

UNIVERSITY OF COLORADO - DEPARTMENT OF ECONOMICS
ECON 7818 - MATHEMATICAL STATISTICS FOR ECONOMISTS - FALL 2021
PROFESSOR CARLOS BRUNET MARTINS-FILHO

Office. Economics Building 105

Meetings. Tuesdays and Thursdays 9:35 AM - 10:50 AM at HLMS 104.

Starting on the second week of this course there will be in-person weekly recitations conducted by Paro Suh - the Teaching Assistant for this class. The time and location for these recitations will be announced by the end of the first week of classes. Attendance is expected and strongly encouraged.

Office hours. Office hours will be held remotely, via Zoom, Tuesdays and Thursdays 5:00 PM - 6:00 PM. You will receive an email with a Zoom meeting invitation to join me for office hours. If you need an appointment outside these hours send an email to carlos.martins@colorado.edu and I will try to accommodate your request.

Class URL. <http://spot.colorado.edu/~martinsc/7818.html>.

Prerequisites. Successful completion of ECON Math Camp or consent of instructor.

Objectives. This is the first course of your first year two-course Ph.D. sequence in Econometrics. The course objectives are:

- to introduce you to fundamental tools and concepts from probability and asymptotic theory needed for a rigorous study of the limiting behavior of estimators and test statistics that emerge from the study of statistical/econometric models
- if time permits, to introduce you to the classical linear regression model and accompanying estimators and test statistics

Grades. Your course grade depends on your performance in four homework sets, a midterm and a final examination. Relevant dates and points are given below.

Evaluation	Points	Date
Homework sets	40	TBA in class meetings
Midterm examination	25	October 19
Final examination	35	December 11, 1:30 PM - 4:00 PM

Support material and reference books.

A set of class notes are available for this course. They will be available as PDFs on the class website. Study them carefully. In addition, the following books have very good presentations of some of the material we will cover.

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

1. Amemiya, T., 1985, Advanced Econometrics, Harvard University Press, Cambridge, MA.
2. Davidson, J., 2000, Econometric Theory, Blackwell Publishers, Oxford, UK.
3. 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.

Topics.

1. Probability
 - (a) Probability spaces
 - (b) Construction of probability measures and their properties
 - (c) Distribution functions
 - (d) Continuity of probability measures
 - (e) Conditional probability and independence of events
2. Random elements
 - (a) Measurable functions and random elements
 - (b) Probability measures induced by random elements
 - (c) σ -algebras generated by random variables
 - (d) Independent random variables
3. Expectation
 - (a) Integration and expectation of random elements
 - (b) Properties of expectations
 - (c) Lebesgue's monotone and dominated convergence theorems
 - (d) Independence and expectation
 - (e) Markov's inequality
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. Skorohod's Theorem
 - ii. Delta method and the Continuous Mapping Theorem
 - iii. Characteristic functions: uniqueness and continuity theorems
 - iv. Portmanteau Theorem
 - (g) Laws of Large Numbers for IHD sequences
 - (h) Central Limit Theorems for IHD sequences
5. Conditional expectation
6. Linear regression models
- (a) Identification
 - (b) Loss functions and Extremum (M) estimation
 - i. Least squares (LS)
 - ii. Maximum likelihood (ML)
 - iii. Method of moments (MM)
 - (c) Consistency and limiting distributions: LS, ML, MM
 - (d) Asymptotic Efficiency

Important information.

- Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. 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 race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on [classroom behavior](#) and the [Student conduct and conflict resolution](#).
- As a matter of public health and safety due to the pandemic, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct and Conflict Resolution. For more information, see the policy on classroom behavior and the [Student Code of Conduct](#). If you require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the “Accommodation for Disabilities” statement on this syllabus.

As of August 13, 2021, CU Boulder has returned to requiring masks in classrooms and laboratories regardless of vaccination status. This requirement is a temporary precaution during the delta surge to supplement CU Boulder’s COVID-19 vaccine requirement. Exemptions include individuals who cannot medically tolerate a face covering, as well as those who are hearing-impaired or otherwise disabled or who are communicating with someone who is hearing-impaired or otherwise disabled and where the ability to see the mouth is essential to communication. If you qualify for a mask-related accommodation, please follow the steps in the “Accommodation for Disabilities” statement on this syllabus. In addition, vaccinated instructional faculty who are engaged in an indoor instructional activity and are separated by at least 6 feet from the nearest person are exempt from wearing masks if they so choose.

Students who have tested positive for COVID-19, have symptoms of COVID-19, or have had close contact with someone who has tested positive for or had symptoms of COVID-19 must stay home. In this class, if you are sick or quarantined, please send me an email explaining your absence due to illness or quarantine.

- If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to me during the first two weeks of class so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or by e-mail dsinfo@colorado.edu for further assistance. If you have a temporary medical condition, see [Temporary Medical Conditions](#) on the Disability Services website.
- CU Boulder recognizes that students’ legal information doesn’t always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors’ class rosters. In the absence of such updates, the name that appears on the class roster is the student’s legal name.
- Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly 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 29, so that reasonable accommodations can be made. See full details at [campus policy regarding religious observances](#).

- The University of Colorado at Boulder is committed to maintaining a positive learning, working, and living environment. The University of Colorado does not discriminate on the basis of race, color, national origin, sex, age, disability, creed, religion, sexual orientation, or veteran status in admission and access to, and treatment and employment in, its educational programs and activities. (Regent Law, Article 10, amended 11/8/2001). The University of Colorado at Boulder will not tolerate acts of discrimination or harassment based upon Protected Classes or related retaliation against or by any employee or student. For purposes of this The University of Colorado at Boulder policy, "Protected Classes" refers to race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, or veteran status. Individuals who believe they have been discriminated against should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Student Conduct (OSC) at 303-492-5550. Information about the ODH, the above referenced policies, and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at <http://hr.colorado.edu/dh/>
- 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; 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 and at <http://honorcode.colorado.edu>.