

The MGIMO School of Government and International Affairs

INTRODUCTION TO ECONOMETRICS

Undergraduate Course Syllabus

Instructor

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This syllabus is designed in accordance with the MGIMO Educational Standard for the Bachelor's Program in Economics (program track *International Business and Finance*).

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Rationale and design

The course aims to:

- Develop an understanding of the fact that statistics is the basis for econometrics;
- Demonstrate how statistical methods may be useful in further studies and at work when the time comes;
- Introduce students to commonly used instruments of mathematical statistics and econometrics;
- Give basic skills in both performing tasks and solving problems on paper, as well as reading and understanding output of specialized software instruments;
- prioritize understanding of the underlying processes as opposed to formal mathematical models (although the former demands a certain amount of the latter);

Requirements

Students are required to attend all lectures and seminars, read the required literature, and prepare for exercises. Pre-requisites for the course include knowledge of high school mathematics, 1st year University statistics and a capacity to perform basic arithmetic operations without calculators.

Grading

Two mid-term tests (the first will cover mostly lectures 1-5, the second – lectures 6-16) covering lecture and seminar materials: 20% each.

Essay / research project: 20%.

Final exam: 40%.

Active class participation will positively affect the final grade.

Course outline

16 lectures and 16 seminars.

Main readings

Newbold P. *Statistics for Business and Economics*, Pearson, 8th edition, 2013.

Gujarati D. N., Porter D.C. *Basic Econometrics*, McGraw-Hill, 5th edition, 2008.

Additional readings

Айвазян С. А., Мхитарян В. С. Теория вероятностей и прикладная статистика. ЮНИТИ. Москва, 2001.

Dougherty C. *Introduction to econometrics*, Oxford University Press, 3d edition, 2005

Шведов А. С. (2005). Теория вероятности и математическая статистика 2-е издание, ВШЭ.

COURSE READINGS & TENTATIVE CLASS SCHEDULE

1. *Point estimation. Unbiasedness of an estimator. Minimum variance unbiased estimators. Expectation and variance. Normal distribution. Sampling distribution. Distribution of a mean and a sample variance. Student's t distribution, χ^2 distribution, F distribution. Law of Large Numbers. Central limit theorem. Interval estimation. Hypothesis testing. Null and alternative hypothesis. One-sided and two-sided alternative hypothesis. One- and two-tailed tests.*

This lecture is a reminder for the students of the most important topics relevant for the course. It will briefly touch the topics of point and interval estimators, its properties and a number of distributions including 2 new ones (χ^2 distribution, F distribution), refresh the central concept of statistical analysis – how to formulate and test a hypothesis. Most of the meaningful scientific conclusions in very different fields of science are made or verified with the help of the instrument. The seminar will train the relevant skills.

Reading: Newbold ch.5-10

2. *Some non-parametric tests: sign test, Wilcoxon, Mann-Whitney tests for matched pairs and for independent samples.*

This lecture will provide a few instruments to deal with real-life situation which students may face in their future professional career and demonstrate that the data should not always be treated as given: it may require working around, it should be studied, maybe transformed in order that the valuable information it contains may be extracted. The seminar will train the relevant skills in problem solving.

Reading: Newbold ch.14

3. *Goodness-of-fit tests, a test of association of contingency table.*

A couple more useful and interesting tests to verify if a sample is from a distribution with certain parameters and to check if certain criteria are independent of not. In addition, it helps to train skill of working with χ^2 distribution which is a must to understand F-distribution – the basics for further econometric studies. The seminar will train the relevant skills in problem solving.

Reading: Newbold ch.14

4. *Analysis of variance and F-test.*

Another test to check independency/interdependency in the data and to acquire competence in working with F-distribution (important for further tests in regression analysis). The seminar will train the relevant skills in problem solving.

Reading: Newbold ch.15

5. *Spearman's, Kendall's rank correlation coefficients. Linear (Pearson) correlation coefficient. Correlation and causality.*

The last preparatory lecture in the course before econometrics starts and 2 more useful instruments to work with quantitative and ordinal data. It serves to help bridge the (supposedly) new concept of regression with the familiar concept of correlation one lecture later. In addition, it touches very important issue of causality and its relation to correlation. The seminar will train the relevant skills in problem solving.

Reading: Newbold ch.2, 14, https://en.wikipedia.org/wiki/Kendall_rank_correlation_coefficient

6. *Nature of regression analysis. Two-variable regression model. Regression, correlation and causality. Regression analysis (Statistics) and machine learning.*

This part is more about words than formulas. It will explain the links between mathematical statistics and regression analysis; this bridge is important for proper implementation of the knowledge and skills received during previous lectures and seminars. The seminar will train the relevant skills in problem solving (maybe some problems from previous topics to make sure that all the basic knowledge is in the active memory).

Reading: Gujarati ch1-2

7. *Ordinary least squares in case of two-variable regression. Gauss-Markov theorem. Properties of the OLS estimators. R^2 – goodness of fit its relations with correlation in case of pairwise regression*

The lecture will formally present OLS method and derive the appropriate estimators and their properties under the Gauss-Markov theorem assumption. The meaning and value of goodness of fit measure. The seminar will train both the capability to understand the results received and presented by others and the application of the techniques by the students themselves (maybe including solving optimization problem).

Reading: Newbold ch.11, Gujarati ch3

8. *Normality assumption. Hypothesis testing (coefficients R^2), confidence intervals (coefficients).*

The assumption of normally distributed residuals of the regression let a researcher use numerous statistical instruments to verify ideas. This is where most of the material of previous 7 lectures is pretty extensively used. The seminar will train the relevant skills in problem solving.

Reading: Newbold ch.11. Gujarati ch.3-5

9. *Multiple regression analysis. The problem of estimation and interpretation. Hypothesis testing. Forecasting.*

This extension of the previous topic is vital for understanding research results and applying the method in a real-world situation as two-variable regression is rarely used in practical studies now. The seminar will concentrate on the capacity to properly read and understand the results/output (software package potentially, maybe Excel). Different test will be performed using the results of the estimations.

Reading: Newbold ch.12. Gujarati ch.7

10. *Model specification. Overspecification and omitted variables. Diagnostic tests. Randomness of explanatory variables (maybe).*

Model specification is of extreme importance – the cost of omitting an explanatory variable is too high. It is also good to understand what happens if one puts certain assumption of classical regression aside, non-

randomness of explanatory variable for example. The seminar will train the relevant skills in problem solving.

Reading: Newbold ch.13 Gujarati ch.13

11. Multicollinearity.

This lecture continues the block of problems which a researcher may face using OLS. Multicollinearity is not a violation of Gauss-Markov theorem per se, but it may cause significant problems while estimating a regression and selecting explanatory variables.

Reading: Newbold ch.13 Gujarati ch.10

12. Heteroscedasticity.

This is a violation of Gauss-Markov theorem when variance of the dependent variable is not constant which is central for the OLS. The problem has to be solved otherwise it affects the properties of OLS estimators and makes the result less reliable. The appropriate tests and solutions to a number of problems. The seminar will train the relevant skills in problem solving.

Reading: Newbold ch.13 Gujarati ch.11

13. Autocorrelation. Autoregressive models.

This is a violation of Gauss-Markov theorem when residuals are not uncorrelated with each other. The problem has to be solved, otherwise it affects the properties of OLS estimators and makes the result less reliable. It appears usually in time series analysis and is not relevant for cross-section data. So the introduction to time series is planned alongside a small intro to autoregressive models and how to deal with them. The appropriate tests and solutions to a number of problems. The seminar will train the relevant skills in problem solving.

Reading: Newbold ch.13 Gujarati ch.12

14. Dummy variable and regression analysis.

Dummies are very useful in econometric analysis as they help include qualitative information, like seasonal effects, special cases which may not be properly reflected by the other quantitative explanatory variable. The lecture will explain the idea, the seminar will train the relevant skills.

Reading: Newbold ch.13 Gujarati ch.9

15. Dependent/explanatory variable transformation.

OLS is designed to estimate linear models. In real-world situations researches often need to estimate non-linear relations between variable. There are ways how one can still apply OLS to solve such problems. The lecture will explain the idea and introduce some examples, the seminar will train the relevant skills.

Reading: Gujarati ch.6

16. Probability models. Linear probability model. Maximum likelihood estimation. Logit, probit, tobit models.

Estimation of a probability of a certain event is a very popular topic in many fields of econometric studies. The lecture and the seminar are intended just to show the methods and give a taste their possible applications.

Reading: Gujarati ch.15