**Syllabus**

**1. Name of a subject – Econometric research**

The main learning outcome of this discipline is acquiring by a student the basic Econometric research, mathematical statistic knowledge and skills (forming competences) for solving standard economical tasks.

**2. Mapping of learning outcomes (list of competences), with the relevant indicators described and subject learning outcomes indicated**

The discipline provides necessary tools to form competences listed below.

The section lists the graduates’ coded competencies that are to be developed during the learning process, indicators that show their development (generalized descriptions of specific actions performed by the graduate that clarify and reveal the competence content), learning outcomes (knowledge, skills) with indicators of competence development (in the form of a table):

Table 1

|  |  |  |  |
| --- | --- | --- | --- |
| Competence code | Competence | Competence development indicators[[1]](#footnote-1) | Learning outcomes (skills and knowledge) and indicators that show competence development[[2]](#footnote-2) |
| PKN-6 | Ability to apply mathematical methods to solve standard professional financial and economic problems, to interpret the obtained mathematical results. |  | Know the basic mathematical concepts and methods required to solve standard financial and economic problems.  Be able to solve typical mathematical and financial and economic problems, interpret the results obtained.  Possess the skills of mathematical modeling of economic phenomena and processes. |
| UK-7 | Ability to use applied software in solving professional problems |  | Know the main methods and means of obtaining, presenting, storing and processing data;  Be able to use the basic methods and means of obtaining, resenting, storing and processing data; |
| UK-6 | Ability to search, critically analyze, generalize and systematize information, use a systematic approach to solve assigned tasks |  | Know of the methods for describing the composition and structure of the required data  and information; collection methods, data processing and interpretation;  Be able to describe the composition and structure of the required data and information; competently implement the processes of collecting, processing and interpreting data; |

**3. Place of the discipline subject in the curriculum**

The discipline *"Econometric research"* is a discipline of the Module of Econometric research and Computer Science of the direction of training 38.03.01 *"Economics"*.

The study of the discipline *"Econometric research"* is based on the knowledge gained in the framework of the corresponding disciplines of secondary vocational education. The discipline "Econometric research" is the theoretical basis for all disciplines of the module of Mathematics and Computer Science, and mathematical concepts and methods are used in the future in the study of general professional disciplines and disciplines of the profile.

The section describes what place is occupied by the subject in the program curriculum.

**4. Workload in credits and academic hours, with class work (lectures and seminars) and self-study indicated**

The data are presented in the form of a table.

Table 2

|  |  |  |
| --- | --- | --- |
| **Type of work** | **Total**  **(in credits and hours)** | **Module 3 (in hours)** |
| **Overall workload** | ***4/144*** | ***144*** |
| ***Class work*** | ***50*** | ***32*** |
| *Lectures* | ***8*** | ***8*** |
| *Seminars* | ***24*** | ***24*** |
| ***Self-study*** | ***112*** | ***112*** |
| Formative assessment | ***quiz*** | ***quiz*** |
| Summative assessment | ***Exam*** | ***Exam*** |

**5. Subject content (with the thematic components indicated).**

**1.** **Introduction to Econometrics**.

Statistical Investigation of Economic Variables' Relationships. Relationships in the economy: examples, problems of estimation and analysis (demand functions, earnings functions, economic growth models, price and profitability of securities in the financial markets). Economic data: cross sections and time series. Main statistical concepts and facts used in the course. Data bases. Software.

2. **Simple Linear Regression Model (SLR). OLS estimation**.

Proposals and notation in SLR. SLR Model Estimation using Ordinary Least Squares (OLS). Expressions for the OLS estimators of slope coefficient and intercept: derivation and interpretation. Gauss-Markov conditions and the properties of OLS estimators. Gauss-Markov theorem (formulation). Standard deviations and standard errors of regression coefficients: derivation and interpretation. Statistical significance of OLS estimators: hypotheses testing using t-tests. Derivation and interpretation of confidence intervals. The general quality of regression: determination coefficient R2. F-statistics and F-test. Relationship between R2 and correlation coefficients. SLR model without intercept. OLS-estimation, properties and applications.

3. **Multiple Linear Regression Model (MLR): two explanatory variables and k explanatory variables.**

Derivation and properties of OLS-estimators of MLR with two explanatory variables. Determination coefficient R2. Adjasted R2. Testing hypotheses using t-statistics and F-statistics. OLS-estimation of the model with k explanatory variables. Properties of coefficients. F-test. Multicollinearity. Estimation of production functions in volumes and growth rates' forms as multiple regression models. APT model.

4. **Variables Transformations in Regression Analysis.**

Linearisation of non-linear functions and their estimation using Ordinary Least Squares. Disturbance term specification. Interpretation of linear, logarithmic and semi-logarithmic relationships. Comparison of the quality of regression relationships: linear and logarithmic functions.

5. **Dummy Variables**.

Dummy variables in linear regression models. Types of dummy variables: intercept and slope dummies. Interaction dummies. Multiple sets of dummies. Chow test. Dummy variables in economic models: earnings functions, production functions. Dummy variables in seasonal adjustment. Dummy variables in combining time series and cross-sectional data.

6. **Linear Regression Model Specification.**

Consequences of Incorrect Specification. Omitting significant explanatory variable. Including unnecessary explanatory variable in the model. Testing of linear constraints on parameters of MLR. F-test and t-tests. Role and examples of linear constraints in economic models. Lagged Variables in economic models. Gauss-Markov conditions' violation. General principles of consequences' analysis, detection and correction. Generalised Least Squares (GLS).

7. **Heteroscedasticity.**

Concept, consequences and detection of heteroscedasticity. Goldfeld-Quandt, Breusch-Godfrey, White, Spearman, Glejzer tests. Model Correction. Weighted Least Squares (WLS) method as a special case of GLS. White's heteroscedasticity-corrected standard errors. Reasons and examples of heteroscedasticity in economic models.

8. **Stochastic Explanatory Variables.**

Stochastic explanatory variables in LR models. Properties of OLS estimators and test statistics of stochastic explanatory variables' coefficients. Measurement errors. Instrumental variables. Using instrumental variables in economic models.

9. **Simultaneous Equations Models.**

Concept of simultaneous equations model. Exogenous and endogenous variables. Predetermined variables. The simultaneous equations bias. Inconsistency of OLS estimators. Structural and reduced forms of the model. Model of demand and supply and simple Keynesian equilibrium model as simultaneous equations models. Identification problem. Rules of identification. Testing exogeneity: Hausman test. Methods of estimation. Indirect Least Squares (ILS). Instrumental Variables. Two-Stages Least Squares (TSLS). Examples of simultaneous equations models estimation: IS/LM model, Klein's model.

10. **Autocorrelated disturbance term.**

Signs and consequences of disturbance term's autocorrelation in LR model. Durbin-Watson d test for first order autocorrelation. Breusch-Godfrey (BG) test of higher-order autocorrelation. Autocorrelated disturbance term and model misspecification. Model correction: Autoregressive transformation. Cochrane-Orcutt (CO) procedure. CO as a special case of GLS. Prais-Winsten correction. AR, MA, ARMA models. Autocorrelated disturbance term in a model with lagged dependent variable as one of the explanatory variables. Durbin statistic and test. Autoregressive Conditional Heteroscedasticity (ARCH) model.

11. **Modelling with Time Series Data**.

Dynamic Processes Models. Forecasting Distributed lag models: geometrically distributed lags, polynomial lags. Koyck transformation and estimation of geometrical lag's parameters. Polynomially distributed (Almon) lag. Autoregressive Distributed Lag (ADL) model. Common factor test. Partial adjustment. Adaptive expectations. Financial market models: problems of estimation and analysis. Forecasts and prediction. Confidence intervals. Chow test of predictive failure. Forecasts' quality indicators. Causality in Economics: Granger test.

12. **Time Series Econometrics: Non-stationary Time Series.**

Stationary and non-stationary time series. Definitions and examples of stationary

and non-stationary time series. Random walk. Drifts and trends. Consequences

of non-stationarity. Spurious regressions. Detection of non-stationarity. Correlograms. Unit root tests. Cointegration. Fitting models with non-stationary

time series. Detrending. Error-correction models.

13. **Panel Data Models**.

Introduction to panel data and economic examples. Random effects. Fixed Effects.

**6. List of teaching and methodological materials needed for the students self-study**

**6.1. List of questions for student self-study and types of out-of-class activities**

The section lists types of out-of-class activities that correspond to items in the subject content description.

There is a list of questions the students should answer while working independently.

Table 3

|  |  |  |
| --- | --- | --- |
| **Itemized subject content** | **Questions the students should answer within the self-study process** | **Types of out-of-class activities** |
|
| Introduction to Econometric research | Relationships in the economy on the example of supply and demand functions. Main statistical concepts and facts used in the course. | Work with educational literature and tutorial videos. Analysis of questions on the topic of the lesson. |
| Simple Linear Regression Model (SLR). Ordinary Least Squares (OLS) estimation. | Standard deviations and standard errors of regression coefficients: derivation and interpretation. Statistical significance of OLS estimators. OLS-estimation, properties and applications | Work with educational literature and tutorial videos. Analysis of questions on the topic of the lesson. |
| Multiple Linear Regression Model (MLR): two explanatory variables and k explanatory variables | Derivation and properties of OLS-estimators of MLR with two explanatory variables. Properties of coefficients. F-test. Multicollinearity. | Work with educational literature and tutorial videos. Analysis of questions on the topic of the lesson. |
| Variables Transformations in Regression Analysis | Linearisation of non-linear functions and their estimation using Ordinary Least Squares. Disturbance term specification. Interpretation of linear, logarithmic and semi-logarithmic relationships. Comparison of the quality of regression relationships: linear and logarithmic functions. | Work with educational literature and tutorial videos. Analysis of questions on the topic of the lesson. |
| Specification of the Linear Regression Model | Processes Models, the initial information. Consequences of Incorrect Specification. Omitting significant explanatory variable. Including unnecessary explanatory variable in the model. Testing of linear constraints on parameters of MLR. F-test and t-tests. Role and examples of linear constraints in economic models. Lagged Variables in economic models. Gauss-Markov conditions' violation. General principles of consequences' analysis, detection and correction. Generalised Least Squares (GLS). | Work with educational literature and tutorial videos. Analysis of questions on the topic of the lesson. |
| Model with Heteroscedastic disturbance term | Weighted Least Squares (WLS) method as a special case of GLS. Reasons and examples of heteroscedasticity in economic models. | Work with educational literature and tutorial videos. Analysis of questions on the topic of the lesson. |
| Моdels with Autocorrelated disturbance term | Autocorrelated disturbance term and model misspecification. Cochrane-Orcutt (CO) procedure as a special case of GLS. AR, MA, ARMA models. | Work with educational literature and tutorial videos. Analysis of questions on the topic of the lesson. |
| Modelling with Time Series Data. | Dynamic processes of models, initial information. | Work with educational literature and tutorial videos. Analysis of questions on the topic of the lesson. |

**6.2. List of questions/assignments/topics for students’ preparation to formative assessment**

**Templates of questions for the exam preparation**

1. Type of Economic Data and variables.

2. Examples of the famous Models.

3. Role of Econometric research.

4. Main Application of Econometric research.

5. Cross Section Data.

6. Time Series Data.

7. Pooled Cross Section Data.

8. Panel Data.

9. Principles of specification Econometric research models.

10. Matrix of pair correlation. Scatter diagram.

11. What is regression analysis?

12. Difference between Regression and Correlation.

13. The Simple Linear Model.

14. What is the disturbance term?

15. Why does the disturbance term exist?

16. The fitted line.

17. What is a residual for each observation?

18. What is RSS, ESS, TSS?

19. The normal equations for the regression coefficients.

20. Formulas for estimates coefficients of the linear model .

21. OLS, WLS, TSLS techniques.

22. Interpretation of a Regression Equation.

23. Goodness of Fit: R2.

24. The F-Test of Goodness of Fit.

25. The Random Components of the Regression Coefficients.

26. The Gauss – Markov Theorem.

27. Unbiasedness of the Regression Coefficients.

28. Precision of the Regression Coefficients.

29. Testing Hypotheses Relating to the Regression Coefficients.

30. Confidence Intervals.

31. One-Tailed t –Tests.

32. Heteroscedasticity and Its Implications.

33. Possible Causes of Heteroscedasticity.

34. Detection of Heteroscedasticity

35. What Can You Do about Heteroscedasticity?

36. Possible Causes of Autocorrelation.

37. Detection of First-Order Autocorrelation.

38. What Can You Do about Autocorrelation?

39. Multiple regression analysis. A Model with Two Explanatory Variables.

40. Derivation of the Multiple Regression Coefficients. A Model with Several Explanatory Variables.

41. Derivation of the Multiple Regression Coefficients. The General Model.

42. Properties of the Multiple Regression Coefficients: Unbiasedness; Efficiency; Precision; Consistency.

**7. Mandatory and optional reading list**

**7.1. Mandatory**

Трегуб И.В. *Математические модели динамики экономических систем*: монография - Москва: РУСАЙНС, 2018. - 164 с.

Трегуб И.В. *Эконометрические исследования. Практические примеры. Econometric studies. Practical examples*. - Москва: Лань, 2017. 164 с.

Tregub I.V. *Econometric research. Model of real system*. М.: 2016, 164 p.

Трегуб И.В. *Эконометрика на английском языке* Учебное пособие. М.: 2017

**7.2. Optional**

Christopher Dougherty. *Introduction to Econometric research*. Fourth Edition. Oxford University Press, 2016

**8. List of IT resources, incl. the list of software, information and reference systems (as appropriate).**

**8. 1. Software:**

1. Windows OS;

2. Microsoft Office software.

**8.2. Databases and information and reference systems**

1. Information and education portal of the Financial University http://portal.ufrf.ru/.

2. Library of digital resources of the Financial University: http://elib.fa.ru/

**8.3. Certified software/hardware used for information protection**

ESET Endpoint Security antivirus software.

Federal State Educational Budgetary institution of higher education

"FINANCIAL UNIVERSITY UNDER THE GOVERNMENT OF THE RUSSIAN FEDERATION "

(Financial University)

Department of Mathematics

**Ilona V. Tregub**

Econometric research

**SYLLABUS**

***Level of Study:*** *Masters’s Degree*

***Field of Study:*** *Economics*

***Study Program:*** *International Finance (in English)*

1. To be filled in when the updated Financial University educational standards and federal state educational standards of higher education “3++” are implemented. [↑](#footnote-ref-1)
2. Skills are described when the Financial University educational standards of the 1st generation and federal state educational standards of higher education “3+” are implemented. [↑](#footnote-ref-2)