

# Econometrics 1

Module 3, 2019-2020

**Instructor: Konstantin Styrin**

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## Course information

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**Course Website:** [my.nes.ru](http://my.nes.ru)

**Instructor's Office Hours:** by appointment; walk-ins welcome

**Class Time:** TBA

**Room Number:** TBA

**TAs:** TBA

## Course description

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The objective of the course is to familiarize students with basic concepts of econometric analysis. During the course students learn how to apply basic econometric models to cross-sectional data. Also the participants of the course will study basic commands in R software and will do practical exercises.

## Course requirements, grading, and attendance policies

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Students are assumed to have sufficient background in statistics, calculus and matrix algebra. There are 14 lectures and 7 seminars. During first six weeks each week a problem set will be distributed. Best 5 problem sets will be counted for 20% of the final grade. The 3-hour-long final written format A4 exam will give 80% of the final grade.

## Course contents

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Week 1: Introduction. Simple regression model. Ordinary least squares. (Ch. 1,2).

Week 2: Multiple regression analysis: Goodness of fit. Irrelevant variables. Omitted variable bias. Multicollinearity. Misspecified models. Gauss-Markov theorem. (Ch. 3).

Week 3: Multiple regression analysis: Testing hypotheses. Confidence intervals. Testing multiple linear restrictions. F and t statistics. (Ch. 4).

Week 4: Multiple regression analysis: Consistency. Asymptotic normality. Asymptotic efficiency. Lagrange multiplier statistic. (Ch. 5).

Week 5: Multiple regression analysis: Goodness of fit and selection of regressors. Prediction. Dummy variables. Linear probability model. (Ch. 6,7).

Week 6: Heteroskedasticity. Testing for heteroskedasticity. White test. Generalized least squares. Functional form misspecification. Proxy variables. Measurement error. Missing data. (Ch. 8,9).

Week 7: Maximum Likelihood estimation in linear regression. Instrumental variables estimation and two stage least squares. Simultaneous equations models. (Ch. 15,16).

## **Sample tasks for course evaluation**

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Problem 1. Consider the standard simple linear regression model under the Gauss-Markov assumptions. When  $n=3$ , is it possible that the data point with maximal value of dependent variable is located below the regression line? If answer is yes, provide an example, if no, provide a proof.

Problem 2. Consider the simple linear regression model. The independent variable is endogenous and positively correlated with error term.

(a) We estimate the value of  $\beta_0 + \beta_1 E[x]$  as  $b_0 + b_1$  [sample mean of  $x$ ], where  $b_0$  and  $b_1$  are OLS estimates. Compute the sign of the asymptotic bias.

(b) Suppose you know that  $\text{corr}(x,u)=1$  and all random variables are normally distributed. Can you provide asymptotically consistent estimate for  $\beta_1$ ?

Problem 3. Consider the following nonlinear econometric model  $y=A \exp\{x\}+\varepsilon^2$ .

Random variable  $x$  is normally distributed with zero mean and unit variance. Random variable  $\varepsilon$  is independent of  $x$  and is distributed normally with zero mean and variance  $\sigma^2>0$ . Parameter  $A$  is positive. The random sample of size  $n$  is collected. Some econometrician decided to work with the linear model of the form  $y=\alpha+\beta x+u$ , where the restriction  $E[u]=0$  is imposed.

(a) Write down the likelihood function for the nonlinear model.

(b) Is the variable  $x$  endogenous in the linear model? Provide a detailed explanation.

(c) Do we have heteroskedasticity in the linear model? Provide a detailed explanation.

(d) Let  $b$  be the OLS estimate of  $\beta$  in the linear model. Derive formula for  $\text{plim } b$  in terms of integrals of known functions (do not simplify the formula you get).

## **Course materials**

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### **Required textbooks and materials**

Wooldridge, J.M., *Introductory Econometrics: A Modern Approach* (6th edition), South-Western Cengage Learning, 2016.

### **Additional materials**

Angrist, J.D., and J.-S. Pischke, *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton University Press, 2009.

Heiss, F., Using R for Introductory Econometrics, <http://www.urfie.net>

### **Academic integrity policy**

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