Northwestern University
Department of Economics
Federico A. Bugni

ECON 483 - Fall 2021
Applied Microeconometrics:
Nonparametric and Semiparametric Econometrics

1 Contact information

My contact information is as follows:

- *Office:* KGH 3423
- *E-mail:* federico.bugni@northwestern.edu.
- *Homepage:* https://sites.northwestern.edu/federicobugni/

2 Class time and place

- *Lectures:* Tue, Thu 9 am – 10:50 am in KGH 3301
- *Regular office hours:* Fri 2 pm – 3 pm in KGH 3423, or by email appointment.
- *Course website:* https://canvas.northwestern.edu/courses/151501.
- *Course Zoom meetings:* 920-8993-2551 (recorded).

3 Course Description

This course covers classical methods and references in nonparametric and semiparametric econometrics.

The nonparametric portion of the course studies the nonparametric estimation of a density, the mean regression model, and the additive separable mean regression model. We consider both kernel and sieve estimation methods. The results in nonparametric estimation are the building block for semiparametric estimation. The semiparametric portion of the course studies the partially linear model, the semiparametric single-index model, and the binary response model, among others.

The semiparametric portion of the course studies the partially linear model, the semiparametric single-index model, and the binary response model.

4 Grading scheme

- The final course grade is the result of the problem sets, final exam, and class participation.
- Final exam: 12 hour take-home exam, starting on Monday, December 6th, at noon.

5 Problems sets

- There will be 3 or 4 problem sets. After the due date, the solutions of the problem sets will be posted in Canvas and discussed during the lectures.
- You are encouraged to discuss the problem sets with your peers, but individual solutions are required.
- The problem sets will contain both theoretical and empirical questions. You are free to use any statistical/econometric software available for the empirical questions.

6 Overview of the course

1. Introduction to nonparametric estimation.
   - Main: Chen (2007) and Horowitz (2009, Chapter 1).
   - Applications: DiNardo and Tobias (2001) and Quah (1997).
2. Nonparametric density estimator: kernels.
   - Main: Pagan and Ullah (1999), Li and Racine (2007), and Horowitz (2009, Appendix A).
   - Applications: DiNardo and Tobias (2001).
   - Additional: Rosenblatt (1956), Parzen (1962), Silverman (1978), Mack and Rosenblatt (1979), Stone (1980, 1982), Silverman (1986), Härdle and Linton (1994), Wasserman (2006), and Ahamada and Flachaire (2010).
3. Nonparametric regression estimators: kernel and local polynomial estimation.
   - Main: Fan and Gijbels (1996), Pagan and Ullah (1999), Li and Racine (2007), and Horowitz (2009, Appendix A).
   - Applications: CDC data, Hausman and Newey (1995), and RDD: Lee (2008) and Ludwig and Miller (2007).
   - Additional: Stone (1977, 1980, 1982), Wasserman (2006), Nadaraya (1965), Watson (1964), Ruppert and Wand (1987), Cleveland (1979), Masry (1996), Ahamada and Flachaire (2010).
4. Nonparametric additive separable model.
   - Main: Linton and Nielsen (1995), Linton and Härdle (1996), and Horowitz (2009, Chapter 3).
   - Applications: Linton and Nielsen (1995), Linton and Härdle (1996), and Horowitz (2009, Chapter 3).
   - Additional: Linton (1997), Fan et al. (1998), Kim et al. (1999), Hengartner and Sperlich (2005), and Ahamada and Flachaire (2010).
5. Nonparametric estimators: sieve estimation.
   - Main: Chen (2007) and Newey (1994, 1997).
   - Applications: Hausman and Newey (1995) and Heckman and Singer (1984).
   - Additional: Li and Racine (2007).
6. Introduction to semiparametric estimation.
   - Main: Li and Racine (2007) and Horowitz (2009, Chapter 2).

- Additional: Stein (1956), Newey (1994), Powell (1994), and Pagan and Ullah (1999).

7. Partially linear model.
   - Main: Robinson (1988) and Horowitz (2009, Chapter 3).
   - Application: Schmalensee and Stoker (1999).
   - Additional: Ruud (1986), Ahamada and Flachaire (2010), and Schmalensee and Stoker (1999).
8. Semiparametric single index models.
   - Main: Han (1987), Powell et al. (1989), Ichimura (1993), and Horowitz (2009, Chapter 2).
   - Additional: Arabmazar and Schmidt (1982), Ichimura and Lee (1991), Sherman (1993), Ai and Chen (2003), and Ahamada and Flachaire (2010).
9. Binary response models.
   - Main: Cosslett (1983), Klein and Spady (1993), Manski (1975, 1985), Horowitz (1992), and Horowitz (2009, Chapter 3).
   - Application: Horowitz (1996).
   - Additional: Cavanagh (1987), Pakes and Pollard (1989), Abrevaya and Whang (2005), Horowitz (2002).

References

Abrevaya, J. and J. Whang (2005): "On the Bootstrap of the Maximum Score Estimator," *Econometrica*, 73, 1175–1204.

Ahamada, I. and E. Flachaire (2010): *Non-parametric Econometrics*, Oxford University Press.

Ai, C. and X. Chen (2003): "Efficient Estimation of Models with Conditional Moment Restrictions Containing Unknown Functions," *Econometrica*, 71, 1795–1843.

Arabmazar, A. and P. Schmidt (1982): "An Investigation of the Robustness of the Tobit Estimator to Non-Normality," *Econometrica*, 50, 1055–1063.

Cavanagh, C. L. (1987): "Limiting behavior of estimators defined by optimization," Unpublished Manuscript: Harvard University.

Chen, X. (2007): "Large Sample Sieve Estimation of Semi-Nonparametric Models," *Handbook of Econometrics*, 6B, 5550–5588.

Cleveland, W. S. (1979): "Robust Locally Weighted Regression and Smoothing Scatterplots," *Journal of the American Statistical Association*, 74, 829–836.

Cosslett, S. R. (1983): "Distribution-Free Maximum Likelihood Estimator of the Binary Choice Model," *Econometrica*, 51, 765–782.

DiNardo, J. and J. L. Tobias (2001): "Nonparametric Density and Regression Estimation," *The Journal of Economic Perspectives*, 15, 11–28.

Fan, J. and I. Gijbels (1996): *Local polynomial modelling and its applicationss*, Monographs on Statistics and Applied Probability 66, Chapman & Hall/CRC.

Fan, J., E. Mammen, and W. Härdle (1998): "Direct estimation of Low Dimensional Components in Additive Models," *Annals of Statistics*, 26, 943–971.

Han, A. K. (1987): "Non-parametric Analysis of a Generalized Regression Model," *Journal of Econometrics*, 35, 303–316.

Härdle, W. and O. Linton (1994): "Applied nonparametric methods," in *Handbook of Econometrics*, ed. by R. F. Engle and D. L. McFadden, Elsevier Science Publishers B.V., vol. 4 of *Handbook of Econometrics*, chap. 38, 2295–2339.

Hausman, J. and W. K. Newey (1995): "Nonparametric Estimation of Exact Consumers Surplus and Deadweight Loss," *Econometrica*, 63, 1445–76.

Heckman, J. J. and B. Singer (1984): "A Method for Minimizing the Impact of Distributional Assumptions in Econometric Models for Duration Data," *Econometrica*, 52, 271–320.

Hengartner, N. W. and S. Sperlich (2005): "Rate Optimal Estimation with the Integration Method in the Presence of Many Covariates," *Journal of Multivariate Analysis*, 95, 246–272.

Horowitz, J. L. (1992): "A Smoothed Maximum Score Estimator for the Binary Response Model," *Econometrica*, 60, 505–531.

——— (1996): "Semiparametric estimation of a work-trip mode choice model," *Journal of Econometrics*, 58, 49–70.

——— (2002): "Bootstrap critical values for tests based on the smoothed maximum score estimator," *Journal of Econometrics*, 111, 141–167.

——— (2009): *Semiparametric and Nonparametric Methods in Econometrics*, Springer.

Ichimura, H. (1993): "Semiparametric least squares (SLS) and weighted SLS estimation of single-index models," *Journal of Econometrics*, 58, 71–120.

Ichimura, H. and L. F. Lee (1991): "Semiparametric least squares estimation of multiple index models: single equation estimation," in *Nonparametric and Semiparametric Methods in Econometrics and Statistics: Proceedings of the Fifth International Symposium in Econometric Theory and Econometrics*, ed. by J. P. W. A. Barnett and G. Tauchen, Cambridge University Press, 3–49.

Kim, W., O. B. Linton, and N. W. Hengartner (1999): "A Computationally Efficient Oracle Estimator for Additive Nonparametric Regression with Bootstrap Confidence Intervals," *Journal of Computational and Graphical Statistics*, 8, 278–297.

Klein, R. and R. H. Spady (1993): "An Efficient Semiparametric Estimator for Binary Response Models," *Econometrica*, 61, 387–421.

Lee, D. S. (2008): "Randomized experiments from non-random selection in U.S. House elections," *Journal of Econometrics*, 142, 675–697.

Li, Q. and J. S. Racine (2007): *Nonparametric Econometrics: Theory and Practice*, Princeton University Press.

Linton, O. B. (1997): "Miscellanea Efficient Estimation of Additive Nonparametric Regression Models," *Biometrika*, 84, 465–473.

Linton, O. B. and W. Härdle (1996): "Estimation of addtitive regression models with known links," *Biometrika*, 83, 529–540.

Linton, O. B. and J. P. Nielsen (1995): "A Kernel Method of Estimating Structured Nonparametric Regression Based on Marginal Integration," *Biometrika*, 82, 93–110.

Ludwig, J. and D. L. Miller (2007): "Does Head Start Improve Children's Life Chances? Evidence from a Regression Discontinuity Design," *Quarterly Journal of Economics*, 122, 159–208.

Mack, Y. P. and M. Rosenblatt (1979): "Multivariate k-nearest neighbor density estimates," *Journal of Multivariate Analysis*, 9, 1–15.

Manski, C. F. (1975): "The Maximum Score Estimator of the Stochastic Utility Model of Choice," *Journal of Econometrics*, 3, 205–228.

——— (1985): "Semiparametric analysis of discrete response: Asymptotic properties of the maximum score estimator," *Journal of Econometrics*, 27, 313–333.

Masry, E. (1996): "Multivariate regression estimation Local polynomial fitting for time series," *Stochastic Processes and their Applications*, 65, 81–101.

Nadaraya, E. A. (1965): "On Estimation Regression," *Theory of Probability and its Applications*, 9, 141–142.

Newey, W. K. (1994): "The asymptotic variance of semiparametric estimator," *Econometrica*, 62, 1349–1382.

——— (1997): "Convergence rates and asymptotic normality for series estimators," *Journal of Econometrics*, 79, 147–168.

Pagan, A. and A. Ullah (1999): *Nonparametric Econometrics*, Cambridge University Press.

Pakes, A. and D. Pollard (1989): "Simulation and the Asymptotics of Optimization Estimators," *Econometrica*, 57, 1027–1057.

Parzen, E. (1962): "On Estimation of a Probability Density Function and Mode," *The Annals of Mathematical Statistics*, 33, 1065–1076.

Powell, J. L. (1994): "Estimation of Semiparametric Models," in *Handbook of Econometrics*, ed. by R. F. Engle and D. L. McFadden, Elsevier, vol. 4 of *Handbook of Econometrics*, 2444–2514.

Powell, J. L., J. H. Stock, and T. M. Stoker (1989): "Semiparametric Estimation of Index Coefficients," *Econometrica*, 57, 1403–1430.

Quah, D. T. (1997): "Empirics for Growth and Distribution: Stratification, Polarization, and Convergence," *Journal of Economic Growth*, 2, 27–59.

Robinson, P. M. (1988): "Root-N-Consistent Semiparametric Regression," *Econometrica*, 56, 931–954.

Rosenblatt, M. (1956): "Remarks on Some Nonparametric Estimates of a Density Function," *The Annals of Mathematical Statistics*, 27, 832–837.

Ruppert, D. and M. P. Wand (1987): "Multivariate Locally Weighted Least Squares Regression," *The Annals of Statistics*, 22, 1346–1370.

Ruud, P. A. (1986): "Consistent estimation of limited dependent variable models despite misspecification of distribution," *Journal of Econometrics*, 64, 891–916.

Schmalensee, R. and T. M. Stoker (1999): "Household Gasoline Demand in the United States," *Econometrica*, 67, 645–662.

Sherman, R. P. (1993): "The Limiting Distribution of the Maximum Rank Correlation Estimator," *Econometrica*, 61, 123–137.

Silverman, B. W. (1978): "Weak and Strong Uniform Consistency of the Kernel Estimate of a Density and its Derivatives," *The Annals of Statistics*, 6, 626–633.

——— (1986): *Density Estimation for Statistics and Data Analysis*, Chapman & Hall/CRC.

Stein, C. (1956): "Efficient Nonparametric Testing and Estimation," in *Proceedings of the Third Berkeley Symposium on Mathematical Statistics and Probability*, ed. by J. Neyman, University of California Press, vol. 1: Contributions to the Theory of Statistics, 187–195.

Stone, C. J. (1977): "Consistent nonparametric estimation," *The Annals of Statistics*, 5, 595–645.

——— (1980): "Optimal Rates of Convergence for Nonparametric Estimators," *The Annals of Statistics*, 8, 1348–1360.

——— (1982): "Optimal global rates of convergence for nonparametric regression," *The Annals of Statistics*, 10, 1040–1053.

Wasserman, L. (2006): *All of Nonparametric Statistics*, Springer.

Watson, G. S. (1964): "Smooth Regression Analysis," *Sankhya: The Indian Journal of Statistics, Series A*, 26, 359–372.