ECONOMETRICS III

Module 5, 2024–2025

Professor: Stanislav Anatolyev
sanatoly@nes.ru

Course information

Course website: my.nes.ru

Instructor's office hours: by appointment in Zoom

Regular class time: TBA

Room: instructor's personal Zoom room

Teaching assistants: TBA

Course description

The course is a bridge between introductory econometric knowledge and serious thinking about econometric estimation and inference, when applied in both cross-sectional and time-series setting. Apart from reviewing or getting familiar with important econometric notions and inference tools such as asymptotic theory and bootstrap, we concentrate on parametric regression models, both linear and nonlinear, then proceed to maximum likelihood and generalized method of moments. Home assignments serve as an important ingredient of the learning process.

Course requirements, grading, and attendance policies

• There will be 6 weekly home assignments that account for 20% of the final grade. Home assignments will be posted regularly on my.nes.ru.

• Home assignments will contain analytical problems, as well as computer exercises based on Python.

• Solutions to home assignments may be handwritten legibly and photocopied in a portrait A4 format, or, which is much better, may be typed in scientific software such as LaTeX and compiled.

• Please submit homework in time to avoid discounts for (even one-minute) late submissions.

• Any traces of copying from previous years' materials are considered plagiarism.

• Answer keys (which may not constitute full solutions!) will be posted on my.nes.ru.

• The Problems and Solutions manual contains additional (mostly recycled old exams) problems for independent work and discussion in sections.

• The final exam accounting for 80% of the grade will have a (double-sided, handwritten) A4 format.

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.
    - Time series linear regression.
4. Nonlinear parametric mean regression
    - NLLS estimator. Asymptotic inference in nonlinear mean regression model.
    - Computation of NLLS estimates: concentration method.
5. Method of maximum likelihood
    - Likelihood function and likelihood principle.
    - Consistency and asymptotic normality of ML estimators.
    - Asymptotic efficiency of the ML estimator.
    - ML asymptotic tests: Wald, Likelihood Ratio, Lagrange Multiplier.
    - ML estimation for time series models and data.
    - Quasi-maximum likelihood estimation.
6. Generalized 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.
    - Bootstrap resampling in cross-sections and in time series.
    - Bootstrapping OLS, NLLS, ML and GMM estimators and tests.

Sample tasks for course evaluation

Evaluate the following claims.
1. When one does bootstrap, there is no reason to raise the number of bootstrap repetitions too high: there is a level when making it larger does not yield any improvement in precision.
2. The bootstrap estimator of the parameter of interest is preferable to the asymptotic one, since its rate of convergence to the true parameter is often larger.

Consider the equation $y=(\alpha+\beta x)e$, where y and x are scalar observables, e is unobservable. Let $E[e|x]=1$ and $V[e|x]=1$. How would you estimate (α,β) by OLS? How would you construct standard errors?

Let $x_1,\ldots,x_n$ be a random sample from $N(\mu,\mu^2)$. Derive the ML estimator of μ and prove its consistency.

Show that the J-test statistic diverges to infinity when the system of moment conditions is misspecified. Provide an example showing that the J-test statistic need not be asymptotically chi-squared with degrees of freedom equaling the degree of overidentification under valid moment restrictions, if one uses a non-efficient GMM.

Course materials

Main sources

- Hansen, B. E. (2022) *Econometrics,* selected chapters, Princeton University Press
- Anatolyev, S. (2009) *Intermediate and Advanced Econometrics: Problems and Solutions, 3rd edition,* sections 1–12, New Economic School
- Lecture slides and occasional handouts

Optional/auxiliary sources

- Goldberger, A. (1991) *A Course in Econometrics,* selected chapters, Harvard University Press
- Анатольев, С. (2007) «Основы бутстрапирования», *Квантиль*, №3, сентябрь 2007 г. Доступно на http://quantile.ru/03/N3.htm

Academic integrity policy

Cheating, plagiarism, and any other violations of academic ethics at NES are not tolerated.