). *The Refinement of Econometric Estimation and Test Procedures; Finite Sample and Asymptotic Analysis*. Cambridge University Press.

Kiviet, J.F., 2010. Monte Carlo simulation for econometricians. Monograph in progress (see lecture notes).

MacKinnon, J.G., 2002. Bootstrap inference in econometrics. *Canadian Journal of Economics* 35, 615-645.

MacKinnon, J.G., 2006. Bootstrap methods in econometrics. *Economic Record*, 82, s2-s18.

*Books for topics **not covered** in the course (Method of Simulated Moments, Indirect Inference, Markov Chain Monte Carlo, Gibbs Sampling, Simulated Annealing):*

Fishman, G.S., 2006. *A First Course in Monte Carlo*. Thomson.

Gourieroux, C., Monfort, A. 1996. *Simulation-Based Econometric Methods*. Oxford University Press.

SECOND PART OF THE COURSE

I) Background

The focus of the classes will be on application more than theory. The course is therefore more useful for applied economists than for theoretical econometricians. Students are required to have previous courses in calculus, matrix algebra, probability and statistics, and prior introductory training in econometrics (the course can be scheduled e.g. after the first Econometrics course at a Master or PhD level). Each session will be complemented with concrete examples and applications. Therefore students will find basic programming skills useful in the sense that their previous experience in probability, statistics, linear algebra and econometrics should have included computational aspects and basic knowledge of statistics and econometrics packages. MATLAB programs for performing Bayesian analysis in several models will be provided and discussed. The material covered in class draws upon the (selected) list of references below. Handouts and additional technical material can be distributed during the lectures.

II) Syllabus

1. Fundamentals of Bayesian statistics and econometrics

a. Bayes' Theorem, Uncertainty, Prediction
b. Components of Bayes' Theorem: Likelihood, Priors and Posteriors, Inference
c. Model Checking and Sensitivity analysis
d. Presentation of results
e. Extensions: Hierarchical models, Normal approximation, Objective priors

2. Posterior simulators and Monte Carlo strategies

a. Non-iterative methods:
    i. Direct sampling
    ii. Sampling in parts and sampling by inversion
    iii. Importance sampling
b. Iterative Methods: Markov Chain Monte Carlo (MCMC)
    i. Gibbs Sampling
    ii. Metropolis
c. Computation of the marginal likelihood and model comparison

3. Regression Models

a. The Normal Linear Regression Model
b. Hierarchical modelling: SUR and Panel Data Models

III) Bibliography (Books)

• Bauwens, L., M. Lubrano and J.F. Richard (1999) Bayesian Inference in Dynamics Econometric Models, Oxford University Press.

• Berger, J. and Wolpert, R. (1998), The Likelihood Principle (2nd edition), Institute of Mathematical Statistics, Hayward, Ca.

• Canova, F. (2009), Methods for Applied Macroeconomic Research, Princeton University Press.

• Carlin, B.P., and T.A. Louis (1996), Bayes and Empirical Bayes Methods for Data Analysis, New York: Chapman & Hall.

• Gelman, A., J. B. Carlin, H.S. Stern and D.B. Rubin (1995), Bayesian Data Analysis, Chapman and Hall, London.

• Geweke, J (2005), Contemporary Bayesian Econometrics and Statistics, Wiley.

• Gilks, W.R, S. Richardson and D. Spiegelhalter, (1996), MCMC in practice, NY: Chapman & Hall.

• Greenberg, E. (2008), Introduction to Bayesian Econometrics, Cambridge:Cambridge University Press.

• Hamilton J. D. (1994), Time Series Analysis, Princeton N.J., Princeton University Press.

• Koop, G. (2003), Bayesian Econometrics, J. Wiley.

• Lancaster, T. (2004), An Introduction to Modern Bayesian Econometrics, Blackwell.

• Leamer, E. E. (1978), Specification Searches, J. Wiley.

• Poirier, D. Intermediate Statistics and Econometrics, MIT Press (1995)

• Robert, C.P. (2001), The Bayesian Choice, Springer Verlag.

• Robert, C.P. and G. Casella (2004), Monte Carlo Statistical Methods (2^{nd} edition), Springer Verlag.

• Zellner, A. (1971) Introduction to Bayesian Inference in Econometrics, Wiley and Sons