National Research University Higher School of Economics
The International College of Economics and Finance
Syllabus

TIME SERIES AND PANEL DATA ANALYSIS
2019-2020

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Class teacher: Nikita Toropov

Course Pre-requisites:

Statistics, Mathematics for Economists, Introduction to Econometrics, Introduction to Economics.

Course description:

Time Series and Panel Data Analysis (intermediate level) is a two-module course designed for fourth year ICEF students. The course is divided into two parts. The first part covers time series theory and methods, while the second part goes over panel data analysis. Students will learn basic theoretical results and how to estimate time series and panel data in practice with the help of computational software. The course is taught in English.

Learning Objectives and Learning Outcomes

The main objectives of the course are to introduce the students to the modern methods of time series and panel data analysis and prepare them for individual work, in particular on their bachelor's theses.

In the process, the students will be introduced to basic and advanced approaches to time series and panel data analysis. The students should learn how to:

- look for economic and financial data online;
- apply econometric methods to the investigation of economic relationships and processes;
- evaluate the quality of statistical and econometric analysis;
- construct and evaluate forecasts for time series data;
- use panel data to account for various forms of heterogeneity in data;
- read academic articles in the field of econometrics.

Upon completion of the course the students should develop the following competencies:

- ability to work with information: to find, evaluate and use information from various sources, necessary to solve scientific and professional problems;
- ability to conduct research, including problem analysis, setting goals and objectives, identifying the object and subject of research, choosing the means and methods of research, as well as assessing its quality
- ability to collect and analyse the panel and time series data;
- ability to choose tools for processing economic data, analyse the results of calculations and substantiate the findings;
- ability to solve analytical and computational problems with modern computational software.

Methods of Instruction

The class consists of lectures (2 hours per week), practical sessions in the computer lab (2 hours per week), self-study in the computer lab, and self-study with literature. Additionally, specific journal articles and useful internet links for particular topics may be assigned in class (students should expect to be tested on this material). The lecturer and class teachers will be available for office hours. In total, there are 30 hours of lectures and 30 hours of classes.

Essential Reading and Course Materials:

Time Series:

- Francis Diebold, *Elements of forecasting*, 4th ed., Thomson/South-Western, 2006
- James Stock and Mark Watson, *Introduction to Econometrics*, 2nd ed., Pearson, 2007
- Walter Enders, *Applied Econometric Time Series*, 2nd ed., Wiley, 2006
- Ruey Tsay, *Analysis of Financial Time Series*, Wiley, 2002

Panel Data:

- James Stock and Mark Watson, *Introduction to Econometrics*, 2nd ed., Pearson, 2007
- Jeffrey Wooldridge, *Econometric Analysis of Cross Section and Panel Data*, MIT press, 2002
- Jeffrey Wooldridge, *Introductory Econometrics: Modern Approach*, South-Western Cengage Learning, 5th ed., 2012
- Colin Cameron and Pravin Trivedi, *Microeconometrics: methods and applications*, Cambridge University Press, 2005
- Colin Cameron and Pravin Trivedi, *Microeconometrics using Stata*, Stata Press, 2010

Additional Readings:

- Helmut Lütkepohl, *New Introduction to Multiple Time Series Analysis*, Springer, 2005

Online Resources:

1. https://www.sas.upenn.edu/~fdiebold/Textbooks.html
2. https://instruction.bus.wisc.edu/jfrees/jfreesbooks/Longitudinal%20and%20Panel%20Data/Book/PDataBook.htm
3. http://people.stern.nyu.edu/wgreene/Econometrics/PanelDataSets.htm

Special Equipment and Software:

Software: The main software used in the course is Stata (version 12 or above). The students may use other statistical software for solving the problem sets in the first part of the course (EViews, R, Python, etc.) and the midterm (provided the desired software is available in the computer classes where the midterms take place). Stata must be used for all the data analysis in the second part of the course.

Equipment: computer, projector, Internet connection.

Grading System and Examination Type:

The course grade consists of the grades for four problem sets (two on the time series part and two on the panel data part), a midterm test, an essay and a final exam. The midterm test takes place in October and consists of two parts (analytical and computational), which have equal

weights. It covers the time series material only. The final exam takes place in December and also consists of two parts (analytical and computational), which have equal weights. The final exam covers all the materials studied in the course. All printed and hand-written materials are allowed at the computational parts and a hand-written two-sided A4 sheet with notes is allowed for the analytical parts.

The formula for the final grade for the course G is the following:

$$G = 0.15 \cdot G_{PS} + 0.15 \cdot G_{essay} + 0.2 \cdot G_{midterm} + 0.5 \cdot G_{final},$$

where G_{PS} is the average grade for the problem sets, G_{essay} is the grade for the essay, $G_{midterm}$ is the grade for the midterm test, and G_{final} is the grade for the final exam.

All grades are given initially out of 100 points. The final grades are also converted to 10- and 5-points grades. The conversion scale depends on the complexity of the midterm and exam and can be different from year to year.

Students should keep in mind that according to the ICEF regulations, if a student misses the midterm test due to a valid reason, they get 0 grade for the midterm and only a partial compensation for the missed midterm: the weights of all the other components of the final grade are multiplied by $1 + 0.5 \cdot midterm\ weight = 1 + 0.5 \cdot 0.2 = 1.1$. In exceptional cases, at the full discretion of the lecturer, when the grades for all the other forms of assessment (home assignments, essay, and final exam) significantly exceed the final grade computed according to the above rule, the lecturer might reconsider the formula.

Information on how the retakes are organized, and how the final grade is determined in case of a retake can be found in the HSE Interim and Ongoing Assessment Regulations (incl. Annex 8 for ICEF) and ICEF regulations.

Sample materials for knowledge assessment are available in the ICEF Information system.

Course Plan

Time Series Analysis:

1. **Time series: basic concepts** Definition of time series. Introduction of main characteristics of time series (stationarity, ergodicity, autocovariance function, correlogram). Lag operator.
2. **ARMA models** Autoregressive models. Moving-Average models. Wold decomposition. Moments, stationarity and invertibility conditions. Autoregressive Moving-Average models. Aggregation. ADL models.
3. **Nonstationary time series** Deviations from stationarity: unit roots, deterministic trends, structural breaks. Tests of stationarity.
4. **Multivariate time series** VAR models: properties and characteristics. Granger causality.
5. **Estimation and forecasting** Estimation of ARMA and VAR models. Forecasting. Properties of forecasts. HAC variance estimation.
6. **Conditional heteroskedasticity** ARCH and GARCH models: introduction, properties, estimation.

Panel Data Analysis:

1. **Panel data: Introduction** Introduction to panel data analysis. Advantages of panel data.
2. **Linear Panel Data Models** Fixed effects and random effects. Between, within, and pooled estimators. Estimation and hypothesis testing.
3. **Dynamic Panel Data Models** Dynamic panels. Arellano-Bond estimator.

4. **Nonlinear panel models** Binary response models with panel data. Logit and probit models of panel data.

	Topic	Total Hours	Contact hours		Self-study
			Lectures	Seminars	
1	Time series: basic concepts	8	2	2	4
2	ARMA models	12	2	2	8
3	Nonstationary time series	20	4	4	12
4	Multivariate time series	12	2	2	8
5	Estimation and forecasting	20	4	4	12
6	Conditional heteroskedasticity	12	2	2	8
7	Panel data: introduction	8	2	2	4
8	Linear Panel Data Models	25	5	5	15
9	Dynamic Panel Data Models	10	2	2	6
10	Nonlinear panel models	25	5	5	15
	Total	152	30	30	92