

# Econometrics 1

## Module 3, 2022-2023

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**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:** TBA

**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 30% of the final grade. The 3-hour-long final written format A4 exam will give 70% of the final grade.

### Course contents

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Week 1: Introduction. Conditional expectation function vs. best linear predictor. 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. Heteroskedasticity-robust inference. Functional form misspecification. Proxy variables. Measurement error. Missing data. (Ch. 8, 9)

Week 7: Regression analysis with time-series data. Stationarity. Forecasting using AR and ADL models. Estimation of dynamic causal effects. Heteroskedasticity-and-autocorrelation-consistent (HAC) standard errors. (Ch. 10, 11, 12, 18)

## 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.**  $(Y_i, X_{1i}, X_{2i})$  satisfy the four least squares assumptions for causal inference in the multiple regression model that we discussed in class; in addition,  $\text{var}(u_i | X_{1i}, X_{2i}) = 4$  and  $\text{var}(X_{1i}) = 6$ . A random sample of size  $n = 400$  is drawn from the population.

(a) Assume that  $X_1$  and  $X_2$  are uncorrelated. Compute the (asymptotic unconditional) variance of the OLS estimate of  $\beta_1$ .

(b) Assume that  $\text{corr}(X_1, X_2) = 0.5$ . Compute the (asymptotic unconditional) variance of the OLS estimate of  $\beta_1$ .

(c) Comment on the following statements: “When  $X_1$  and  $X_2$  are correlated, the variance of the OLS estimate of  $\beta_1$  is larger than it would be if  $X_1$  and  $X_2$  were uncorrelated. Thus, if you are interested in  $\beta_1$ , it is best to leave  $X_2$  out of the regression if it is correlated with  $X_1$ .”

## 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.