UNIVERSITY OF COLORADO - DEPARTMENT OF ECONOMICS
ECON 7818 - INTRODUCTION TO PROBABILITY AND ASYMPTOTIC THEORY - FALL 2023
PROFESSOR CARLOS BRUNET MARTINS-FILHO

Office. Economics Building 105

Meetings. Tuesdays and Thursdays 9:30 AM - 10:45 AM at ECON 117.

Starting on the second week of this course there will be in-person weekly recitations conducted by a Teaching Assistant. 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 Tuesdays and Thursdays from 4:30 PM - 5:30 PM. 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 form 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 on 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 16, 1:30 PM - 4:00 PM

Support material and reference books.

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

    (a) Hilbert spaces

    (b) Projection Theorem

    (c) Radon-Nikodym Theorem

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.

- Classroom behavior

  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 at www.colorado.edu/policies/classbehavior.html and at www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code.

- Requirements for COVID-19

  As a matter of public health and safety, 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. CU Boulder currently requires COVID-19 vaccination and boosters for all faculty, staff and students. Students, faculty and staff must upload proof of vaccination and boosters or file for an exemption based on medical, ethical or moral grounds through the MyCUHealth portal.

  The CU Boulder campus is currently mask-optional. However, if public health conditions change and masks are again required in classrooms, students who fail to adhere to masking 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.

  If you feel ill and think you might have COVID-19, if you have tested positive for COVID-19, or if you are unvaccinated or partially vaccinated and have been in close contact with someone who has COVID-19, you should stay home and follow the further guidance of the Public Health Office (contacttracing@colorado.edu). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home; rather, you should self-monitor for symptoms and follow the further guidance of the Public Health Office (contacttracing@colorado.edu).

- Accommodation for disabilities

  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.

  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.

- Preferred student names and pronouns

  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.

- Honor code

  All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code academic integrity policy. Violations of the Honor Code may include, but are not limited to: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu; 303-492-5550). Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the Honor Code website.

- Sexual misconduct, discrimination, harassment and/or related retaliation

  CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. The university will not tolerate acts of sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, or protected-class discrimination or harassment by or against members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or email cureport@colorado.edu. Information about university policies, reporting options, and the support resources can be found on the OIEC website. Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of incidents of sexual misconduct, dating and domestic violence, stalking, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about their rights, support resources, and reporting options. To learn more about reporting and support options for a variety of concerns, visit Don't Ignore It.

- Religious holidays

  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. See the campus policy regarding religious observances for full details.www.colorado.edu/policies/fac_relig.html.