### **Econ 221: Nonparametrics and Semiparametric Econometrics**

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Office Hours: W 3:00pm--4:30pm

Time and Location: MW 12:30pm -- 1:50pm Econ 300

Prerequisites: Econ 220A-220D.

## **Course Description**

The primary goal of this course is to introduce modern nonparametric and semiparametric techniques in Econometrics. The course contains two parts. In the first part, we provide a rigorous introduction to nonparametric methods. We give a thorough treatment of the so-called kernel estimators and briefly discuss an alternative class of nonparametric estimators, the class of so-called sieve (or series) estimators. We consider both the estimation of probability densities and the estimation of their functionals, such as conditional density and conditional moments. In the second part, we examine semiparametric estimators, which are the intermediate situation between the fully parametric and the nonparametric cases. Here, we are interested in estimating a finite-dimensional parameter in the presence of infinite-dimensional nuisance parameter(s). We provide a unified framework to analyze the asymptotic properties of the semiparametric estimator of the finite dimensional parameter. We give an in-depth discussion on semiparametric efficiency bounds. If time permits, we will consider semiparametric sieve methods and semiparametric models with endogenous covariates.

Our main goal is to establish the asymptotic properties of the estimator in question. We make no attempt to analyze the finite-sample behavior of the estimator. Moreover, we focus on nonparametric and semiparametric techniques for cross sectional data. However, most of the results carry over to time series data under suitable regularity conditions including some mixing and moment conditions. We discuss empirical applications in this course but the emphasis is on econometric ideas and econometric techniques.

The course will be taught at an advanced level. It is designed as a course for students who plan to choose econometrics as their primary field or secondary field, and for students who want to use sophisticated empirical techniques in their field of study. Students are assumed to be familiar with estimation and inference in parametric models, say at the level of my Econ 220C lecture note on extremum estimators or at the level of Sections 1-7 of Newey and McFadden (1994) in the Handbook of Econometrics, Vol. 4.

# Assignments

- One or two problem sets.
- a referee report on one of the two working papers by econometrics job market candidates.

The referee report should be 2-3 pages double-spaced. The report should start off with a one paragraph summary of the main argument of the article. You should describe your main points in detail as if you were writing directly to the author. Conclude the report with more minor comments. A good referee report not only clearly states the shortcomings of the work, but also lays out detailed (and realistic) suggestions for improvement.

• One research proposal, about 10 pages double-spaced. The research proposal should first briefly (3-4 pages) survey an existing literature in nonparametric and semiparametric econometrics and then describe a planned research project.

# Textbooks

The main textbooks used in the course are:

- 1. Pagan, A. and A. Ullah (1999): Nonparametric Econometrics. Cambridge University Press.
- 2. Li, Q. and J.S. Racine (2007): Nonparametric Econometrics: Theory and Practice. Princeton University Press

The main Handbook of Econometrics chapters used in this course are:

- 1. Chen, X. (2007): Semiparametric and Nonparametric Estimation via the Method of Sieves. Forthcoming in Handbook of Econometrics vol. 6 (eds. J.J. Heckman & E.E. Leamer). Elsevier.
- Härdle, W. and O. Linton (1994): Applied Nonparametric Methods. In Handbook of Econometrics, Vol. 4 (eds. R.F. Engle and D.L. McFadden), 2295-2339. Elsevier.
- Ichimura, H. and P. Todd (2007): Implementing nonparametric and semiparametric estimators, Forthcoming in Handbook of Econometrics vol. 6 (eds. J.J. Heckman & E.E. Leamer). Elsevier.
- 4. Powell, J.L. (1994): Estimation of Semiparametric Models. In Handbook of Econometrics, Vol. 4 (eds. R.F. Engle and D.L. McFadden), 2443-2521. Elsevier.

## **Additional Reading**

- 1. A.W. Van Der Vaart Asymptotic Statistics, Cambridge University Press, 1998
- Andrews, D.W.K. (1991): Asymptotic Normality of Series Estimators for Nonparametric and Semiparametric Regression Models. *Econometrica* 59, 307-45.
- 3. Andrews, D.W.K. (1994): Asymptotics for Semiparametric Econometric Models via Stochastic Equicontinuity. *Econometrica* 62, 43-72.
- 4. Barnett, W. A., J. L. Powell, and G.E. Tauchen (editors) (1991): *Nonparametric and Semiparametric Methods in Economics and Statistics*. Cambridge University Press.
- 5. Bickel, P.J., C.A.J. Klaassen, Y. Ritov and J.A. Wellner (1993): *Efficient and Adaptive Estimation for Semiparametric Models*. The John Hopkins University Press.
- 6. Eubank, R.L. (1999): *Nonparametric Regression and Spline Smoothing*. Marcel Dekker.
- 7. Fan, J. and I. Gibjbels (1996): *Local Polynomial Modelling and Its Applications*. Chapman and Hall.
- 8. Härdle, W. (1990): *Applied Nonparametric Regression*. Cambridge University Press.
- 9. Härdle, W., M. Müller, S. Sperlich, and A. Werwatz (2004): *Nonparametric and Semiparametric Models*. Springer.
- 10. Newey, W.K. (1990): Semiparametric Efficiency Bounds. *Journal of Applied Econometrics* 5, 99-135.
- 11. Newey, W.K. (1994): The Asymptotic Variance of Semiparametric Estimators. *Econometrica* 62, 1349-1362
- 12. Newey, W.K. (1997): Convergence Rates and Asymptotic Normality for Series Estimators. *Journal of Econometrics* 79, 147-168.
- 13. Robinson, P.M. (1988): Semiparametric Econometrics: A Survey. *Journal of Applied Econometrics* 3, 35-51.
- 14. Robinson, P.M. (1988): Root-N-Consistent Semiparametric Regression. *Econometrica* 56, 931-954.
- 15. Silverman, B.W. (1986): *Density Estimation for Statistics and Data Analysis*. Chapman and Hall.
- 16. Yatchew, A. (2003): *Semiparametric Regression for the Applied Econometrician*. Cambridge University Press.