Economics 7828: Seminar – Econometrics
Spring 2025
TTh 9:30 – 10:45am
Economics – Room 5

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Office Hours: T 10:45am – 12:15pm

Course Description

This is the second course of the first-year PhD econometrics sequence. It is a graduate-level introduction to estimation and inference for linear and nonlinear parametric models of regression, including least squares, generalized method of moments and maximum likelihood estimation.

Prerequisites

ECON 7818 – Introduction to Probability and Asymptotic Theory (or equivalent)

Course Materials

I will distribute a pdf copy of the required textbook *Econometrics*, by Pierre Perron, for free. An optional supplemental textbook is *Econometric Theory and Methods*, by Russell Davidson and James G. MacKinnon, which I will also distribute for free. This is an excellent supplement that goes into more detail on certain subjects. Problem sets will be handed out in class. Problem sets and exam questions will be based upon both lectures given in class and required readings.

Grades

Final Exam (cumulative)	TBD	50%
Midterm Exam	March 11	40%
Problem Sets	Periodic (about seven)	10%

Problem Sets

Periodic problem sets (about seven total) will be based on the textbook and material given in class. Students may work together on problem sets but problem sets must be completed individually.

Tentative Course Outline

I. Geometric Interpretation of Least-Squares
- -Review of Vector Spaces, Linear Maps and Matrices
- -Projections
- -Generalized Inverses

Readings: Chapter 1

II. Properties of Least-Squares Projections

-Fitted Values, Residuals, R-squared
-Frisch-Waugh-Lovell Theorem

Readings: Chapters 2-3

III. Finite Sample Results for the Basic Linear Model
-Linear Regression Model
-Ordinary Least Squares Estimator
-Unbiasedness of Least-Squares Estimator
-Exogeneity and Predeterminedness
-Variance of Least-Squares Estimator
-Gauss-Markov Theorem

Readings: Sections 4.1 – 4.8

IV. Restricted Least Squares
-Restricted Least Squares Estimator
-Misspecification

Readings: Chapter 5

V. Normal Distribution Theory for Least Squares Estimator
-Hypothesis Testing
-Confidence Intervals and Sets

Readings: Chapter 6

VI. Asymptotic Theory for Least Squares Estimator
-Consistency
-Asymptotic Normality
-Hypothesis Testing
-Confidence Intervals and Sets

Readings: Chapter 7

VII. Instrumental Variables
-(Generalized) Instrumental Variables and Two-Stage Least Squares Estimation
-Consistency and Asymptotic Normality of IV Estimator

Readings: Sections 10.1 – 10.5, 10.7.2 – 10.7.6

VIII. Least-Squares Estimation with Non-Spherical Errors
-Asymptotic Normality
-Estimation of Asymptotic Variance

Readings: Sections 11.1, 11.3, 11.4, 11.7

IX. (Feasible) Generalized Least-Squares
-(Feasible) Generalized Least Squares Estimator
-Consistency and Asymptotic Normality of (F)GLS Estimator
-Geometric Interpretation
-FGLS for autocorrelated errors
-Weighted Least Squares

Readings: Sections 12.1, 12.3, 13.1.1 – 13.1.2, 13.4

X. Maximum Likelihood Estimation
- -Likelihood Function
- -Maximum Likelihood Estimator
- -Information Matrix
- -Consistency and Asymptotic Normality of MLE
- -Efficiency of MLE
- -Estimation of Asymptotic Variance

Readings: Sections 15.1 – 15.8, 15.10.1, 15.10.3, 15.10.5

XI. Nonlinear Regressions
- -Nonlinear Least Squares Estimator
- -Consistency and Asymptotic Normality of Nonlinear Least Squares
- -Numerical Optimization

Readings: Chapter 16

XII. The Trinity of Test Procedures
- -Likelihood Ratio, Wald and Lagrange Multiplier Tests
- -Testing Subsets of Parameters
- -Asymptotic Distributions of Test Statistics
- -Trinity of Tests in Linear Model

Readings: Chapter 17

XIII. Misspecified Models
- -Kullback-Leibler Information Criterion
- -Quasi-Maximum Likelihood Estimation
- -Hypothesis Testing Under Potential Misspecification
- -Testing for Misspecification

Readings: Sections 19.1 – 19.3

XIV. Generalized Method of Moments
- -GMM Estimation
- -Identification
- -Consistency and Asymptotic Normality of GMM Estimator
- -Efficient GMM
- -Hypothesis Testing
- -Model Diagnostics
- -Optimal Instruments

Readings: Sections 23.1 – 23.7

University Policies

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner 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 dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website. ***Please submit your accommodation letter as soon as possible to ensure we have enough time to set up accommodations.***

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 race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. 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. For more information, see the policies on classroom behavior and the Student Code of Conduct.

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: 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 who are 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 at the Honor Code Office website.

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Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

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. Please let me know *within the first two weeks of the course* if you have any of these conflicts.
See the campus policy regarding religious observances for full details.