

UNIVERSITY OF COLORADO - DEPARTMENT OF ECONOMICS  
ECON 8828 - SEMINAR IN ECONOMETRICS - FALL 2017  
PROFESSOR CARLOS BRUNET MARTINS-FILHO

**Office.** Economics Building 105

**Meetings.** Tuesdays and Thursdays from 9:30 AM - 10:45 AM in ECON 5.

**Office hours.** Thursdays 2:00 PM - 3:30 PM and by appointment. For appointment send an email to [carlos.martins@colorado.edu](mailto:carlos.martins@colorado.edu).

**Class URL.** <http://spot.colorado.edu/~martinsc/Econ.8828.html>

**Prerequisites.** ECON 7828 (or equivalent) or consent of instructor.

**Objectives.** This is the first course of the sequence Econ 8828-8838. This sequence is the core of a Ph.D. field in Econometrics. The course objectives are:

- to introduce you to the fundamental tools and concepts from probability theory needed for a rigorous study of the limiting properties of estimators for parametric and nonparametric statistical/econometric models
- to provide a general asymptotic characterization of a broad set of parametric estimators commonly used in econometrics, including method of moments, minimum distance, least squares and maximum likelihood.
- to introduce you to nonparametric estimators for density and regression

**Grades.** Your course grade depends on four homework sets and a final examination. Relevant dates are given below.

Evaluation	Points	Date
Homework sets	70	TBA in class
Final examination	30	December 16, 1:30 PM - 4:00 PM

**Support and Reference Books.**

A. Mathematics, Probability and Asymptotic Theory

1. Apostol, T., 1974, Mathematical Analysis, Addison Wesley, New York.
2. Bartle, R., 1966, Elements of Integration, John Wiley and Sons, New York.
3. Davidson, J., 1994, Stochastic Limit Theory, Oxford University Press, Oxford.
4. Dhrymes, P., 1989, Topics in Advanced Econometrics: Probability Foundations, Springer Verlag, New York.
5. Grimmett, G.R. and D.R. Stirzaker, 1992, Probability and Random Processes, Oxford University Press, Oxford.
6. Jacod, J. and P. Protter, 2000, Probability Essentials, Springer, Berlin.

7. Resnick, S. I., 2005, A Probability Path, Birkhauser, Boston.

## B. Econometrics and Statistics

1. Amemiya, T., 1985, Advanced Econometrics, Harvard University Press, Cambridge, MA.
2. Davidson, R. and MacKinnon, J. G., 2003, Estimation and Inference in Econometrics, Oxford University Press.
3. Li, Q. and J. S. Racine, 2007, Nonparametric Econometrics: Theory and Practice, Princeton University Press, Princeton.
4. Newey, W. and McFadden, D., 1994, Large sample estimation and hypothesis testing. In Handbook of Econometrics IV, R. Engle and D. McFadden Editors, Chapter 36.
5. Pagan, A. and A. Ullah, 1999, Nonparametric Econometrics, Cambridge University Press, Cambridge.
6. Tsybakov, A., 2009, Introduction to Nonparametric Estimation, Springer, New York.
7. van der Vaart, A., 1998, Asymptotic Statistics, Cambridge University Press, Cambridge.
8. I will distribute class notes. Read them carefully. They reflect my view of what are the most important concepts and results we cover in the course.

## Topics.

1. Probability
  - (a) Probability spaces
  - (b) Continuity of probability measures
  - (c) Conditional probability, independence and Bayes Theorem
  - (d) Borel-Cantelli Lemma
  - (e) Construction of probability measures:  $\pi$  and  $\lambda$  systems, Dynkin's Theorem
  - (f) The distribution function induced by a probability measure
2. Random elements
  - (a) Measurable functions and random elements
  - (b) Probability measures induced by random elements
  - (c)  $\sigma$ -algebras generated by random variables
  - (d) Independent random variables
3. Expectation
  - (a) Measurability Theorem
  - (b) Expectation of simple functions and extensions to general functions
  - (c) Properties of expectations
    - i. Monotone convergence theorem
    - ii. Inequalities: Modulus, Markov's, Chebyshev's
    - iii. Dominated convergence theorem
  - (d) Riemann vs. Lebesgue integral

- (e) Product spaces and joint measures
  - (f) Conditional expectation
  - (g) Radon-Nikodym derivative
4. Convergence
- (a) Almost sure convergence
  - (b) Convergence in probability
  - (c)  $L_p$  convergence
  - (d) Uniform integrability
  - (e) Moment inequalities: Schwartz's, Hölder's, Minkowski's, Jensen's, Lyapounov's
  - (f) Convergence in distribution
    - i. Scheffé's Lemma
    - ii. Skorohod's Theorem
    - iii. Delta method and the Continuous Mapping Theorem
    - iv. Characteristic functions: uniqueness and continuity theorems
    - v. Portmanteau Theorem
  - (g) Weak Law of Large Numbers for IID sequences
  - (h) Central Limit Theorem for IID sequences
  - (i) Convergence of Moments
  - (j) Lindeberg-Feller Theorem
5. Parametric models
- (a) Identification
  - (b) Loss functions and Extremum (M) estimation
    - i. Linear and nonlinear least squares (LS)
    - ii. Maximum likelihood (ML)
    - iii. Method of moments (MM)
    - iv. Minimum distance (MD)
  - (c) Z-estimation
  - (d) Consistency: LS, ML, MM, MD
  - (e) Stochastic equicontinuity and uniform convergence
  - (f) Asymptotic Normality: LS, ML, MM, MD
  - (g) Estimation of Covariances of Asymptotic Distributions
  - (h) Asymptotic Efficiency
  - (i) Feasible estimation
  - (j) Two-Step estimation
6. Hypothesis testing for parametric models
- (a) Basic concepts: level, asymptotic power functions, relative efficiency
  - (b) Likelihood ratio tests

(c) Wald and Score tests

7. Nonparametric and semiparametric models

(a) Kernel density and distribution estimation

(b) Kernel regression estimation

(c) Partially linear regression models

## Important information.

- If you qualify for accommodations because of a disability, please submit a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail [dsinfo@colorado.edu](mailto:dsinfo@colorado.edu).

If you have a temporary medical condition or injury, see Temporary Medical Conditions: Injuries, Surgeries, and Illnesses guidelines under Quick Links at Disability Services website and discuss your needs with me.

- Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, if the midterm, final or homework due dates prevent/inhibit you from exercising your rights to religious observance, please inform me by August 28, 2012 so that reasonable accommodations can be made.

See full details at [www.colorado.edu/policies/fac\\_relig.html](http://www.colorado.edu/policies/fac_relig.html).

- Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at [www.colorado.edu/policies/classbehavior.html](http://www.colorado.edu/policies/classbehavior.html) and at [www.colorado.edu/studentaffairs/judicialaffairs/code.html#student\\_code](http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code).
- All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council ([honor@colorado.edu](mailto:honor@colorado.edu); 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at [www.colorado.edu/policies/honor.html](http://www.colorado.edu/policies/honor.html) and at [www.colorado.edu/academics/honorcode/](http://www.colorado.edu/academics/honorcode/).
- The University of Colorado Policy on Sexual Harassment applies to all students, staff and faculty. Sexual harassment is unwelcome sexual attention. It can involve intimidation, threats, coercion, or promises or create an environment that is hostile or offensive. Harassment may occur between members of the same or opposite gender and between any combinations of members in the campus community: students, faculty, staff, and administrators. Harassment can occur anywhere on campus, including the classroom, the workplace, or a residence hall. Any student, staff or faculty member who believes s/he has been sexually harassed should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH and the campus resources available to assist individuals who believe they have been sexually harassed can be obtained at [www.colorado.edu/odh/](http://www.colorado.edu/odh/).