ECONOMETRICS 1

Spring semester, 2020–2021

Course information

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Course description

The course presents technical aspects of modern econometric estimation and inference, applied in both cross-sectional and time-series settings. After reviewing important econometric notions and asymptotic inference tools, we concentrate on parametric regression models, including linear and nonlinear. Then we turn to methods applied to non-regression settings, including maximum likelihood and method of moments estimation. Finally, we will study methods of bootstrap inference. Home assignments serve as an important ingredient in the learning process.

Course requirements, grading, and attendance policies

- There will be weekly home assignments that account for 20% of the final grade.
- Home assignments will contain analytical problems as well as computational exercises.
- You need to use Julia programming language for computational exercises.
- Answer keys to analytical problems will be distributed.
- The *Problems and Solutions* manual has problems for independent work and discussion in ES.
- The midterm exam accounting for 30% of the final grade will have a two-sided A4 format.
- The final exam accounting for 50% of the final grade will have a two-sided A4 format.
- Lecture and ES attendance of at least 50% is a prerequisite for passing the course.

Course contents

1. Econometric concepts
   - Conditional distribution and conditional expectation. Notion of regression.
   - Conditional expectation function as a best predictor.
   - Random sampling. Analogy principle.
   - Parametric, nonparametric and semi-parametric estimation.
2. Asymptotic inference
   - Why asymptotics? Limitations of exact inference.
   - Asymptotic tools: convergence, LLN and CLT, continuous mapping theorems, delta-method.
   - Asymptotic confidence intervals and large sample hypothesis testing under random sampling.
   - Asymptotics with time series: stationarity, ergodicity, MDS, LLN and CLT, HAC estimation.
3. Linear parametric mean regression
   - OLS estimator. Asymptotic inference in linear mean regression model.
   - Variance estimation robust to conditional heteroscedasticity.
   - Efficiency and GLS estimation.
   - Time series linear regression.
4. Nonlinear parametric mean regression
   - NLLS estimator. Asymptotic inference in nonlinear mean regression model.
   - Computation of NLLS estimates: concentration method.
   - Efficiency and Weighted NLLS estimation.
5. Method of maximum likelihood
   - Likelihood function and likelihood principle.
   - Consistency and asymptotic normality of ML estimators.
   - Asymptotic efficiency of the ML estimator. Asymptotic variance estimation.
   - ML asymptotic tests: Wald, Likelihood Ratio, Lagrange Multiplier.
   - ML estimation for time series models and data.
6. Method of moments
   - Moment restrictions and moment functions. Exact identification and overidentification.
   - Classical and generalized methods of moments.
   - Asymptotic properties of GMM estimators. Efficient GMM.
   - Test for overidentifying restrictions.
   - Linear instrumental variables regression.
   - GMM and time series data. Rational expectations models and other applications.
7. Bootstrap inference
   - Empirical distribution. Approximation by bootstrapping.
   - Bootstrap confidence intervals and bootstrap hypothesis testing.
   - Recentering and pivotization. Asymptotic refinement.
   - Bootstrap resampling in cross-sections and in time series.

Course materials

Main sources

Hansen, Bruce (2021). *Econometrics*, version of Febuary 2021. Available online on author's webpage at University of Wisconsin

Anatolyev, Stanislav (2009). *Intermediate and Advanced Econometrics: Problems and Solutions*. Available online at *is.gd/EconometricsPS*

Occasional chapters from other sources and handouts

Optional textbooks for reference

Goldberger, Arthur (1991). *A Course in Econometrics*, Harvard University Press.

Greene, William H. (2003). *Econometric Analysis*, 5th edition, Prentice Hall.

Academic integrity policy

Cheating, plagiarism, and any other violations of academic ethics at CERGE-EI are not tolerated.